

Form 71H

(April 2014)



The **ACT**[®]

2013|2014

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

If you wish to order a photocopy of your answer document—including, if you took the Writing Test, a copy of your written essay—please use the order form on the inside back cover of this booklet.

Useful Links:

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✓ **ACT Math Tests:** <http://www.crackact.com/act/math/>

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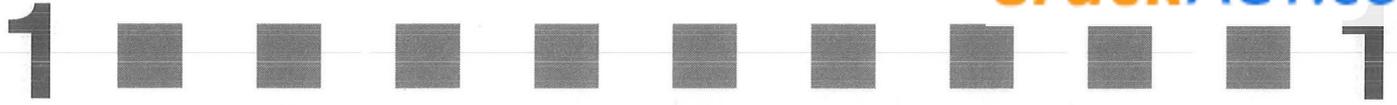
Real ACT Tests Download: <http://www.crackact.com/act-downloads/real-act-tests.html>

SAT Online Practice Tests: <http://www.cracksat.net>

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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

A Saturday with the Sea Turtles

Hawaii's green sea turtle, has been classified as ¹ an endangered species for over 25 years. Signs around the Mauna Lani lagoon ² warn tourists to keep their distance from the humped creatures that look like gray-green boulders along the shoreline. My friends and me, however, ³ ignore the signs, wade into the water, and ⁴ struggling to flip a 150-pound turtle onto its back in the center of an oversized inner tube. We aren't being intentionally cruel. Nor are we breaking the law. We are spending another sunny Hawaiian Saturday volunteering for a government-sponsored sea turtle research project.

We float our latest turtle ashore. Flippers flapping and beak snapping, the turtle resists as we hoist it onto the examination table that we've set up beneath an awning on the beach. It's my turn to ⁵ enact the exam.

1. A. NO CHANGE
B. turtle has been classified as
C. turtle, has been classified as,
D. turtle has been classified: as
2. F. NO CHANGE
G. warns
H. is warning
J. has warned
3. A. NO CHANGE
B. I, however,
C. I however,
D. me, however
4. F. NO CHANGE
G. the struggle
H. were struggling
J. struggle
5. A. NO CHANGE
B. act out
C. perform
D. operate

1

As I weigh the turtle and measure its carapace (shell),
another volunteer, Kiko, watches as I record the data.

Tourists always seem delighted by the opportunity to
closely observe a turtle.

Kiko tells the tourists that this turtle has likely
made a remarkable migration from breeding grounds

in shoals located over 400 miles away. I open the

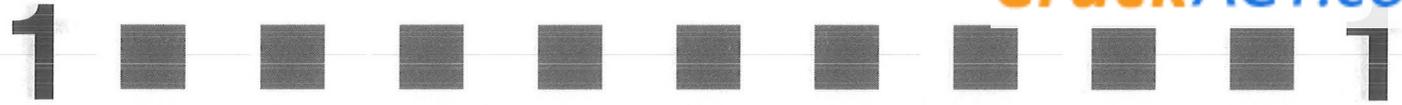
turtle's mouth so I can document what it has been eating,

and I wonder if the turtle is hungry. Kiko laughs and
says that one of the first lessons a volunteer learns is
that green sea turtles have terrible breath! A supervising
marine biologist helps me insert a small microchip—a
tag—beneath the skin of one flipper. Tagging helps with
monitoring the turtle population and gathering information
to help the turtles recover from their endangered status.

After we pull the heavy turtle
back to the water. I don fins, a mask, and a

snorkel watching the turtle after it's released.

6. Given that all the choices are true, which one would most effectively provide a transition into the next sentence?
- F. NO CHANGE
G. explains the project to people who have gathered nearby.
H. stands near me as I work at the examination table.
J. was the one who introduced me to this turtle project.
7. Which of the following alternatives to the underlined portion would NOT be acceptable?
- A. totally
B. most likely
C. probably
D. presumably
8. If the writer were to delete the phrase “in shoals located over 400 miles away” from the preceding sentence, the sentence would primarily lose:
- F. background information about why the turtles choose the shoals as breeding grounds.
G. important geographical data for tourists who are interested in seeing a turtle.
H. a generalization about the size of the breeding grounds.
J. a specific detail that helps clarify why the migration would be remarkable.
9. A. NO CHANGE
B. turtles'
C. turtles
D. turtles's
10. Which choice most specifically anticipates the lesson described in the next sentence?
- F. NO CHANGE
G. wrinkle my nose.
H. peer inside.
J. look at the tongue.
11. A. NO CHANGE
B. water. So
C. water,
D. water;
12. F. NO CHANGE
G. that watch
H. in order to watch
J. that will be watching



Though shy and quiet on land, these animals are graceful

13

swimmers. Kicking my fins, I follow the turtle as

14

it beats its flippers like wings and soars through the

15

canyon reefs toward the deep water beyond.

15

PASSAGE II

Patsy Mink: Equal Rights Champion

[1]

Using just thirty-seven words, the federal law prohibiting sex discrimination against students and employees in school districts and universities changed public education. Enacted in 1972 as part of the Education

16

Amendment to the Civil Rights Act of 1964, Title IX

16

stipulates that no person shall be excluded from any arenas of public schooling on the basis of sex. The

most widely known thing about Title IX has been

17

equal participation in sports. Actually, though, the

law requires fair and equal treatment in all educational

areas: which are including admissions, scholarships,

18

housing, and academic programs. One of its principal

authors was the U.S. congresswoman from Hawaii,

Patsy Takemoto Mink. [A]

13. Which choice sets up the clearest contrast with the sentence's later description of the sea turtles' swimming?

- A. NO CHANGE
- B. sluggish and cumbersome
- C. mysterious and reclusive
- D. sleek and colorful

14. F. NO CHANGE

- G. I followed
- H. were I to follow
- J. if I follow

15. Given that all the choices are true, which one most effectively completes the sentence and the essay by maintaining the focus on the turtle?

- A. NO CHANGE
- B. I dream of being a marine biologist who spends a lifetime making the ocean a better place.
- C. it swims farther into the ocean; when we both surface, my friends are distant figures on the sand.
- D. I am soon left behind, and I look forward to returning to the sunny Hawaiian Saturday.

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

- F. Kept, because it puts Title IX into its appropriate historical context.
- G. Kept, because it explains the significance of the Civil Rights Act of 1964.
- H. Deleted, because it's a detail that's repeated at the conclusion of the essay.
- J. Deleted, because the legal jargon it uses is inappropriate for this essay.

17. Which choice most effectively emphasizes that Title IX was a compelling influence in forcing change?

- A. NO CHANGE
- B. impact of
- C. thought about
- D. meaning of

18. F. NO CHANGE

- G. areas that included
- H. areas, since including
- J. areas, including

1

[2]

19. After completing

duel bachelor's degrees in zoology
²⁰
and chemistry at the University of Hawaii
in 1948, Mink applied to twenty medical

schools. At the time, none of the schools that

she applied accepted women. A disappointedly

Mink vowed to spend her life opposing discrimination

by using the legal system. [B] She enrolled in law

school at the University of Chicago and received

her degree in 1951. [C]

[3]

[1] After graduation, Mink and her husband
moved to Honolulu, where she started her own law firm.

[2] Increasingly interested in politics, Mink ran for federal
office. [3] Mink used her position in Congress to fight
for the rights of immigrants, ethnic minorities, women,
and children. [4] In 1965, she became the first

Asian American woman to be elected to the U.S.

Congress when she won the first of six consecutive
²³
elections. [5] For example, in addition to Title IX,

Mink introduced: the Early Childhood Education Act
²⁴
and supported the Women's Educational Equity Act.

19. Which of the following true statements, if added here,
would most effectively introduce this paragraph?

- A. Mink was elected student body president her junior year in high school.
- B. Mink began dating her future husband in college.
- C. Mink knew about sex discrimination firsthand.
- D. Mink made an unsuccessful run for the U.S. Senate in 1976.

20. F. NO CHANGE

- G. twice
- H. second
- J. dual

21. A. NO CHANGE

- B. to which
- C. while
- D. DELETE the underlined portion.

22. F. NO CHANGE

- G. To disappointment,
- H. A disappointed
- J. Disappointing,

23. Which of the following alternatives to the underlined
portion would NOT be acceptable?

- A. Congress, she won
- B. Congress after winning
- C. Congress, winning
- D. Congress as a result of winning

24. F. NO CHANGE

- G. introduced
- H. introduced,
- J. introduced—



[6] All three were landmark laws because

they substantially altered civil rights

25

policies. [26]

[4]

Mink used her passionate politics voice

27

to advocate equality for all citizens. [D] After her
 death in 2002, Title IX was officially renamed the
 Patsy T. Mink Equal Opportunity in Education Act.

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

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

Her enduring popularity among her constituents was further evidenced by her last election, which she won posthumously.

If the writer were to make this addition, 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 4.

25. Which of the following alternatives to the underlined portion would NOT be acceptable?

- A. differed
- B. revised
- C. amended
- D. changed

26. For the sake of the logic and coherence of this paragraph, Sentence 3 should be placed:

- F. where it is now.
- G. after Sentence 1.
- H. after Sentence 4.
- J. after Sentence 5.

27. A. NO CHANGE

- B. passionately politics
- C. passionate political
- D. passionately politician

28. Which of the following alternatives to the underlined portion would NOT be acceptable?

- F. champion
- G. support
- H. endorse
- J. accept

30. Suppose the writer's goal had been to provide a detailed description of how legislation is written and enacted by the U.S. Congress. Would this essay accomplish that goal?

- F. Yes, because it explains that Title IX was an amendment to the Civil Rights Act of 1964.
- G. Yes, because it shows how a congresswoman's personal experiences affected her support of Title IX.
- H. No, because it focuses on Title IX and gives a brief biography of one of Title IX's authors.
- J. No, because it primarily explains the differences between two important pieces of legislation.

PASSAGE III

Playing the Theremin

The theremin, the first electronic musical instrument, invented in 1918

31

by Russian physicist, Léon Théremin.

32

31. A. NO CHANGE

- B. inventing
- C. invents
- D. was invented

32. F. NO CHANGE

- G. physicist
- H. physicist—
- J. physicist:

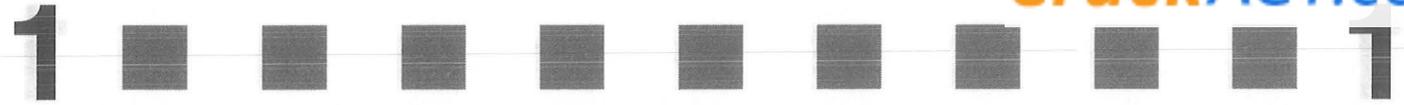
1

Its' eerie, high-pitched sound has been compared to that
³³
 of stringed instruments—particularly the violin—and
 even to a wailing human voice. Not in widespread use
 today, a major film featured the theremin is perhaps best
³⁴
 known for its use in sound tracks of 1950s science fiction
 movies, such as *The Day the Earth Stood Still*.

The theremin is remarkable because, unlike most
 traditional musical instruments, it does not have any
 keys strings, or valves. Instead, it consists of a box
³⁵
 with two antennae—one vertical antenna on the top
³⁶
 and another antenna, shaped like a loop, on the side.
 When the theremin is turned on, weak electromagnetic
 waves are generated around the antennae. Early theremins
 were built into large wooden cabinets, but many of today's
 instruments are much lighter and more portable.

Theremin musicians play the instrument
 by moving their hands, which get tired easily,
³⁷
 around the antennae. The resulting change
³⁸
 in the frequency of the waves produce a
³⁹
 theremins characteristic sound. The musician
³⁹
 literally “plays the air” around the instrument without
 touching any part of the instrument itself. Theremin
⁴⁰
 musicians can produce a higher pitch by moving their
 hands closer to the vertical antenna and a lower pitch

33. A. NO CHANGE
 B. It's
 C. Its
 D. It is
34. F. NO CHANGE
 G. the theremin
 H. the film that featured the theremin
 J. the theremin that
35. A. NO CHANGE
 B. keys, strings or,
 C. keys, strings, or
 D. keys strings or
36. Which of the following alternatives to the underlined
 portion would NOT be acceptable?
 F. antennae one
 G. antennae: one
 H. antennae, with one
 J. antennae. It has one
37. Given that all the choices are true, which one best
 maintains the paragraph's focus on how a theremin
 produces sound?
 A. NO CHANGE
 B. look graceful above the instrument,
 C. act as electrical conductors,
 D. seem to be floating apart from the musician,
38. F. NO CHANGE
 G. produces
 H. produced
 J. had produced
39. A. NO CHANGE
 B. theremins'
 C. theremin's
 D. theremins,
40. Which of the following alternatives to the underlined
 portion would be LEAST acceptable?
 F. instrument.
 G. instrument at all.
 H. instrument however.
 J. instrument whatsoever.



by moving them farther away. They can also raise the volume of the sound by moving their hands away from the loop-shaped antenna and lowering the volume by moving them closer.

41

Because any disturbance of the electromagnetic field around the instrument causes a change in sound, the theremin musician must stand perfectly still, avoiding any odd or accidental moves while playing. 42 The

musician's hand movements must be precise in order

43

to manipulate the sound. In contrast, the theremin is

44

difficult to learn and demanding to play; however,

45

theremin enthusiasts still practice the instrument today and even build their own versions of it.

41. A. NO CHANGE
B. lower
C. lowered
D. have lowered

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

Clara Rockman, a virtuoso who dedicated decades of her life to playing the theremin with symphony orchestras and other musical groups, died in 1998.

Should the writer make this addition here?

- F. Yes, because it proves that the theremin is an instrument that is used in the world of music.
G. Yes, because it adds specific details necessary for understanding the paragraph.
H. No, because it doesn't provide enough information about Rockman.
J. No, because it blurs the focus of the paragraph.
43. Which of the following alternatives to the underlined portion would be LEAST acceptable?
A. vigorous
B. exact
C. accurate
D. unerring
44. F. NO CHANGE
G. As a result,
H. Nevertheless,
J. For proof of this,
45. A. NO CHANGE
B. play, however,
C. play however,
D. play however

PASSAGE IV

Radiocarbon Dating, Tree Rings, and the Distant Past

[1]

Radiocarbon dating, developed by Willard F. Libby in the 1940s, seemed to offer archaeologists a definitive method for determining the age of artifacts. The

method for archaeologists to date artifacts was based on the amount of radioactive carbon 14 found in organic matter such as wood, bones, and shells. [A] A living organism absorbs carbon 14 until the moment it dies, at which point the amount of carbon 14 in an organism starts to decay to nitrogen 14. Carbon 14's half-life is 5,730 years. Therefore, as long as even the smallest

amount of carbon 14 is present; radiocarbon dating can date an artifact by calculating its ratio of carbon 14 to nitrogen 14. [B]

[2]

However, questions were arisen at the time about the method's accuracy. The data from radiocarbon dating conflicted with long-established theories archaeologists had developed on the basis of Egyptian dynastic records. [C]

46. F. NO CHANGE
G. method that was developed for determining age
H. method that Libby designed to figure out age
J. dating method
47. At this point, the writer is considering adding the following accurate information:
(the time it takes for half of the carbon 14 to decay to nitrogen 14)
Should the writer make this addition here?
A. Yes, because it explains the interaction between carbon 14 and nitrogen 14 during an organism's lifetime.
B. Yes, because it provides a definition of the term *carbon 14's half-life*.
C. No, because it doesn't explain how scientists discovered this information.
D. No, because it's not relevant to the main point of the sentence.
48. F. NO CHANGE
G. present. Radiocarbon
H. present, radiocarbon
J. present radiocarbon
49. A. NO CHANGE
B. had arised
C. arised
D. arose
50. F. NO CHANGE
G. has been developing
H. were developed
J. are developing

[3]

Even though Libby won the Nobel Prize in

51

1960, experts realizing, they needed another method to corroborate Libby's findings. They turned to a much older

52

dating method; dendrochronology, the use of tree rings for mapping intervals of time. [D] Working together, experts in both methods dated thousands of wood samples

53

from bristlecone pines, some of which share habitats with Douglas firs and piñon pines. When plotted on a graph

54

54

called a calibration curve, these data with calendar dates provided a method for correlating radiocarbon dates.

55

[4]

The radiocarbon dates, now verified as accurate, overturned conventional thinking in archaeology and proved that dating methods based

56

on Egyptian records were inaccurate. [57] Some stone monuments in Europe, for example, were found to be up to 800 years older than the Egyptian and Greek structures that had supposedly inspired them.

57

51. A. NO CHANGE
B. Nevertheless,
C. Whenever
D. Indeed,
52. F. NO CHANGE
G. realized
H. realized,
J. realizing
53. A. NO CHANGE
B. method,
C. method:
D. method
54. F. NO CHANGE
G. trees that fascinate many with their scraggly appearance.
H. whose cones are prized by collectors.
J. DELETE the underlined portion and end the sentence with a period.
55. The best placement for the underlined portion would be:
A. where it is now.
B. after the word *provided*.
C. after the word *method*.
D. after the words *radiocarbon dates* (and before the period).
56. Which of the following alternatives to the underlined portion would NOT be acceptable?
F. archaeology. They proved
G. archaeology; they proved
H. archaeology, proving
J. archaeology; proving
57. The writer is considering deleting the phrase "based on Egyptian records" from the preceding sentence. Should the phrase be kept or deleted?
A. Kept, because it adds a transition from the preceding paragraph's description of one type of dating method.
B. Kept, because it clarifies which dating methods were inaccurate.
C. Deleted, because it disrupts the sentence's description of Libby's dating method.
D. Deleted, because it adds information that's too specific at this point in the essay.

1

These findings lead to the
58

establishment of different facts and
59

things about many places, such as
59

Stonehenge and the stone temples of Malta.
59

58. F. NO CHANGE
G. will led
H. leads
J. led
59. Given that all the choices are true, which one most effectively concludes the paragraph and the essay?
A. NO CHANGE
B. use of Libby's method to develop new time lines and hypotheses about the distant past.
C. confirmation of dates of prehistoric monuments across the world.
D. increase in other uses of radiocarbon dating, too.

Question 60 asks about the preceding passage as a whole.

60. The writer is considering adding the following true statement to the essay:

For instance, although long-established theories had dated certain artifacts to 1400 BCE, the objects were dated with radiocarbon dating to only 1250 BCE.

The sentence would most logically be placed at Point:

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

PASSAGE V

The Influence of Public Relations

The popular breakfast of bacon and eggs are,
historically speaking, a relatively new tradition in
most of the United States, and its beginnings reveal
much about the art of public relations. In the 1920s,
the Beechnut Packing Company, wanting to boost its
sales of bacon, hired a repute expert in public relations
named Edward Bernays.

61. A. NO CHANGE
B. are
C. is,
D. is
62. F. NO CHANGE
G. Company wanting
H. Company wanted
J. Company wants
63. A. NO CHANGE
B. reputation of
C. reputable
D. reputing



[1] Bernays considered his uncle's insights into the human psyche and they're unconscious motivations to

be high-priced tools in manipulating the public to think and act in certain ways. [2] Bernays was the nephew of Sigmund Freud, "the father of psychoanalysis." [3] In his book *Propaganda*, Bernays suggested that if one could determine the "mechanisms and motive" of the group mind, it would be possible to exert indirect control over the public. [4] He termed this process, "the engineering

of consent."

Instead of recommending that bacon be advertised directly, Bernays suggested surveying thousands of

physicians across the United States. [69] At the time, many people's breakfasts consisted of juice and coffee with either rolls or toast. Bernays asked a single question in the survey: is it healthier to eat a light breakfast or a hearty breakfast? Most doctors chose "a hearty breakfast,"

64. F. NO CHANGE
G. there
H. it's
J. its

65. A. NO CHANGE
B. invaluable
C. expensive
D. lavish

66. F. NO CHANGE
G. process—
H. process:
J. process

67. 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.

68. F. NO CHANGE
G. a survey suggested by Bernays included
H. Bernays's suggested survey asked
J. they surveyed

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

One type of direct advertising preferred by many manufacturers is coupons, a way to discount a product while simultaneously promoting it.

Should the writer make this addition here?

- A. Yes, because it provides a specific example of other types of advertising that competed with Bernays's approach.
B. Yes, because it clarifies the concept of direct advertising that is alluded to in the preceding sentence.
C. No, because it contradicts Bernays's belief in avoiding publications such as newspapers when advertising a product.
D. No, because it deviates from the paragraph's focus on an example of Bernays's public relations technique.

1

which Bernays himself had defined as including bacon

and eggs. Then, Bernays simply released the survey

70

findings regarding the breakfasts to hundreds of

71

newspapers and other media sources. 72 Beechnut's

bacon market expanded, generating profits for both

Beechnut and Bernays.

Bernays gained fame from his application of
psychology to business strategy; after being hired by

73

varied groups and corporations, became known as

“the father of public relations.” However, unlike Freud,

whose work was promoted in the United States by his

74

nephew, Bernays used his understanding of psychology

74

to mask his clients' motives. His indirect approach is why

some people today refer to public relations as the unseen

75

power that shapes many of our individual decisions.

75

70. F. NO CHANGE

G. Nonetheless,

H. However,

J. Also,

71. A. NO CHANGE

B. findings about breakfast

C. breakfast findings

D. findings

72. Given that all the following statements are true, which one, if added here, would NOT provide a logical transition into the concluding sentence of the paragraph?

F. He varied his ideas for different products.

G. People started to eat more bacon and eggs.

H. The public followed the doctors' advice.

J. His indirect approach worked.

73. A. NO CHANGE

B. strategy and,

C. strategy; and

D. strategy,

74. Given that all the choices are true, which one most clearly provides support for the sentence's contrast between the work of Bernays and the work of Freud?

F. NO CHANGE

G. whose work was designed to help people understand their unconscious drives,

H. who communicated with his nephew regarding American publishers,

J. some of whose work focused on the interpretation of dreams,

75. Given that all the choices are true, which one most effectively concludes the sentence and the essay by emphasizing the influence of the indirect approach to public relations?

A. NO CHANGE

B. circulate information over the Internet about advertising and public relations strategies.

C. can enter the field of public relations through many different educational specialties.

D. dislike public relations, especially when employed by political campaigns.

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. Danica is trying to encourage her classmates to donate books for the fund-raiser and book-drive for the local library. Danica will donate \$35.00, plus \$0.07 for each book donated by her classmates. Which of the following equations gives Danica's donation, d dollars, if b books are donated by her classmates?

- A. $d = 35 + 0.07b$
- B. $d = 35 + 0.7b$
- C. $d = 35 + 7b$
- D. $d = 35.07b$
- E. $d = 42b$

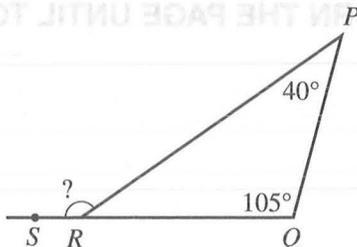
2. If $\frac{z}{-4} = -16$, then $z = ?$

- F. -64
- G. -12
- H. -4
- J. 4
- K. 64

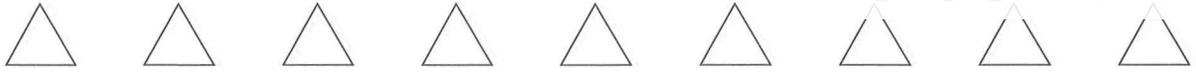
3. $4b^8 \cdot 5b^3$ is equivalent to:

- A. $9b^5$
- B. $9b^{11}$
- C. $9b^{24}$
- D. $20b^{11}$
- E. $20b^{24}$

4. In the figure below, $\angle QPR$ measures 40° , $\angle PQR$ measures 105° , and points Q , R , and S are collinear. What is the measure of $\angle PRS$?



- F. 105°
- G. 125°
- H. 130°
- J. 140°
- K. 145°



5. The sum of 2 numbers is 90. The smaller number is 50 less than the larger number. What is the larger number?
- A. 20
 - B. 40
 - C. 45
 - D. 70
 - E. 80

DO YOUR FIGURING HERE.

6. $|7 - 5| - |1 - 8| = ?$
- F. -9
 - G. -5
 - H. 5
 - J. 9
 - K. 21

7. What is the value of $x^2 + 2 + y^2 - 3$ when $x = 3$ and $y = -3$?
- A. -5
 - B. -1
 - C. 1
 - D. 11
 - E. 17

8. What is the sum of the 4 binomials listed below?
- $$x^2 + 2x, 3x + 5, x^2 + 1, 6x - 4$$
- F. $x^2 + 11x + 2$
 - G. $2x^2 + 11x + 2$
 - H. $2x^2 + 11x + 10$
 - J. $x^4 + 11x^3 + 2$
 - K. $2x^4 + 11x^3 + 10$

9. Bert's Building Supply receives shipments of only 2 kinds of lawn mowers: Tough Cuts and Easy Pushes. Today's shipment contains 96 lawn mowers with twice as many Tough Cuts as Easy Pushes. How many of these 96 are Tough Cuts?
- A. 16
 - B. 32
 - C. 47
 - D. 48
 - E. 64

Age (years)	Height (inches)
20	70
22	72
24	74
26	76
28	78
30	80





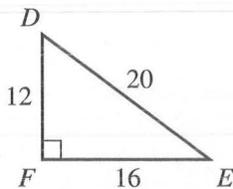
10. Adina plays in a bowling league. Her bowling scores for last week are listed below. What is the median of Adina's bowling scores for last week?

142, 186, 201, 191, 116, 201, 175

- F. $158\frac{1}{2}$
 G. $180\frac{1}{2}$
 H. 186
 J. 191
 K. 201
11. The table below shows Shannon's height, in inches, on her birthday from the day she was born (birth) to age 5. What was the average rate of change in Shannon's height, in inches per year, from birth to age 5?

Age (years)	Height (inches)
Birth	20
1	27
2	32
3	38
4	43
5	50

- A. 2
 B. 5
 C. 6
 D. 7
 E. 14
12. The side lengths, in centimeters, of right triangle $\triangle DEF$ are given in the figure below. What is the area, in square centimeters, of $\triangle DEF$?



- E. 48
 G. 96
 H. 120
 J. 160
 K. 192
13. Christopher bought 4 cans of soup for a total of \$3.36, which included sales tax of \$0.16. At the same per-can cost, what is the cost before the sales tax is added for 6 cans of the same soup?
- A. \$0.80
 B. \$0.84
 C. \$4.80
 D. \$5.04
 E. \$6.40

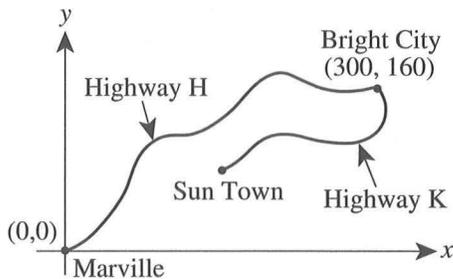
DO YOUR FIGURING HERE.



Use the following information to answer questions 14–16.

DO YOUR FIGURING HERE.

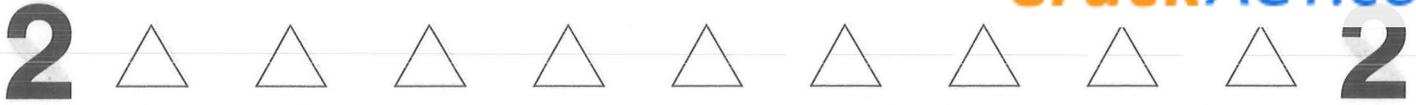
A map of the locations of Marville, Sun Town, and Bright City is shown in the standard (x,y) coordinate plane below, where coordinates for x and y are given in miles. The coordinates of Marville and Bright City are given, and Sun Town is located along a straight line exactly halfway between Marville and Bright City. Highway H from Marville to Bright City is 390 miles long. Highway K from Sun Town to Bright City is 200 miles long.



14. What are the coordinates of Sun Town?
 - F. (80, 150)
 - G. (140, 140)
 - H. (150, 80)
 - J. (195, 100)
 - K. (230, 70)

15. The straight-line distance, in miles, from Marville to Bright City *must* be:
 - A. less than 140.
 - B. between 140 and 300.
 - C. between 300 and 390.
 - D. between 390 and 460.
 - E. more than 460.

16. Chelsea’s car travels an average of 32 miles per gallon of gas used, and she pays an average of \$2.25 per gallon of gas. Chelsea will drive her car along Highway H from Marville to Bright City. To the nearest \$1, what will be the total cost of gas that her car uses for the drive?
 - F. \$ 5.00
 - G. \$13.00
 - H. \$14.00
 - J. \$27.00
 - K. \$32.00



17. Let $0 < a < b < c < d$ be true for integers $a, b, c,$ and d . Which of the following expressions has the greatest value?

- A. $\frac{d}{a}$
- B. $\frac{c}{b}$
- C. $\frac{a}{b}$
- D. $\frac{d}{c}$
- E. $\frac{a}{d}$

18. Maurice earns \$12.50 per hour for the first 40 hours he works each week. For each hour beyond 40 that he works in 1 week, Maurice earns \$18.75 per hour. Last week Maurice earned \$931.25. How many hours did Maurice work last week?

- F. 23
- G. 30
- H. 55
- J. 63
- K. 76

19. An apartment building is 3 stories tall. Each story has 4 identical apartments. Each apartment's living space consists of 4 rectangular rooms: a bathroom 8 feet by 10 feet, a kitchen 10 feet by 12 feet, a bedroom 12 feet by 12 feet, and a living room 12 feet by 14 feet. What is the area, to the nearest 1,000 square feet, of living space in the 3-story apartment building?

- A. 8,000
- B. 6,000
- C. 5,000
- D. 4,000
- E. 3,000

20. The perimeter of a parallelogram is 80 inches, and the length of 1 side is 18 inches. If it can be determined, what are the lengths, in inches, of the other 3 sides?

- F. 18, 13, 13
- G. 18, 18, 26
- H. 18, 22, 22
- J. 18, 31, 31
- K. Cannot be determined from the given information

DO YOUR FIGURING HERE.

14. What are the coordinates of Sun Town?

A. (200, 70)
 B. (150, 100)
 C. (140, 140)
 D. (80, 150)
 E. (80, 20)



15. The straight line distance, in miles, from Marville to Bright City must be:

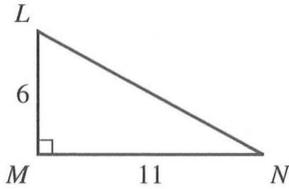
A. less than 150
 B. between 140 and 300
 C. between 300 and 350
 D. between 360 and 450
 E. more than 450

16. Chelsea can travel an average of 15 miles per gallon of gas and she pays an average of \$2.25 per gallon of gas. Chelsea will drive her car along Highway H from Marville to Bright City. To the nearest \$1, what will be the total cost of gas that she will use for the drive?

A. \$ 1.00
 B. \$ 214.00
 C. \$ 231.00
 D. \$ 2.00
 E. \$ 2.25

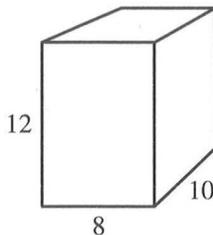


21. The side lengths of right triangle $\triangle LMN$ are given in centimeters in the figure below. What is $\tan N$?



- A. $\frac{6}{11}$
- B. $\frac{6}{\sqrt{157}}$
- C. $\frac{11}{6}$
- D. $\frac{11}{\sqrt{157}}$
- E. $\frac{\sqrt{157}}{11}$

22. The empty container shown below is a right rectangular prism with dimensions given in inches. How many cubic inches of liquid are needed to fill the container to 75% of its capacity?



- F. 148
- G. 240
- H. 444
- J. 720
- K. 960

23. The length of a rectangle is 4 inches longer than the width. The perimeter of the rectangle is 28 inches. What is the width of the rectangle, in inches?

- A. 5
- B. 7
- C. 10
- D. 12
- E. 14

DO YOUR FIGURING HERE.



24. The probability that a number chosen from the set of integers from 1 to 100 is a multiple of 5 is $\frac{1}{5}$. What is the probability that a number chosen from the set of integers from 1 to 100 is a multiple of 10?

A. $\frac{1}{10}$
 B. $\frac{1}{5}$
 C. $\frac{1}{2}$
 D. $\frac{2}{5}$
 E. $\frac{4}{5}$

25. For functions f and g defined by $f(x) = 3x^2 + 2$ and $g(x) = 2x - 1$, what is the value of $(fg)(2)$?

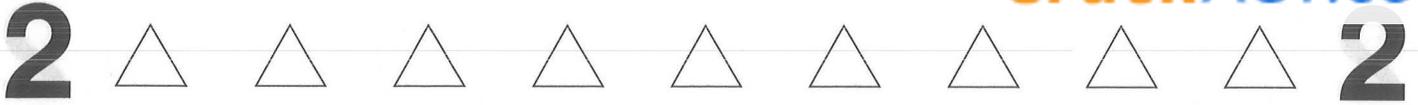
A. 29
 B. 62
 C. 134
 D. 162
 E. 169

26. What is the value of $\sqrt{2} + \sqrt{2}$ when $n = \sqrt{2}$ and $k = \sqrt{10}$?

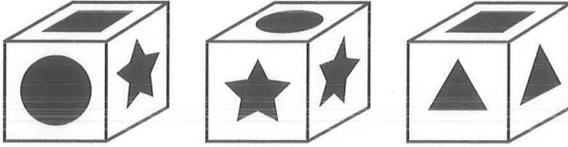
A. $\sqrt{13}$
 B. $2\sqrt{3}$
 C. $2\sqrt{2}$
 D. $2\sqrt{5}$
 E. 12
 F. 122

27. All of the following statements concern triangles that are similar congruent or both. Which statement is FALSE?

A. Triangles that are congruent to each other are always similar to each other.
 B. Lengths of corresponding sides of similar triangles are always equal.
 C. Lengths of corresponding sides of congruent triangles are always equal.
 D. Measures of corresponding angles of similar triangles are always equal.
 E. Measures of corresponding angles of congruent triangles are always equal.



24. The figure below shows 3 different views of the same fair cube. Each face of the cube has 1 design drawn on it. The cube will be rolled once. What is the probability that a face showing a star (★) will be on top?



- F. $\frac{1}{2}$
 G. $\frac{1}{3}$
 H. $\frac{2}{3}$
 J. $\frac{1}{4}$
 K. $\frac{1}{6}$
25. For functions f and g defined by $f(x) = 2x^2 + x$ and $g(x) = 3x - 1$, what is the value of $f(g(3))$?

- A. 29
 B. 62
 C. 136
 D. 162
 E. 168

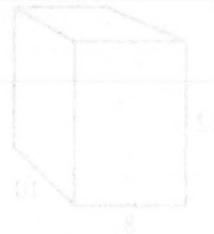
26. What is the value of $\sqrt{a^2 + b^2}$ when $a = \sqrt{5}$ and $b = \sqrt{10}$?

- F. $\sqrt{15}$
 G. $5\sqrt{2}$
 H. $5\sqrt{5}$
 J. 15
 K. 125

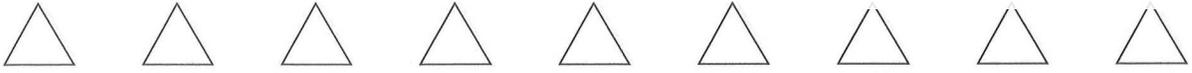
27. All of the following statements concern triangles that are similar, congruent, or both. Which statement is FALSE?

- A. Triangles that are congruent to each other are always similar to each other.
 B. Lengths of corresponding sides of similar triangles are always equal.
 C. Lengths of corresponding sides of congruent triangles are always equal.
 D. Measures of corresponding angles of similar triangles are always equal.
 E. Measures of corresponding angles of congruent triangles are always equal.

DO YOUR FIGURING HERE.



2



2

28. Distinct lines l and m intersect, forming 4 pairs of adjacent angles. Which of the following statements *must* be true about these 4 pairs of angles?

- F. The difference of the angle measures in each pair is less than 45° .
- G. The difference of the angle measures in each pair is 90° .
- H. The measure of each angle in each pair is 45° .
- J. The sum of the angle measures in each pair is 90° .
- K. The sum of the angle measures in each pair is 180° .

29. In the standard (x,y) coordinate plane, what is the slope of the line through $(3,7)$ and $(-2,4)$?

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

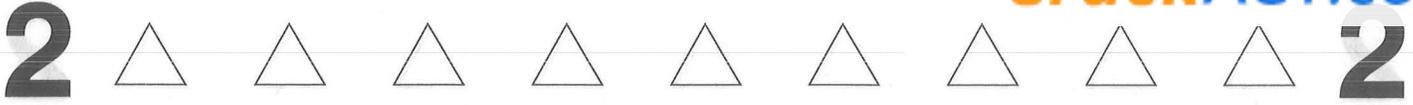
30. Which of the following expressions is equivalent to $(2x - 3)(-x - 7)$?

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

31. Tomas plans to construct a circular fishpond with a diameter of 9 ft. Which of the following is closest to the length, in feet, of the decorative fencing that Tomas needs to enclose the fishpond along its perimeter?

- A. 15
- B. 19
- C. 29
- D. 64
- E. 255

DO YOUR FIGURING HERE.



32. Ursula will order boxes of red pens and boxes of blue pens for her company. The table below gives the number of pens in each box and the price per box.

Color	Number in each box	Price per box
Red	15	\$5
Blue	20	\$6

Ursula will order a total of 50 boxes of pens for a total price of \$280. Which of the following systems of equations gives a true relationship between the r boxes of red pens and b boxes of blue pens that Ursula will order?

- F. $r + b = 50$
 $5r + 6b = 280$
- G. $r + b = 50$
 $15r + 20b = 280$
- H. $r + b = 280$
 $15r + 20b = 50$
- J. $5r + 6b = 50$
 $15r + 20b = 280$
- K. $5r + 6b = 280$
 $15r + 20b = 50$
33. Which of the following inequalities is an equivalent algebraic expression for the statement below?

5 less than the product of 4 and a number n is greater than 28

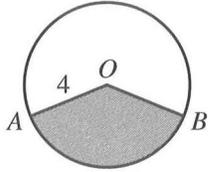
- A. $5 - 4n > 28$
- B. $23 > 4n$
- C. $28 - 4n > 5$
- D. $4n > 23$
- E. $4n - 5 > 28$
34. The quadratic formula gives the 2 roots $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ for the equation $ax^2 + bx + c = 0$. What are the 2 roots of the equation $3x^2 - x = 10$?
- F. $\frac{1 \pm 2\sqrt{-30}}{6}$
- G. $\frac{1 \pm 2\sqrt{30}}{6}$
- H. -2 and $\frac{5}{3}$
- J. 2 and $-\frac{5}{3}$
- K. 6 and -5

DO YOUR FIGURING HERE.

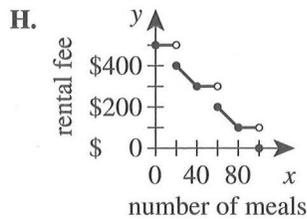
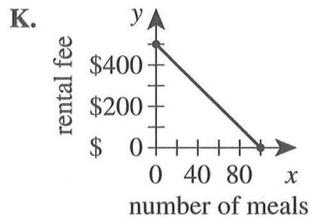
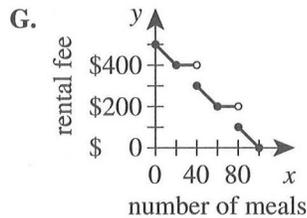
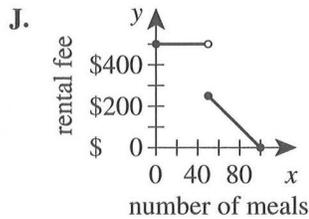
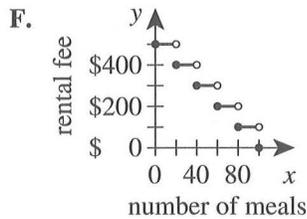


35. The shaded sector of the circle shown below is bounded by radius \overline{AO} , radius \overline{BO} , and minor arc \widehat{AB} . The length of \overline{AO} is 4 meters, and the area of the shaded sector is 6π square meters. What is the measure of $\angle AOB$?

- A. 105°
- B. 120°
- C. 135°
- D. 160°
- E. 175°



36. The rental fee for the use of a reception hall is \$500. To encourage use of the hall's catering service, the hall's rental fee is reduced by \$100 for each group of 20 meals ordered through the hall's catering service. All 20 meals in a group must be ordered for each reduction in the rental fee. One of the following graphs shows the hall's rental fee when 0 to 100 meals are ordered. Which graph is it?



37. A line in the standard (x,y) coordinate plane is parallel to the x -axis and 6 coordinate units above it. Which of the following is an equation of this line?

- A. $y = 6$
- B. $x = 6$
- C. $y = 6x$
- D. $y = x + 6$
- E. $x = y + 6$

DO YOUR FIGURING HERE.



- A. $\frac{10}{13}$
- B. $\frac{10}{12}$
- C. $\frac{12}{13}$
- D. $\frac{12}{10}$
- E. $\frac{13}{10}$

38. The only factor that is common to 200 and an integer n is 1. When $\frac{n}{200}$ is written as a decimal number, what is the minimum number of digits to the right of the decimal point?

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

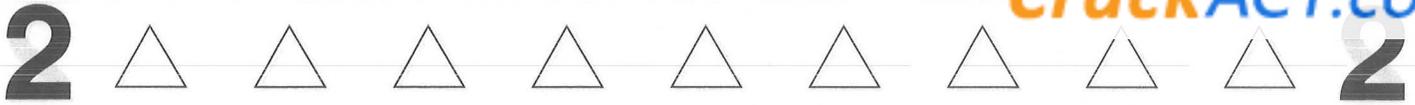
39. Right triangle $\triangle ABC$ is shown below with each side length given in meters. What is the value of x ?



- A. $\frac{1}{2}$
- B. $\frac{3}{4}$
- C. $\frac{1}{4}$
- D. $\frac{3}{12}$
- E. $\frac{1}{3}$

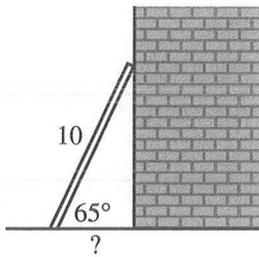
40. If $\frac{2x-2}{x+2} = \frac{5}{3}$, then $\frac{x}{x+2} = ?$

- A. $\frac{1}{2}$
- B. $\frac{3}{4}$
- C. $\frac{1}{4}$
- D. $\frac{3}{12}$
- E. $\frac{1}{3}$



38. The figure below shows a 10-foot ladder leaning against a vertical wall. The base of the ladder makes a 65° angle with the level ground. Which of the following expressions gives the distance, in feet, between the base of the ladder and the wall?

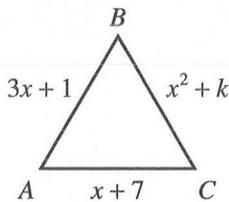
- F. $10 \sin 65^\circ$
- G. $10 \cos 65^\circ$
- H. $10 \tan 65^\circ$
- J. $\frac{10}{\sin 65^\circ}$
- K. $\frac{10}{\cos 65^\circ}$



39. The only factor that is common to 200 and an integer n is 1. When $\frac{n}{200}$ is written as a decimal number, what is the minimum number of digits to the right of the decimal point?

- A. 1
- B. 2
- C. 3
- D. 5
- E. 6

40. Equilateral triangle $\triangle ABC$ is shown below with each side length given in meters. What is the value of k ?



- F. -6
- G. 1
- H. 4
- J. 6
- K. 8

41. If $\frac{3x-y}{x+y} = \frac{2}{5}$, then $\frac{x}{y} = ?$

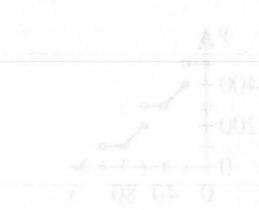
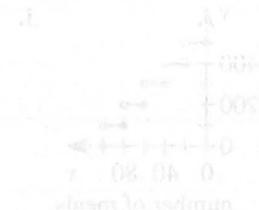
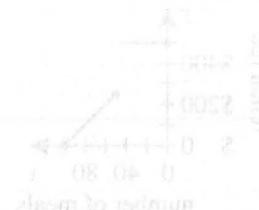
- A. $\frac{2}{5}$
- B. $\frac{2}{13}$
- C. $\frac{7}{4}$
- D. $\frac{7}{13}$
- E. 7

DO YOUR FIGURING HERE.

... The length of the hypotenuse is 10 feet. The angle between the ladder and the ground is 65 degrees. ...



... The total fee for the use of a reception hall is \$200. ...





Use the following information to answer questions 42–45.

DO YOUR FIGURING HERE.

Jin's Office Supply sells different styles of notebooks. The sale price and number of sheets per notebook for 3 styles of notebooks are given in the table below. The sale price is the amount a customer pays for that notebook.

Style of notebook	Number of sheets per notebook	Sale price per notebook
A	50	\$1.00
B	125	\$1.50
C	200	\$2.00

42. Which of the following amounts is closest to the average sale price per sheet for a Style B notebook?

- F. \$0.01
- G. \$0.02
- H. \$0.03
- J. \$0.12
- K. \$0.83

43. A bin contains 100 Style A notebooks, 100 Style B notebooks, and 100 Style C notebooks. Antoine will select 3 notebooks from the bin. How many different selections of 3 notebook styles are possible?

(Note: The order in which the notebooks are selected does not matter.)

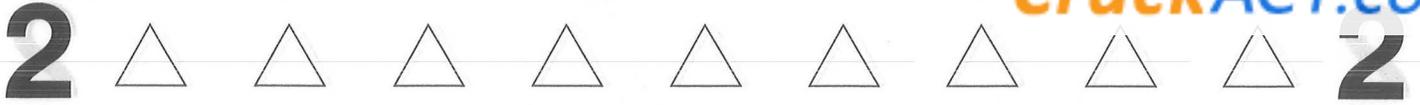
- A. 3
- B. 6
- C. 10
- D. 14
- E. 27

44. Last week, customers bought 5 times as many Style A notebooks as Style C notebooks, and customers bought 2 times as many Style B notebooks as Style C notebooks. Last week, customers bought 392 notebooks. What total amount did customers pay for the 392 notebooks?

- F. \$490.00
- G. \$560.00
- H. \$588.00
- J. \$686.00
- K. \$784.00

45. The notebook supplier is offering Jin's a Style D notebook that has 60% more sheets than the Style C notebook has. How many sheets does the Style D notebook have?

- A. 200
- B. 260
- C. 275
- D. 320
- E. 350



46. Given that $3x + 5y = 17$ and $2x + 3y = 11$, what is the value of $x + y$?

- F. 3
- G. $3\frac{1}{2}$
- H. 4
- J. 5
- K. 6

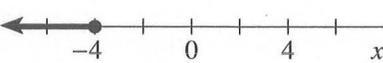
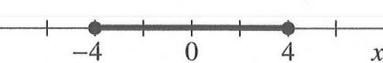
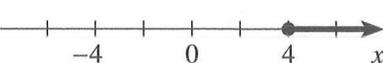
47. The least common multiple (LCM) of 2 numbers is 108. The greater of the 2 numbers is 54. What is the maximum value of the other number?

- A. 2
- B. 6
- C. 18
- D. 27
- E. 36

48. In the standard (x,y) coordinate plane, what is the slope of a line that is perpendicular to $2x - 3y = 9$?

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

49. Which of the following number line graphs is that of the solution set to the inequality $-2x + 12 \geq 20$?

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

DO YOUR FIGURING HERE.

Use the following information to answer questions 42-45.

The amount a customer pays for that notebook, the price and number of sheets per notebook for 3 styles of notebooks are given in the table below.

Style of notebook	Number of sheets per notebook	Price per notebook
A	40	\$1.00
B	125	\$1.50
C	300	\$2.00

42. Which of the following amounts is closest to the average sale price per sheet for a Style B notebook?

- F. \$0.01
- G. \$0.02
- H. \$0.03
- J. \$0.12
- K. \$0.21

43. A bin contains 100 Style A notebooks, 100 Style B notebooks, and 100 Style C notebooks. A student will select 3 notebooks from the bin. How many different selections of 3 notebook styles are possible?

(Note: The order in which the notebooks are selected does not matter.)

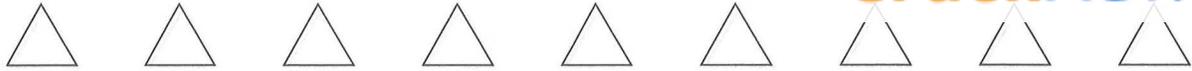
- A. 3
- B. 6
- C. 10
- D. 14
- E. 27

44. Last week, customers bought 2 times as many Style A notebooks as Style C notebooks, and customers bought 2 times as many Style B notebooks as Style C notebooks. Last week, customers bought 302 notebooks. What total amount did customers pay for the 302 notebooks?

- F. \$100.00
- G. \$250.00
- H. \$388.00
- J. \$680.00
- K. \$984.00

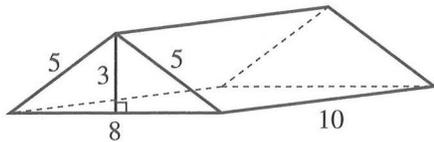
45. The notebook supplier is offering Jim a Style D notebook that has 600 more sheets than the Style C notebook has. How many sheets does the Style D notebook have?

- A. 300
- B. 500
- C. 125
- D. 150
- E. 190



50. A right prism with triangular bases and with dimensions given in inches is shown below. What is the prism's total surface area, in square inches?

- F. 120
- G. 204
- H. 228
- J. 240
- K. 264

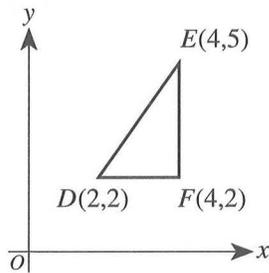


51. If # represents the operation defined by $a \# b = a + b^a$, then $(1 \# 2) \# 3 = ?$

- A. 6
- B. 12
- C. 30
- D. 32
- E. 216

52. In the standard (x,y) coordinate plane below, $\triangle DEF$ will be translated 12 coordinate units down and 2 coordinate units right. What will be the coordinates of E after the translation?

- F. $(7, -8)$
- G. $(6, -7)$
- H. $(3, -7)$
- J. $(-7, 6)$
- K. $(-8, 7)$



53. The product of 2 numbers is 25. If 1 of the numbers is the complex number $4 + 3i$, what is the other number?

- A. $21 - 3i$
- B. $\frac{4}{25} + \frac{3}{25}i$
- C. $4 - 3i$
- D. $100 + 75i$
- E. $\frac{100}{7} - \frac{75}{7}i$

54. Experimental data is represented in the standard (x,y) coordinate plane by a scatterplot consisting of 6 points: $(1, 1.4)$, $(2, 2.9)$, $(3, 3.4)$, $(4, 3.1)$, $(5, 1.9)$, and $(6, 0.2)$. When all possible real values for a , b , and c are considered, which of the following functions best fits the experimental data?

- F. $y = a$
- G. $y = ax + b$
- H. $y = a + b(c^x)$
- J. $y = a + b \log_c x$
- K. $y = ax^2 + bx + c$

DO YOUR FIGURING HERE.

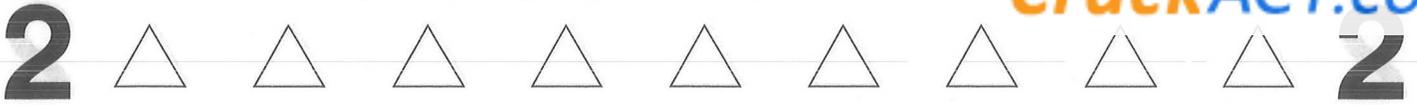


55. A shown below, 2 circular pulleys with centers 8 inches apart are connected with a tight belt. The belt wraps $\frac{1}{4}$ of the way around the larger pulley, which has a radius of 4 inches, and $\frac{1}{4}$ of the way around the smaller pulley, which has a radius of 1 inch. What is the exact length of the belt in inches?



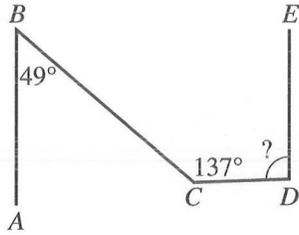
56. Given that $\sin \theta = \frac{3}{5}$ and $0^\circ < \theta < 180^\circ$, which of the following are possible values of $\cos \theta$?

- A. $\frac{4}{5}$ only
- B. $\frac{4}{5}$ and $-\frac{4}{5}$
- C. $-\frac{4}{5}$ only
- D. $-\frac{4}{5}$ and $\frac{4}{5}$
- E. $\frac{4}{5}$ and $-\frac{4}{5}$ only



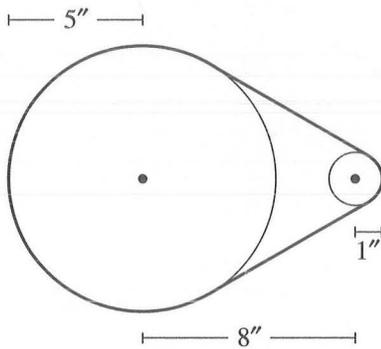
55. In the figure below, \overline{AB} is parallel to \overline{DE} , the measure of $\angle ABC$ is 49° , and the measure of $\angle BCD$ is 137° . What is the measure of $\angle CDE$?

- A. 78°
- B. 88°
- C. 90°
- D. 92°
- E. 96°



56. As shown below, 2 circular pulleys with centers 8 inches apart are connected with a tight belt. The belt wraps $\frac{2}{3}$ of the way around the larger pulley, which has a radius of 5 inches, and $\frac{1}{3}$ of the way around the smaller pulley, which has a radius of 1 inch. What is the exact length of the belt, in inches?

- F. $\frac{22\pi}{3} + 8$
- G. $\frac{22\pi}{3} + 8\sqrt{3}$
- H. $17\pi + 8$
- J. $17\pi + 8\sqrt{2}$
- K. $17\pi + 8\sqrt{3}$



57. Given that $\sin A = \frac{5}{13}$ and $0^\circ \leq A < 360^\circ$, what are all possible values of $\cos A$?

- A. $-\frac{5}{13}$ only
- B. $-\frac{5}{13}$ and $\frac{5}{13}$
- C. $\frac{12}{13}$ only
- D. $-\frac{12}{13}$ only
- E. $-\frac{12}{13}$ and $\frac{12}{13}$

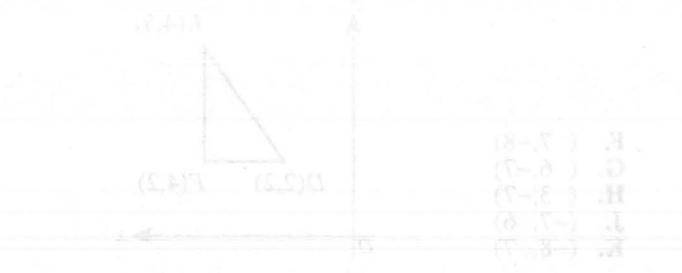
DO YOUR FIGURING HERE.



50. A right triangle with dimensions given in inches is shown below. What is the perimeter of the square inscribed in the triangle?

51. The expression $\frac{1}{x^2}$ is equivalent to the expression defined by $\frac{1}{x^2} = \frac{1}{x^2} + \frac{1}{x^2}$.

52. In the standard (x,y) coordinate plane below, a triangle will be translated 13 coordinate units down and 2 coordinate units left. What will be the coordinates of the translation?



53. The product of 2 numbers is 25. If 1 of the numbers is the complex number $4 + 3i$, what is the other number?

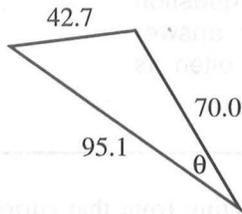
54. Experimental data is represented in the standard (x,y) coordinate plane by a scatterplot consisting of 6 points: (1, 1), (2, 2), (3, 3), (4, 4), (5, 5), and (6, 6). When all possible real values for a, b, and c are considered, which of the following functions best fits the experimental data?



58. The lengths of the sides of the triangle shown below are given in meters. Which of the following equations gives the degree measure θ ?

DO YOUR FIGURING HERE.

(Note: For any triangle, $c^2 = a^2 + b^2 - 2ab \cos C$, where a , b , and c are the lengths of the sides opposite angles with measures A , B , and C , respectively.)

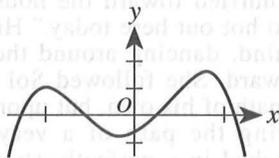


- F. $42.7^2 = 95.1^2 + 70.0^2 - 2(95.1)(70.0) \cos \theta$
- G. $70.0^2 = 95.1^2 + 42.7^2 - 2(95.1)(42.7) \cos \theta$
- H. $95.1^2 = 70.0^2 + 42.7^2 - 2(70.0)(42.7) \cos \theta$
- J. $\sin \theta = \frac{42.7}{95.1}$
- K. $\cos \theta = \frac{70.0}{95.1}$

59. The sum of the first 30 positive integers is 465. Which of the following is the sum of the first 60 positive integers?

- A. 465²
- B. 930
- C. 1,395
- D. 1,830
- E. 12,865

60. What is the minimum degree possible for the polynomial function whose graph is shown in the standard (x,y) coordinate plane below?



- F. 0
- G. 1
- H. 2
- J. 3
- K. 4

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 *Tropic of Orange: A Novel* by Karen Tei Yamashita (©1997 by Karen Tei Yamashita).

This passage uses elements of a literary genre called *magic realism* to describe a mysterious thin line that is simultaneously real and imaginary.

The tree was a sorry one, and so was the orange. Rafaela knew it was an orange that should not have been. It was much too early. Everyone said the weather was changing. The rains came sooner this year. The tree had been fooled, and little pimples of budding flowers began to burst through its branches. And then came a sudden period of dry weather; the flowers withered away, except for this one. Perhaps it had been the industriousness of the African bees, their furry feet dusted heavily in yellow pollen, that had quickly mated the flower to its future, producing this aberrant orange—not to be picked, not expected, and probably not very sweet.

But from the very beginning Rafaela somehow felt this particular orange was special. Perhaps it was her desire to see a thing out of season struggle despite everything and become whole. As time went on, she found herself watching the orange, wandering out to the tree every day even in the rain, feeling great contentment in the transition of its small growing globe, first from green and then to its slow golden burnish.

But there was something else. Just where its tiny bud had broken through the tree's branch, Rafaela noticed a line—finer than the thread of a spiderweb—pulled with delicate tautness. It was most visible in the dewy mornings as the sun rose from the east; at other times, it was barely visible. But she had always sensed its presence. If she could not reach out and touch it, she sensed its peculiar, very supple strength. Rafaela knew that it ran across the property. In fact, she sensed that it continued farther in both directions, east and west, east across the highway and west toward the ocean and beyond.

In the days when the orange was a blossom of soft petals, its fragrance surprised her. She had passed beneath the orange several times, drawn to its sweet scent before she had discovered it. The perfume could

only be emanating from that curious flower. She came often then to secure the whiff that tingled her deep memory. It was then that she noticed the line. And when the baby orange appeared, it seemed to grasp that line as its parent, if a line could be a parent. As expected, the orange did not grow to be very big or seem very succulent, but it did begin to hang rather heavily. And when the salty wind blew west from the sea rocking it back and forth like a small cradle, the curious line—now running through the growing orange—rocked back and forth with it like a lullaby.

Rafaela and her son Sol walked hand in hand past the orange tree, careful not to disturb the lizards and beetles waiting breathlessly beneath scattered leaves and brush. For three days now, it had not rained. And yet any cool surface bled the air's moisture. Rafaela felt this wetness; it gathered in tiny molecules over her skin. It was a little before noon, and the sun was particularly bright and oppressive that day. If Rafaela had bothered to look at the calendar, she would have noticed that it was Monday, June 22. She might have also noticed the lunar signs in the corner of the calendar and the small print that said summer solstice.

She glanced briefly at the orange with some satisfaction and hurried toward the house. "Come on Sol. It's much too hot out here today." His little quick steps pattered behind, dancing around the young trees, and then ran forward. She followed Sol who seemed to be following a path of his own, but upon closer inspection, he was tracing the path of a very thin but distinct shadow stretched in a perfectly straight line along the dirt and sand. There were no telephone cables or electric lines above, nothing to cast such a shadow, and yet it was clearly there. Rafaela glanced back toward the orange tree and the single orange, suddenly aware of the only possible and yet entirely impossible thing that could obstruct the intensity of the sun's light at this hour, slicing the heavy atmosphere with cruel precision. Indeed the sun was a great ball of fire directly above the orange tree. It seemed even to point at the tree, at the strange line, at the orange itself.

Rafaela ran after Sol into the cool shadows of the house. There was a sudden gust of tepid wind, and from the corner of her eye, she thought she saw the line's razor shadow dip away, south. Rafaela felt a dizzy nausea. She did not realize that the orange had fallen

irresistibly from a height of two meters, rolling in dusty turbulence down a small slope, under the barbed-wire fence, and just beyond the frontiers of the property to a neutral place between ownership and the highway.

1. It can reasonably be inferred from the passage that which of the following events occurs first chronologically?
 - A. Rafaela follows Sol into the cool shadows.
 - B. Rafaela and Sol avoid disturbing the lizards and beetles.
 - C. The orange seems to take hold of the line.
 - D. The orange rolls off the property.
2. How do descriptions of the line in the fourth paragraph (lines 34–48) compare with those of the line’s shadow in the sixth and seventh paragraphs (lines 61–87)?
 - F. Descriptions of the line indicate that the line stays in place, while those of the shadow suggest that the shadow rocks with the wind.
 - G. Descriptions of both the line and its shadow work together to suggest that the line is directly connected to the pattern of rainfall.
 - H. Descriptions of both the line and its shadow emphasize that the line is benevolent and brings hope to those who see it.
 - J. Descriptions of the line make the line seem positive and nurturing, while those of the shadow suggest that there is something ominous about the line.
3. The first paragraph establishes all of the following details about the orange EXCEPT that it:
 - A. was not expected to grow.
 - B. was likely a product of bee pollination.
 - C. grew in the path of a peculiar line.
 - D. grew as a result of unseasonal rains.
4. The main purpose of the fifth paragraph (lines 49–60) is to:
 - F. describe how the weather affects even the smallest creatures and add to the passage’s overall sense of frenzied chaos.
 - G. emphasize Rafaela’s grief by contrasting it with the apparent joyfulness of the creatures she sees on the property.
 - H. illustrate the intensity of the summer heat and convey a sense of the building tension in the passage.
 - J. highlight the increasing resentment between Rafaela and Sol by emphasizing the stillness of everything around them.
5. It can reasonably be inferred from the passage that when Sol runs ahead of Rafaela, Rafaela comes to believe that he is following a:
 - A. worn path formed by numerous people walking through the yard to the house.
 - B. shadow cast by a telephone line that runs across the property.
 - C. line through the dirt that he had drawn with a stick.
 - D. shadow cast by the line that goes through the orange.
6. The passage indicates that only one of the tree’s flowers produced an orange because the:
 - F. African bees were so inactive that they pollinated only one flower.
 - G. other flowers wilted and shriveled from a sudden dry period.
 - H. flowers smelled so sweet that people picked all but one of them.
 - J. unusually strong winds blew the other flowers off the tree.
7. According to the passage, how often does Rafaela look at the orange?
 - A. Once each morning and once each evening
 - B. A couple of times a week
 - C. Every day, even when it rains
 - D. Constantly, never losing sight of it
8. In the passage, the line has all of the following characteristics EXCEPT:
 - F. dryness.
 - G. tautness.
 - H. strength.
 - J. fineness.
9. As it is used in line 39, the word *secure* most nearly means:
 - A. protect.
 - B. fasten.
 - C. guarantee.
 - D. obtain.
10. In the passage, Rafaela hurries Sol toward the house because she wants to:
 - F. get water for the withering plants.
 - G. escape from the summer heat.
 - H. get inside the house before it rains.
 - J. prevent Sol from picking the orange.

Passage II

SOCIAL SCIENCE: This passage is adapted from the article “The Green Monster” by James E. McWilliams (©2009 by Washington Post.Newsweek Interactive Co. LLC).

GMO refers to “genetically modified organisms.” A genetically modified crop results from the laboratory insertion of a gene from one organism into the DNA sequence of another in order to confer an advantageous trait such as insect resistance, drought tolerance, or herbicide resistance. Today almost 90 percent of soy crops and 80 percent of corn crops in the United States sprout from genetically engineered seeds. Forty-five million acres of land worldwide contain genetically engineered crops. From the perspective of commercial agriculture, the technology has been seamlessly assimilated into traditional farming routines.

Not all consumers share the enthusiasm. It’s as likely as not that you know GMOs by their stock term of derision: *Frankenfoods*. The moniker reflects a broad spectrum of concerns: Some anti-biotech activists argue that these organisms will contaminate their wild cousins with GM pollen and drive native plants extinct. Others suggest that they will foster the growth of “superweeds”—plants that develop a resistance to the herbicides many GMOs are engineered to tolerate. And yet others fear that genetic alterations will trigger allergic reactions in unsuspecting consumers. Whether or not these concerns collectively warrant a ban on GMOs—as many environmentalists would like to see—is a hotly debated topic. The upshot to these potential pitfalls, however, is beyond dispute: A lot of people find this technology to be creepy.

Whatever the specific cause of discontent over GM crops, popular resistance came to a head in 2000, when the National Organic Program solicited public input on the issue of whether GM crops should be included in an organic food program. In response, sustainable-food activists deluged officials with a rain-forest’s worth of letters—275,000, to be exact—beating the measure into oblivion. Today, in the same spirit, environmentalists instinctively deem GMOs the antithesis of environmental responsibility.

Many scientists, and even a few organic farmers, now believe the 2000 rejection was a fatal rush to judgment. Most recently, Pamela Ronald, a plant pathologist and chair of the Plant Genomics Program at the University of California–Davis, has declared herself one such critic. She argues that we should, in fact, be actively merging genetic engineering and organic farming to achieve a sustainable future for food production. Her research—which she conducts alongside her husband, an organic farmer—explores genetically engineered crops that, instead of serving the rapacity of agribusiness, foster the fundamentals of sustainability. Their endeavor, counterintuitive as it seems, points to an emerging green biotech frontier—a hidden realm of opportunity to feed the world’s impending 9 billion a diet produced in an environmentally responsible way.

To appreciate how “responsible genetic modification” isn’t an oxymoron, consider grass-fed beef. Cows that eat grass are commonly touted as the sustainable alternative to feedlot beef, a resource-intensive form of production that stuffs cows with a steady diet of grain fortified with antibiotics, growth hormones, steroids, and appetite enhancers that eventually pass through the animals into the soil and water. One overlooked drawback to grass-fed beef, however, is the fact that grass-fed cows emit four times more methane—a greenhouse gas that’s more than 20 times as powerful as carbon dioxide—as regular, feedlot cows. That’s because grass contains lignin, a substance that triggers a cow’s digestive system to secrete a methane-producing enzyme. An Australian biotech company has recently produced a genetically modified grass with lower amounts of lignin. Lower amounts of lignin mean less methane, less methane means curbed global warming emissions, and curbed emissions means environmentalists can eat their beef without hanging up their green stripes.

When commercial farmers hear about GM grass, they’re excited. And when they hear about other products in the works, they’re also excited. And they’re excited not only because these products have the potential to streamline production but also because GM technology allows them to play a meaningful role in reducing their carbon footprint.

Given the potential of these products to reduce the environmental impact of farming, it’s ironic that traditional advocates for sustainable agriculture have led a successful campaign to blacklist GMOs irrespective of their applications. At the very least, they might treat them as legitimate ethical and scientific matters deserving of a fair public hearing.

11. The main purpose of the passage is to:
- argue in support of GMOs by challenging their critics to acknowledge some of the advantages of GMOs.
 - explain the laboratory process used to create GMOs.
 - discuss the extent to which GM crops have become part of conventional farming.
 - describe in detail how GMOs compete with conventionally raised and organic food.
12. What role does the passage’s author claim the National Organic Program played in bringing resistance to GM crops to a head?
- It organized a nationwide boycott of GM foods.
 - It proved that commercial agriculture increased crop production through conventional farming practices.
 - It conducted a study showing that consumers would not pay higher prices for GM food.
 - It solicited public input on whether GM crops should be included in an organic food program.

13. According to Ronald, one environmentally responsible way to feed the world's growing population would be to:
- follow the rules made by the National Organic Program in 2000.
 - organize a global sustainable-food pantry to distribute food equitably.
 - merge genetic engineering with organic farming.
 - focus efforts on conventional farming practices.
14. It is reasonable to conclude from the passage that one drawback to raising feedlot beef is that:
- feedlot cows emit four times more methane than grass-fed cows.
 - feedlot cows require GM grains, unlike the organic grasses that sustain grass-fed cows.
 - additives in the grain eaten by feedlot cows end up in the soil and water supply.
 - raising feedlot cows is costly, which makes feedlot beef more expensive than GM beef.
15. The statistics in lines 6–8 are most likely included to:
- emphasize the disadvantages of planting GM crops.
 - illustrate that GM crops already play a vital role in commercial agriculture.
 - point out that the rest of the world lags behind the United States in its production of GM crops.
 - give examples of the way GM crops differ from their organic counterparts.
16. As it is used in line 14, the word *stock* most nearly means:
- commonly used.
 - generic title.
 - easily available.
 - estimated amount.
17. As it is used by some consumers, the term *Frankenfoods* (line 15) is meant to:
- advertise a new brand of food.
 - ridicule genetically modified products.
 - be a friendly nickname.
 - pay tribute to organic food.
18. It is logical to infer that when Ronald declared herself “one such critic” (lines 43–44), she meant that she:
- only eats food grown organically.
 - believes she was wrong to think that GM crops cannot be grown organically.
 - continues to find GM crops objectionable.
 - finds the scarcity of organic food available in her grocery store frustrating.
19. According to the passage, lignin is a:
- genetically modified grass produced by an Australian biotech company.
 - substance in grass that triggers the secretion of a methane-producing enzyme in cows.
 - specialized grain fortified with antibiotics and appetite enhancers.
 - greenhouse gas that is more than twenty times as powerful as carbon dioxide.
20. As it is used in lines 72 and 73, the word *curbed* most nearly means:
- bent.
 - shortened.
 - parked.
 - reduced.

Passage III

HUMANITIES: This passage is adapted from the article “British Modernism’s Many Manners . . . and Its American Admirers” by Steve Moyer, which appeared in 2009 in *Humanities: The Magazine of the National Endowment for the Humanities*.

Bloomsbury, the group of innovative writers and artists, came out of its embryonic phase around 1910 as the Victorian era finally expired with the funeral of Edward VII. Its young mix of writers, thinkers, and artists stood at the vanguard of a shift in manners away from nineteenth-century formality and reticence and toward twentieth-century candor and playfulness. Male and female, mostly in their twenties, the Bloomsbury lot addressed each other by their first names, and, till the wee hours of the morning, reflected on how to spend their lives.

Fascinated by the difference between the world of appearances and the world of reality, in the visual and literary arts, the Bloomsberries (as they were sometimes called) experimented with brush and pen to express above all the subjective qualities of their work. For the painters, who opened themselves up to the currents swirling around on the [European] Continent since the final days of Impressionism, this translated into an emphasis on line, mass, contour, and the rhythms they create.

If any one work by the Bloomsbury painters sums up adequately the era’s avant-garde break with London’s Victorian taste in art, and the influence of the French Post-Impressionists on British artists, it would be Vanessa Bell’s 1915 oil on canvas of Mary St. John Hutchinson. With arched eyebrow, lips slightly pursed, and cool self-assurance, Mrs. Hutchinson sits noticing something to her left, and the viewer, disarmed at first perhaps by the flatness of the composition and the coarse brushwork, feels as much as sees the various tones of the few colors in the portrait—ochre, green, and pink, and, where the whites of the eyes should be, teal. The work broke all the reigning conventions in British painting. Treatment of subject, use of line and color, lack of shadowing, and the solidness of the background in relation to the figure are all in sync with the modernist modes that had been in style on the Continent, most notably in France.

If Bloomsbury had been an art department, Roger Fry would have been faculty chairman. Painter, curator, and instigator, Fry studied the sciences at Cambridge University in the 1880s, developing a habit of skepticism that would serve him well as he guided painters Vanessa Bell and Duncan Grant toward modernism in the years leading up to World War I.

Influenced by paintings they had seen in France, Fry, Grant, and Bell experimented early on with cubism and abstraction, which helped the latter two immensely in their designing and painting of objects. Fry had also convinced the traditionally trained Grant to lighten the colors of his palette and Bell to express her feelings

more completely. The result was an outpouring of their creative energy. Bell wrote, “That autumn of 1910 is to me a time when everything seemed springing to new life—a time when all was a sizzle of excitement, new relationships, new ideas, different and intense emotions seemed to be crowding into one’s life.”

Bloomsbury’s anti-Victorian revolt had, in fact, as much to do with getting back to Fry’s perceptions of the great traditions in art as it did with youthful rebellion. In France, the painter Simon Bussy acted as cicerone for the group, introducing them to French artists and reaffirming the necessity to study the old masters.

A Victorian ideal the group chose to keep was the veneration of comfortable home life but with the subsequent Bloomsbury love of color, brightening what they saw as stuffy and stodgy in the homes of their youth. Fry felt, moreover, that nineteenth-century British artists in general, and Victorian painters in particular, had lost their way by becoming preoccupied with attempts at highly detailed and, in some cases, photographically accurate representations of reality.

The French painters Fry admired had been trending toward a new aesthetic for over two decades. But these artists, unlike the Impressionists, had little in common as a group except for the fact that they were all influenced in some way by Impressionism’s ideals; they passed through the era, learning from it and reacting to it while continuing to develop their own visions. Gauguin had been vibrantly imbuing his work with desire and emotion; Matisse pared his down to a harmonious interplay of line and rhythm; and Cézanne had been looking back to the masterpieces of primitive and epic works in order to bring about a monumental effect. Fry’s study of their painting taught him a new language of design, which he wanted to try out himself and convince other British painters to take up.

21. The main purpose of the passage is to:
- A. compare and contrast Impressionism and Modernism in European paintings.
 - B. describe the philosophy and influences of the Bloomsbury artists.
 - C. argue that Vanessa Bell was the most talented of the Bloomsbury artists.
 - D. provide a historical overview of the end of the Victorian era.
22. In the passage, the Bloomsbury artists are described as being:
- F. naive and misguided.
 - G. meticulous and skeptical.
 - H. young and innovative.
 - J. formal and reticent.

23. The main purpose of the third paragraph (lines 22–39) is to:
- describe a painting that exemplifies the stylistic influences embraced and rejected by the Bloomsbury painters.
 - contradict the passage’s claim that the Bloomsbury painters chose to keep some Victorian ideals in their art.
 - suggest that Vanessa Bell’s artistic choices defined the reigning conventions in British painting.
 - imply that Mrs. Hutchinson’s cool self-assurance was an attitude common among Bloomsbury artists.
24. As it is used in line 29, “the viewer” most nearly refers to:
- the subject of the painting, who is “noticing something to her left” (lines 28–29).
 - an art critic famous for writing about the Bloomsbury artists’ paintings.
 - the painter, Bell, who regarded her own work with a critical eye.
 - a generalized notion of anyone who might see the painting.
25. The author’s characterization of the Bloomsbury painters as artists who “opened themselves up to the currents swirling around” (lines 17–18) most nearly conveys that they were:
- inspired by the waters separating Britain from continental Europe.
 - vulnerable to negative outside influences.
 - receptive to new ideas and trends.
 - uncertain about their future.
26. The author refers to the “faculty chairman” (line 41) of an “art department” (line 40) primarily to make the point that:
- the Bloomsbury artists were employed by Cambridge University.
 - the Bloomsbury artists rejected traditional academic studies.
 - Roger Fry was a leader within the group of Bloomsbury artists.
 - artists are continually learning and relearning their craft.
27. The passage states that Fry’s, Grant’s, and Bell’s early experimentations with cubism and abstraction were influenced by:
- London’s Victorian taste in art.
 - paintings these artists had seen in France.
 - changing trends in interior design.
 - the looming threat of World War I.
28. According to the passage, the Bloomsbury artists’ ideal of the veneration of comfortable home life differed from the same Victorian ideal primarily in choice of:
- furniture.
 - lighting.
 - location.
 - color.
29. According to the passage, Fry’s opinion of nineteenth-century British artists included disapproval of their:
- preoccupation with accurately representing reality.
 - use of bold colors and their lack of shadowing.
 - emphasis on classical notions of beauty.
 - tendency to imitate each other’s artwork.
30. The passage indicates that the Impressionists differed from the French painters that Fry admired in that the Impressionists:
- were more interested in the subjective qualities of their work.
 - were less likely to challenge artistic conventions.
 - had fewer social restrictions to rebel against.
 - had more in common as a group.

Passage IV

NATURAL SCIENCE: This passage is adapted from the article "What Causes Ice Ages?" by Traci Watson (©2002 by U.S. News & World Report).

The Cenozoic era, the most recent of the four major subdivisions of geologic history, began about sixty-five million years ago and continues to the present.

Scientists have long known about the giant ice sheets that the Cenozoic Ice Age ushered in. Even in the mid-19th century they knew that glaciers had repeatedly raked swaths of Europe and North America in the not so distant past. Yet despite the efforts of marine geologists, atmospheric chemists, oceanographers, and more, no one knows what caused the ice ages.

If they tried, scientists could hardly invent a more difficult mystery to crack. Most of the events in question took place tens or hundreds of millions of years ago. The shift in the Earth's climate was subtle: The planet is only 10 degrees cooler today than it was in the tropical period just before the Cenozoic.

Sixty million years ago, the planet started to cool in earnest. Twenty-five million years later, Antarctica was buried under a thick sheet of ice; 18 million years after that, glaciers overran Greenland. Last of all, ice sheets invaded North America and Europe, retreated, advanced, retreated, and so on. Today, the planet is enjoying an "interglacial," one of the slightly warmer periods when the glaciers slink back to the poles.

The cause of the ice ages is a remarkably consensus-free scientific topic, but on one point most researchers agree: The cooling that started 60 million years ago was caused by a drop in carbon dioxide in the atmosphere. Carbon dioxide is a so-called greenhouse gas. It traps sunlight close to the Earth, raising the planet's temperature. Less carbon dioxide in the atmosphere means colder weather.

But why did carbon dioxide levels fall? The leading theory is because two of the Earth's tectonic plates collided, forming the Himalayas.

Marine geologist Maureen Raymo, now at the Massachusetts Institute of Technology, worked out a scenario that is widely cited in the scientific literature—both favorably and not. Raymo noted that the Himalayas are taller than any other mountain range on Earth and that they formed at nearly the same time as the start of the ice ages. Scientists realize that carbon dioxide from the atmosphere combines with rain to make an acid that erodes rock; in the process, minerals such as calcium silicate in the rocks react with carbon dioxide, removing the gas from the atmosphere. Therefore, erosion on slopes as vast as the Himalayas', says Raymo, could reduce carbon dioxide levels enough to give the ice ages a push.

Raymo acknowledges that her idea has holes. Weathering on the scale she theorizes would devour so

much carbon dioxide that soon there wouldn't be any left at all. Other scientists point to an opposite problem: The kind of minerals in the Himalayan rocks rarely consume carbon dioxide when they erode. The mystery of Cenozoic cooling has encouraged researchers to propose many other candidate culprits. One recent scientific paper theorizes that the key factor is the tons of sediment shed by the mountains every year. The sediment runs into the Indian Ocean and buries large amounts of marine plankton and other plants. Entombed along with the plants is their carbon dioxide, meaning less carbon dioxide in the atmosphere and therefore less warming. Solutions championed by other scientists include the evolution of grasses, which happened at roughly the right time and would have stored large amounts of carbon dioxide in the soil; and weathering of the mountains in either New Guinea or Siberia.

There is equally great bafflement over the much more recent Northern Hemisphere glaciations. For most of the Cenozoic Ice Age, the polar regions were the only place to suffer heavy invasions of ice. But 2.5 million years ago, glaciers moved into Europe and North America and have paid regular visits since. Scientists can explain the *timing* of these local ice ages. As the Earth's orbit slowly changes, so does the pattern of the sunlight falling on a given spot on the globe, triggering the glaciers' advance and retreat. The problem is that the orbital changes are not big enough to make or to melt ice sheets.

What ice age scholars need are cold, hard data. For example, there are no direct measurements of atmospheric carbon dioxide beyond 200,000 years ago. Carbon dioxide levels are revealed by long cylinders of ice extracted from Antarctica. But there is no ice old enough to reveal the composition of the atmosphere 85 millions of years ago.

"Information is pouring in now, and it is not converging on a simple explanation," says Isaac Winograd, a hydrologist at the U.S. Geological Survey.

Until scientists can explain changes in Earth's climatic past, they cannot be sure they aren't overlooking factors that could either counteract a human-made warming—or amplify it.

31. The main purpose of the passage is to:
- sketch some points of scientific agreement and disagreement about the causes of the ice ages.
 - explain the techniques used by scientists to discover the causes of the ice ages.
 - describe the evidence for and against one particular theory about the causes of the ice ages.
 - defend the practical relevance of discovering the causes of ancient climate change.

32. According to the passage, the causes of the ice ages are mysterious partly because:
- F. geological evidence about ice formation is nonexistent.
 - G. precise data about historically distant atmospheric changes are sometimes impossible to obtain.
 - H. Earth is currently in an interglacial period, making research on ice formation difficult.
 - J. the processes by which mountains are formed aren't fully understood.
33. According to the passage, which of the following events occurred last chronologically?
- A. Glaciers overran Greenland.
 - B. Ice sheets invaded Europe.
 - C. Antarctica was buried under ice.
 - D. Earth started to cool.
34. According to the passage, the feature of the Himalayas that makes Raymo's theory of the cause of the ice ages both appealing and problematic is the mountains':
- F. sheer size.
 - G. formation by tectonic collisions.
 - H. age.
 - J. geographical location.
35. The passage indicates that, compared to the immediate pre-Cenozoic period, the present temperature of Earth is:
- A. much cooler.
 - B. slightly cooler.
 - C. unchanged.
 - D. slightly warmer.
36. The passage states that which of the following occurs during an interglacial period?
- F. Existing glaciers recede.
 - G. New glaciers begin to form.
 - H. Old glaciers grow rapidly.
 - J. Glaciers remain unchanged.
37. The passage states that most researchers studying the causes of the ice ages agree on which of the following points?
- A. The rise of the Himalayas was responsible for the onset of the Cenozoic Ice Age.
 - B. The cause of the Cenozoic Ice Age will shortly be well understood thanks to new data.
 - C. More recent glaciations in the Northern Hemisphere were caused by changes in Earth's orbit.
 - D. A drop in the level of atmospheric carbon dioxide led to the cooling of the planet.
38. The passage indicates that changes in Earth's orbit do not provide a complete explanation of Northern Hemisphere glaciations because:
- F. the timing of these changes does not match the timing of the retreats and advances of glaciers.
 - G. these changes affect the distribution of sunlight rather than its intensity.
 - H. the nature and extent of these changes is not yet fully understood.
 - J. these changes are too small in degree to affect glaciations profoundly.
39. As it is used in line 79, the phrase *cold, hard data* most nearly means data that would be:
- A. extracted from cylinders of ice.
 - B. clearly supportive of one theory.
 - C. reliable and accurate.
 - D. relevant to discovering how mountains form.
40. It can most reasonably be inferred from the passage that Winograd thinks a simple explanation of the causes of the ice ages:
- F. has already emerged.
 - G. is about to emerge.
 - H. is unlikely to emerge.
 - J. will emerge within his lifetime.

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

A 1-hectare (10,000 m²) area of forest was equally divided into Plots X and Y. The *herbaceous layer* (all non-woody plants ≤ 1 m tall) in Plot Y was then killed using an herbicide. Next, equal numbers of seeds from 5 tree species were evenly dispersed throughout both plots. Figure 1 shows, for each tree species, the *seedling emergence* (average number of seedlings per m² that emerged from the forest floor) for each plot. Figure 2 shows, for each tree species, the percent of the seedlings that were surviving in each plot 1 yr after emergence. Figure 3 shows, for each plot, the percent distribution of the 5 tree species among those 1-year-old seedlings.

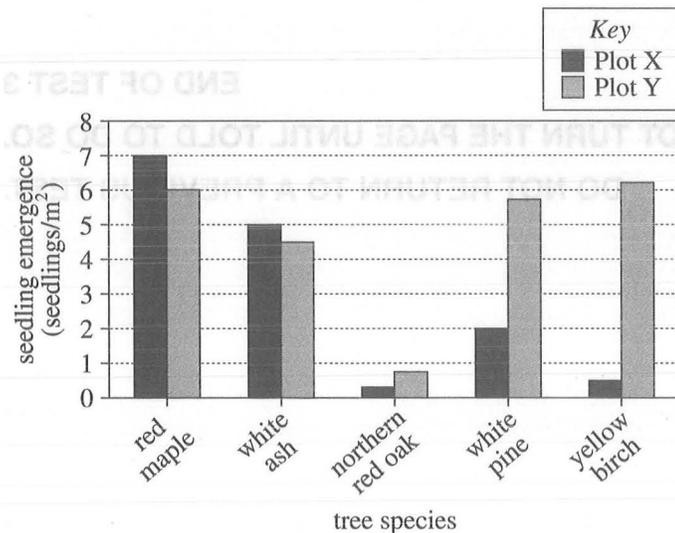


Figure 1

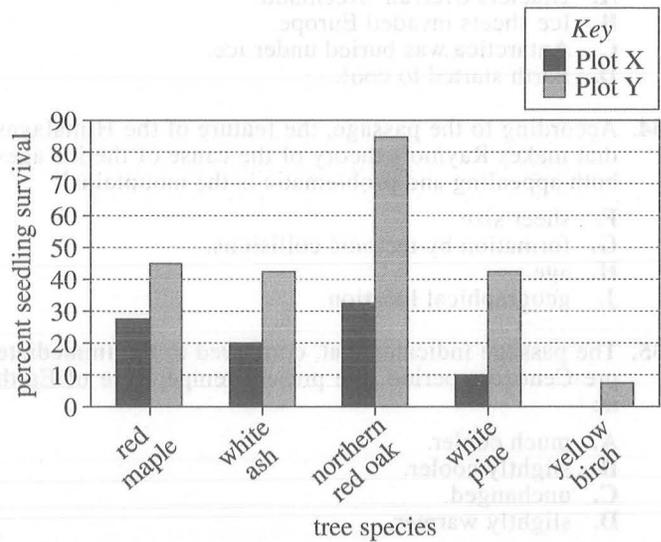


Figure 2

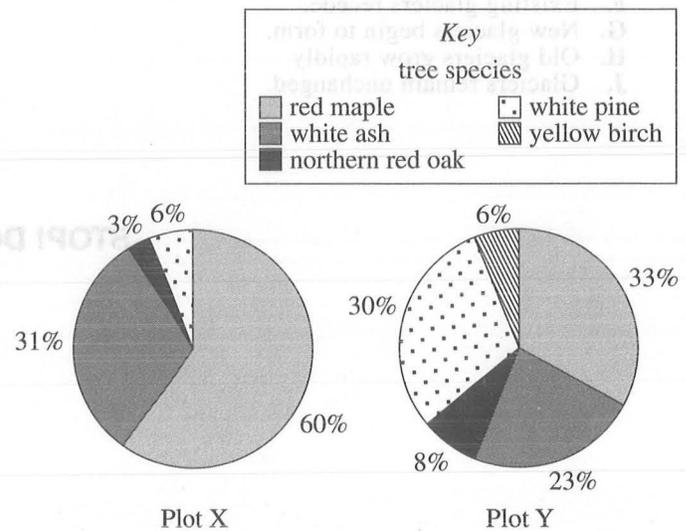


Figure 3

Figures adapted from Frank S. Gilliam and Mark R. Roberts, *The Herbaceous Layer in Forests of Eastern North America*. ©2003 by Oxford University Press, Inc.

1. Which of the 5 tree species had no surviving seedlings 1 yr after emergence in the plot for which the herbaceous layer was undisturbed?

- A. White ash
- B. Northern red oak
- C. White pine
- D. Yellow birch

2. According to Figure 3, 1 yr after emergence, the greatest percent of the seedlings were from which of the tree species in Plot X and Plot Y, respectively?

Plot X Plot Y

- | | |
|--------------|-----------|
| F. red maple | red maple |
| G. red maple | white ash |
| H. white ash | red maple |
| J. white ash | white ash |

3. According to the data in Figure 3, what effect, if any, did removing the herbaceous layer have on the percent distribution among the 1-year-old seedlings in the 1-hectare area of the forest? The removal of the herbaceous layer:

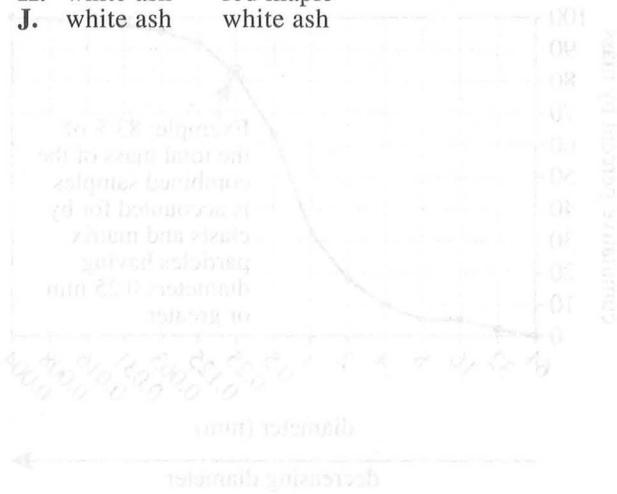
- A. changed the percent for the northern red oak only.
- B. changed the percent for the red maple and the percent for the white pine only.
- C. changed the percent for each of the 5 tree species.
- D. did not change the percent for any of the 5 tree species.

4. According to Figure 1, the difference in seedling emergence between Plots X and Y was greatest for which tree species?

- F. Red maple
- G. White ash
- H. White pine
- J. Yellow birch

5. Based on Figure 1, for each tree species, the number of seeds that were dispersed per m² in Plot X must have been:

- A. 2 or less.
- B. between 2 and 4.
- C. between 5 and 7.
- D. 7 or greater.



Passage II

A *lahar* is a flow of water-saturated volcanic ash and rock. A *lahar deposit*, formed once the flow stops, consists of *clasts* (rocks having diameters ≥ 16 mm) embedded in a *matrix* (a mixture of particles having diameters ≤ 8 mm).

A sample of a lahar deposit was collected at each of 7 distances from a volcano's crater. For each sample, Figure 1 shows the percent by mass of the clasts by composition, and Figure 2 shows the percent by mass of the matrix by particle size class. For the 7 samples combined, Figure 3 shows the cumulative percent by mass of clasts and matrix particles, or of clasts alone, as diameter decreases.

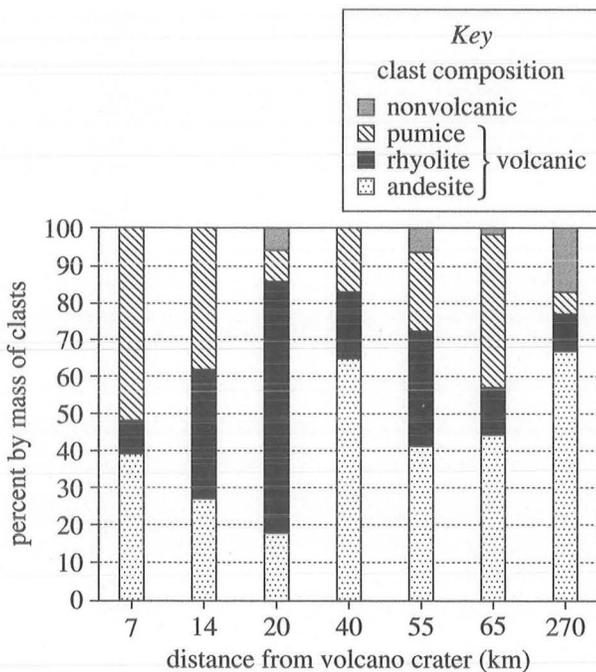


Figure 1

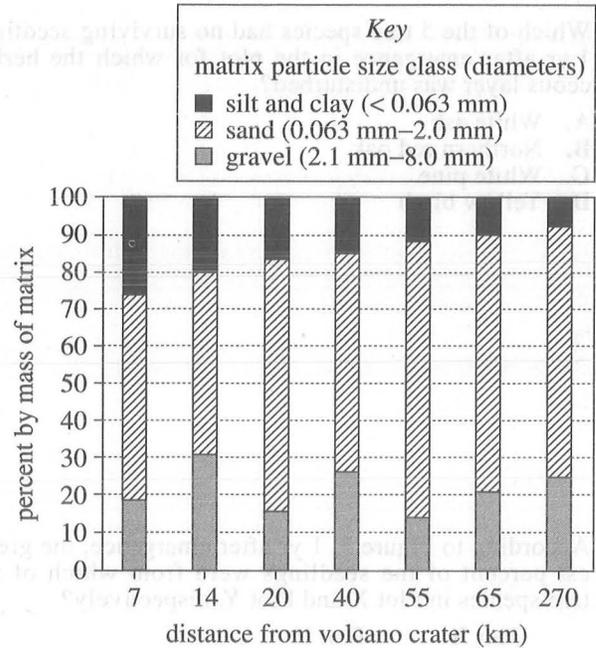


Figure 2

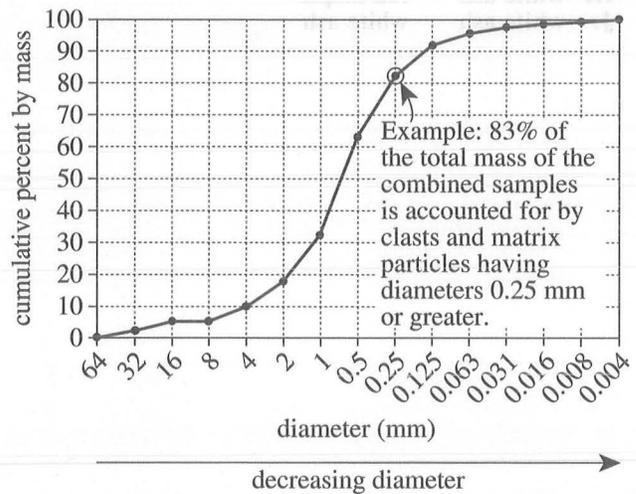


Figure 3

Note: The cumulative percent by mass for a particular diameter x is the percent of the total mass of the combined samples that is accounted for by clasts and matrix particles, or by clasts alone, having diameters greater than or equal to the value of x . (See example in the graph above.)

Figures adapted from P. A. Mothes, M. L. Hall, and R. J. Janda, "The Enormous Chilllos Valley Lahar: An Ash-Flow-Generated Debris Flow from Cotopaxi Volcano, Ecuador." ©1998 by Springer-Verlag.

6. According to Figure 2, as the distance from the volcano's crater increased, the percent by mass of silt- and clay-size particles in the matrix of the samples:

- F. increased only.
- G. decreased only.
- H. increased, then decreased.
- J. decreased, then increased.

7. According to Figure 3, the largest increase in cumulative percent by mass was between which of the following diameters?

- A. 4 mm and 2 mm
- B. 2 mm and 1 mm
- C. 1 mm and 0.5 mm
- D. 0.5 mm and 0.25 mm

8. According to Figure 3, clasts and matrix particles having diameters greater than or equal to 0.5 mm made up approximately what percent of the total mass of the combined samples?

- F. 13%
- G. 33%
- H. 63%
- J. 83%

9. Consider the information in Figures 1 and 2 about the lahar deposit sample collected 270 km from the volcano's crater. Clasts of which composition accounted for more than 50 percent by mass of the clasts in the sample, and matrix particles of what size class accounted for more than 50 percent by mass of the matrix in the sample?

	clast composition	matrix particle size class
A.	rhyolite	silt and clay
B.	rhyolite	sand
C.	andesite	silt and clay
D.	andesite	sand

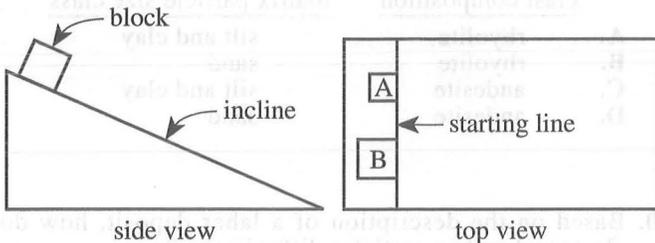
10. Based on the description of a lahar deposit, how do clasts and matrix particles differ in size?

- F. Any clast is larger than the largest matrix particle.
- G. Any clast is smaller than the smallest matrix particle.
- H. Some, but not all, clasts are smaller than the largest matrix particle.
- J. Some, but not all, matrix particles are larger than the smallest clast.

Passage III

A science teacher presents the following scenario.

Block A and Block B are released at precisely the same instant from the same starting line on a frictionless inclined plane (see the figure below).



The mass of Block A is 1 kg, and the mass of Block B is 2 kg. Earth's gravity is the only force causing the 2 blocks to accelerate down the incline. (Note: A block sliding down the incline can be considered to be falling toward Earth along the incline.)

The teacher asks 3 students to predict which block, if either, will reach the bottom of the incline first.

Student 1

The force of gravity exerted by Earth on Block A, F_A , is equal to the force of gravity exerted by Earth on Block B, F_B . Moreover, the force of gravity on a block equals the block's mass times the block's acceleration due to Earth's gravity. Thus, the mass of Block A times the acceleration of Block A must equal the mass of Block B times the acceleration of Block B. Because the mass of Block A is less than the mass of Block B, the acceleration of Block A must be greater than the acceleration of Block B. Therefore, the average speed of Block A will be greater than the average speed of Block B, so Block A will reach the bottom of the incline first.

Student 2

Because Block B has more mass than Block A, the force of gravity exerted by Earth on Block B, F_B , is greater than the force of gravity exerted by Earth on Block A, F_A . Therefore, Block B is heavier than Block A, so the acceleration of Block B will be greater than the acceleration of Block A, and Block B will slide down the incline with a greater average speed than will Block A. Thus, Block B will reach the bottom of the incline first.

Student 3

In the absence of forces other than gravity, any 2 objects falling toward Earth from the same height above Earth's surface will have the same acceleration. Because the 2 blocks will be released from the same starting line, they will be released from the same height above Earth's surface; so the blocks will slide down the incline with the same acceleration. Consequently, the 2 blocks will have the same average speed and will reach the bottom of the incline at the same time.

11. Suppose that a feather and a brick were dropped from the same height above the surface of the Moon. Based on the 3 students' discussions, what prediction would each student make regarding whether the feather or the brick would be the first to reach the Moon's surface or whether they would reach the surface at the same time?

	Student 1	Student 2	Student 3
A.	feather	brick	brick
B.	brick	feather	brick
C.	same time	brick	feather
D.	feather	brick	same time

12. Which of the students agree that the acceleration due to gravity varies with the mass of a block?
- F. Students 1 and 2 only
 G. Students 1 and 3 only
 H. Students 2 and 3 only
 J. Students 1, 2, and 3
13. According to Student 2, as the force of gravity exerted by Earth on a block increases, will the average speed of the block increase or decrease, and why?
- A. Increase, because the weight of the block will increase.
 B. Increase, because the weight of the block will decrease.
 C. Decrease, because the weight of the block will increase.
 D. Decrease, because the weight of the block will decrease.
14. Based on Student 1's discussion, how will the acceleration of Block A compare to the acceleration of Block B? The acceleration of Block A will be:
- F. $\frac{1}{4}$ as great as the acceleration of Block B.
 G. $\frac{1}{2}$ as great as the acceleration of Block B.
 H. equal to the acceleration of Block B.
 J. twice as great as the acceleration of Block B.
15. Two new blocks, Block X and Block Y, have the same mass. Assume that the relationship between F_X and F_Y is the same as the relationship stated by Student 1 between F_A and F_B . Consider also Student 1's statement relating the force of Earth's gravity on a block to the block's mass and its acceleration due to Earth's gravity. Will Block X have the same acceleration or a different acceleration down the incline as Block Y, and why?
- A. The same acceleration, because the force of Earth's gravity on each block will be the same.
 B. The same acceleration, because the force of Earth's gravity on each block will be different.
 C. A different acceleration, because the force of Earth's gravity on each block will be the same.
 D. A different acceleration, because the force of Earth's gravity on each block will be different.

16. The force of gravity on a block equals the block's mass times the block's acceleration due to Earth's gravity. Based on this information and Student 3's assertion about the blocks' acceleration, is the force on Block A greater than or less than the force on Block B, and why?
- F. Greater, because Block A's mass is greater than Block B's mass.
 - G. Greater, because Block A's mass is less than Block B's mass.
 - H. Less, because Block A's mass is greater than Block B's mass.
 - J. Less, because Block A's mass is less than Block B's mass.

17. Based on Student 1's discussion, as acceleration increases, will the time it takes a block to reach the bottom of the incline increase or decrease, and why?
- A. Increase, because average speed will increase.
 - B. Increase, because average speed will decrease.
 - C. Decrease, because average speed will increase.
 - D. Decrease, because average speed will decrease.

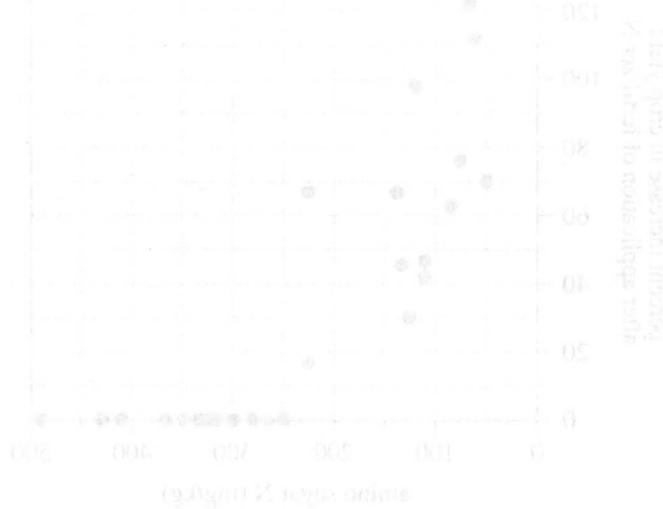
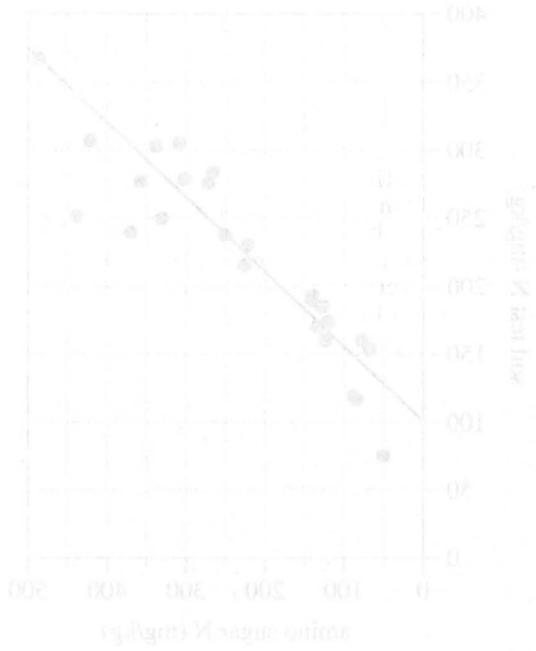


Figure 2
 Figures adapted from S. A. Khan, R. J. Alexander, and R. S. Hoyle. A Simple Soil Test for Detecting Sites that are Responsive to Nitrogen Fertilization. ©2001 by the Soil Science Society of America.

18. Suppose another cornfield in the same area had been included in Study 1 and that the soil in this field had been found to have a soil test N content of 300 mg/kg. Based on Figure 1, this soil's amino sugar N content would most likely have been closest to which of the following?
- F. 75 mg/kg
 - G. 175 mg/kg
 - H. 275 mg/kg
 - J. 375 mg/kg

Study 1
 For each field just before the spring planting, samples of the top 15 cm of soil were collected in several locations, then thoroughly mixed and subsampled for 15 to 20 g. The dried, mixed soil was analyzed for amino sugar N content and soil test N content in milligrams per kilogram (mg/kg). The results are shown in Figure 1. No field-level N was added to any of the fields. At harvest, the yield for each field was recorded.



Passage IV

To increase corn crop yield (amount produced), fertilizer nitrogen (fertilizer N) is added to soil to supplement soil test N (various naturally occurring N sources in soil). In a responsive soil, the yield is greater when fertilizer N is added than when fertilizer N is not added. In a nonresponsive soil, the yield does not change when fertilizer N is added.

A soil's amino sugar N (a naturally occurring N source different from soil test N) content can determine whether a soil will be responsive. Two studies were done over 2 consecutive years in 25 cornfields in the same 1,000-hectare area. The soils' amino sugar N and soil test N contents were examined, as well as how the yield was affected by adding fertilizer N.

Study 1

For each field, just before the spring planting, samples of the top 15 cm of soil were collected in several locations, then thoroughly mixed and oven-dried for 24 hr. The dried mixed soil for each field was analyzed for amino sugar N content and soil test N content, in milligrams per kilogram (mg/kg). The results are shown in Figure 1. No fertilizer N was added to any of the fields. At harvest, the yield for each field was recorded.

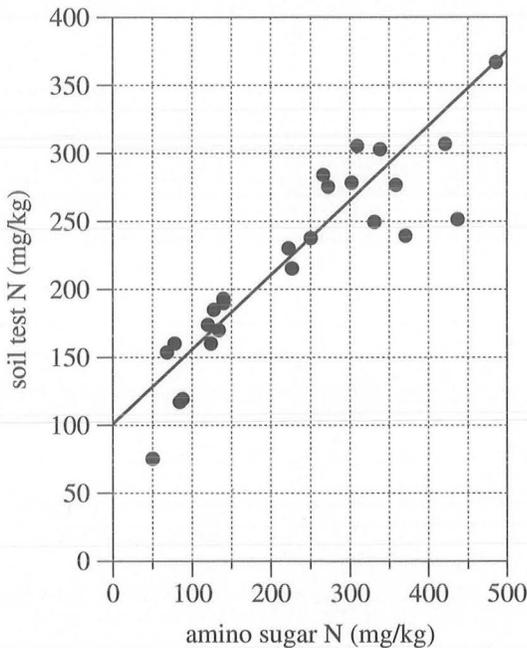


Figure 1

Study 2

The next spring, for each field, soil samples were collected, mixed, dried, and analyzed for amino sugar N as in Study 1. After collection and before spring planting, fertilizer N was added to each field at a rate of 120 kg N/hectare. No other fertilizer N was added over the growing season. At harvest, the yield for each field was recorded. Then, for each field, the percent increase in yield from the previous year was determined and plotted against the soil amino sugar N content (see Figure 2).

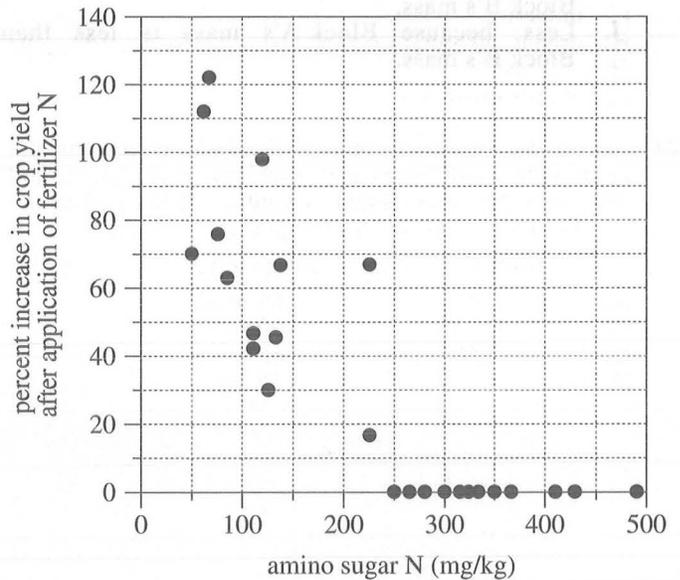


Figure 2

Figures adapted from S. A. Khan, R. L. Mulvaney, and R. G. Hoefl, "A Simple Soil Test for Detecting Sites that are Nonresponsive to Nitrogen Fertilization." ©2001 by the Soil Science Society of America.

18. Suppose another cornfield in the same area had been included in Study 1 and that the soil in this field had been found to have a soil test N content of 200 mg/kg. Based on Figure 1, this soil's amino sugar N content would most likely have been closest to which of the following?
- F. 75 mg/kg
 - G. 175 mg/kg
 - H. 275 mg/kg
 - J. 375 mg/kg

19. Consider the cornfield with soil that had an amino sugar N content of 350 mg/kg in Study 2. Based on Figure 2 and other information provided, was the soil in the cornfield responsive or nonresponsive?
- A. Responsive, because the yield did not increase.
 - B. Responsive, because the yield increased.
 - C. Nonresponsive, because the yield did not increase.
 - D. Nonresponsive, because the yield increased.
20. In the 2 studies, the purpose of oven-drying the mixed soil was to remove all the:
- F. moisture.
 - G. organic matter.
 - H. soil test N.
 - J. amino sugar N.

21. According to the results of Study 2, what was the greatest percent increase in yield for a cornfield, and what was the amino sugar N content of the soil in the cornfield with this increase in percent yield?

	<u>% increase in yield</u>	<u>amino sugar N</u>
A.	100%	65 mg/kg
B.	112%	100 mg/kg
C.	122%	65 mg/kg
D.	122%	125 mg/kg

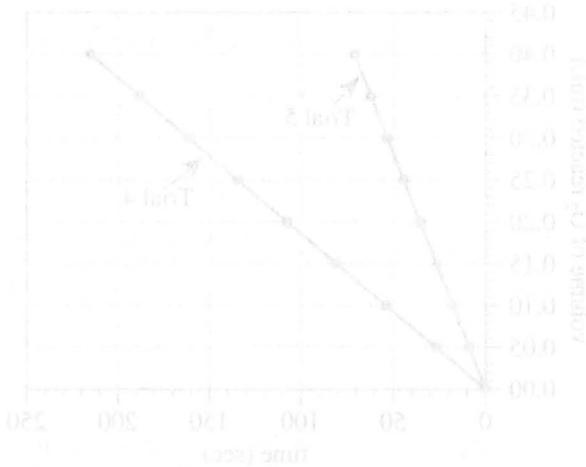


Figure 2

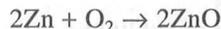
Diagram and figures adapted from Masahiro Kamata and Miki Park, "Exploring Faraday's Law of Electrolysis Using Zinc-Air Fuel Cells with Current Regenerative Circuit," ©2007 by Division of Chemical Education, Inc., American Chemical Society.

22. By selecting cornfields that were all located in the same 1,000-hectare area, the researchers who performed the studies ensured that which of the factors listed below would be nearly identical for all the fields?
- I. Rainfall
 - II. Amount of sunlight
 - III. Amino sugar N content
- F. I only
 - G. I and II only
 - H. II and III only
 - J. I, II, and III

23. One of the cornfields involved in the studies had an area of 2.5 hectares. In Study 2, how many kg N was added to that field as fertilizer N?
- A. 60 kg N
 - B. 100 kg N
 - C. 240 kg N
 - D. 300 kg N

Passage V

A zinc-air battery (ZAB) produces an electrical current when O_2 in the air flowing into the ZAB reacts with zinc metal to produce solid zinc oxide:



Two experiments were done using the apparatus shown in the diagram below.

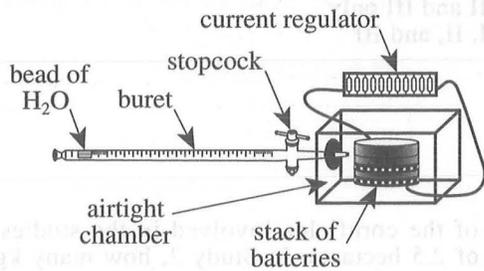


diagram of apparatus

For each trial, Steps 1–5 were followed:

- Three 1.4-volt batteries were stacked in *series* (so that their voltages added together) in the airtight chamber. Each battery was either a ZAB or an SLB, a *sealed lithium battery* (the type of battery used in watches).
- A small *buret* (a graduated tube that could be opened or closed using a stopcock) was inserted through a port into the chamber. A bead of H_2O was introduced into the buret to act as a free-moving barrier to the surrounding air.
- A current regulator was connected to the batteries to ensure they would generate a constant current.
- The chamber was sealed, and then the stopcock was opened (at time = 0 sec) to allow only the air from the buret to enter the chamber. As the Zn in a ZAB reacted with O_2 , more air was drawn into the chamber.
- As each 0.050 mL of air entered the chamber—indicated by the movement of the bead toward the chamber—the elapsed time was recorded. When 0.40 mL of air had entered the chamber, the stopcock was closed.

Experiment 1

Three trials were done at a current of 20 milliamps (mA). In Trial 1, 1 ZAB and 2 SLBs were tested. In Trial 2, 2 ZABs and 1 SLB were tested. In Trial 3, 3 ZABs were tested (see Figure 1).

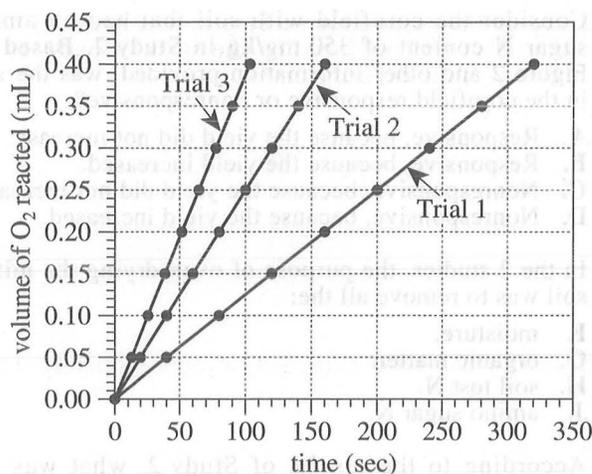


Figure 1

Experiment 2

Trial 3 was repeated in 2 trials except that in Trial 4 the current was 10 mA, and in Trial 5 the current was 30 mA (see Figure 2).

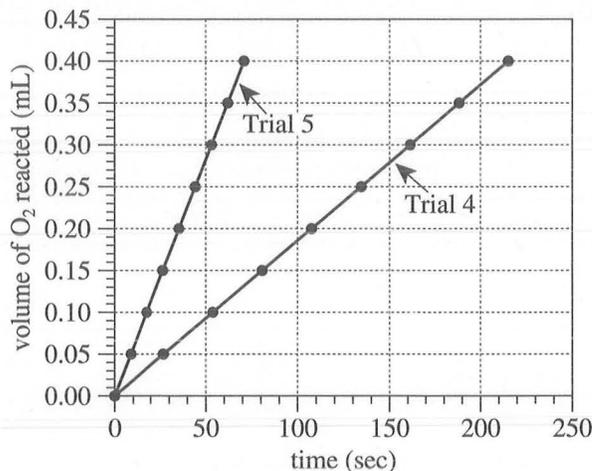


Figure 2

Diagram and figures adapted from Masahiro Kamata and Miei Paku, "Exploring Faraday's Law of Electrolysis Using Zinc-Air Batteries with Current Regulative Diodes." ©2007 by Division of Chemical Education, Inc., American Chemical Society.

24. Based on the description of Step 1, what was the total voltage that was produced by the stack of batteries in each trial of the experiments?
- F. 1.4 volts
 - G. 4.2 volts
 - H. 10 volts
 - J. 20 volts

25. If Trial 4 had been extended, at approximately what time would 0.45 mL of O₂ have reacted?
- A. 70 sec
 - B. 140 sec
 - C. 240 sec
 - D. 270 sec

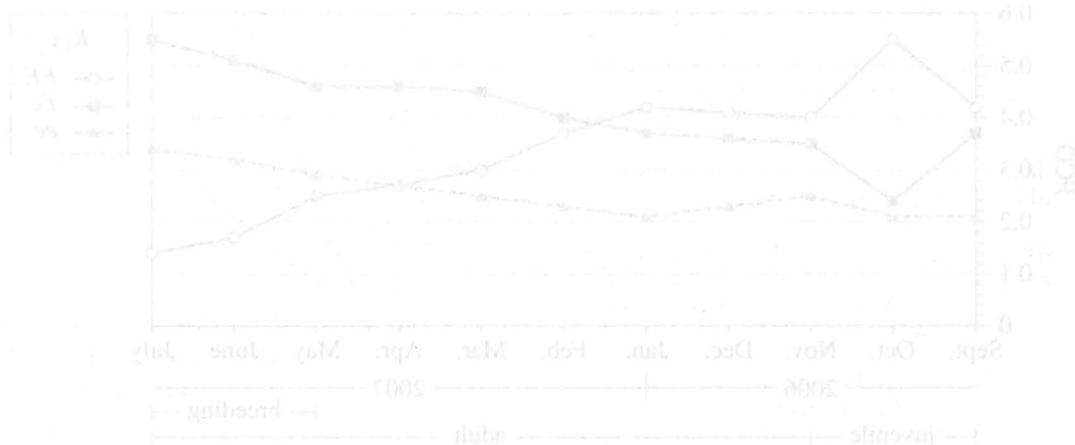
26. How many SLBs, if any, were tested in Experiment 2?
- F. 0
 - G. 1
 - H. 2
 - J. 3

27. A chemist predicted that the volume of O₂ reacted would increase at a faster rate if the number of ZABs present in the stack of 3 batteries was increased. Do the results of Trials 1 and 3 support this prediction?
- A. Yes, because the final volume was reached sooner in Trial 3 than it was in Trial 1.
 - B. Yes, because the final volume was reached sooner in Trial 1 than it was in Trial 3.
 - C. No, because the final volume was reached sooner in Trial 3 than it was in Trial 1.
 - D. No, because the final volume was reached sooner in Trial 1 than it was in Trial 3.

28. Based on the chemical equation in the passage, in a ZAB, as 5 O₂ molecules are consumed, how many Zn atoms, if any, must also be consumed?

- F. 0
- G. 2
- H. 5
- J. 10

29. Suppose Trial 1 is repeated except at a current of 10 mA. At 200 sec, the volume of O₂ reacted will most likely be:
- A. less than 0.25 mL.
 - B. between 0.25 mL and 0.32 mL.
 - C. between 0.32 mL and 0.39 mL.
 - D. 0.40 mL, because the stopcock will be closed much sooner than 200 sec.



Passage VI

Threespine sticklebacks are fish that can live in *marine* (saltwater) and freshwater environments. Marine sticklebacks and freshwater sticklebacks have *plates* (bony scales) that provide protection from predators, such as fish and birds. However, due to the low number of these predators in freshwater environments, freshwater sticklebacks typically have fewer plates than do marine sticklebacks.

The *Eda* gene regulates plate formation and has 2 alleles: *E* and *e*. Table 1 describes the phenotype associated with each *Eda* genotype.

Genotype	Phenotype	Description
<i>EE</i>	complete	30–36 plates, head to tail, continuous
<i>Ee</i>	partial	9–18 plates, head to tail, gap in midsection
<i>ee</i>	low	0–9 plates, head only

Two studies were done to determine how moving a marine stickleback population to a freshwater environment affects the *Eda* genotypes of the population's offspring and how *Eda* genotype relates to the length and the *breeding status* of the offspring.

Study 1

Two hundred adult marine sticklebacks with the *Eda* genotype *Ee* were tagged and placed in an artificial freshwater pond on June 1, 2006, during their breeding season. At the beginning of each month from September 2006 to July 2007, 200 stickleback offspring were collected and their *Eda* genotypes were determined. Figure 1 shows the *fraction of the collected offspring (FCO)* with a particular genotype for each month, as well as the developmental stages of the offspring during the study.

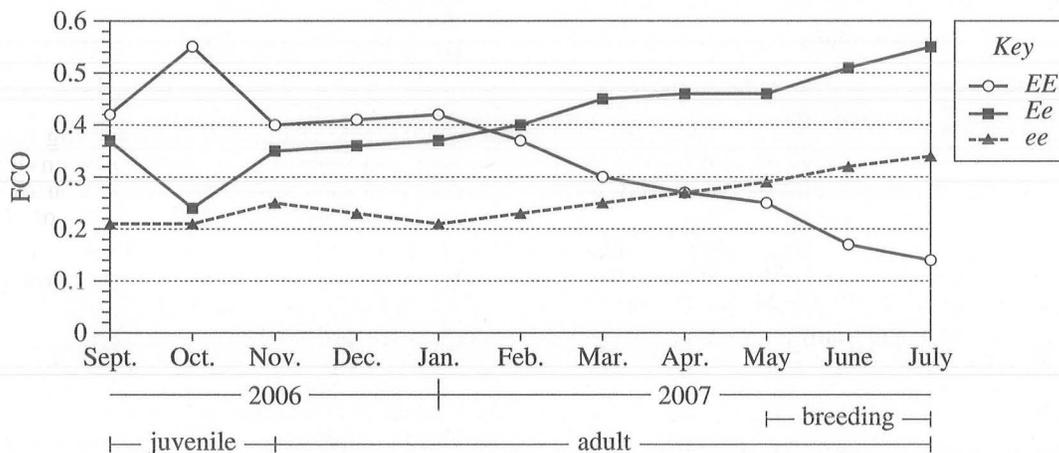


Figure 1



Study 2

The length and the breeding status—sexually immature (SI) or sexually mature (SM)—of each of the offspring collected in May 2007 were determined. Figure 2 shows the results by *Ee* genotype.

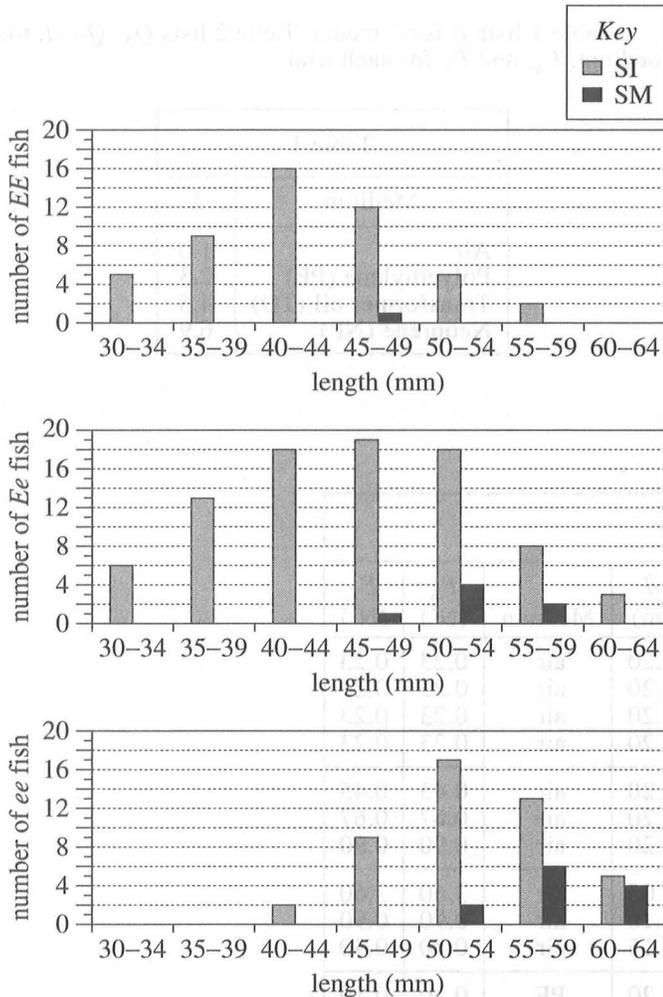


Figure 2

Figures 1 and 2 adapted from Rowan D. H. Barrett, Sean M. Rogers, and Dolph Schluter, "Natural Selection on a Major Armor Gene in Threespine Stickleback." ©2008 by the American Association for the Advancement of Science.

30. One of the offspring collected during Study 1 in June 2007 had 7 plates. According to Table 1, this fish had which phenotype and which genotype?

	phenotype	genotype
F.	low	<i>Ee</i>
G.	low	<i>ee</i>
H.	partial	<i>Ee</i>
J.	partial	<i>ee</i>

31. Which of the offspring listed below were collected in Study 1?

I. Juveniles
II. Adults that were breeding
III. Adults that were not breeding

- A. I only
B. III only
C. I and III only
D. I, II, and III

32. One of the offspring measured in Study 2 was 62 mm in length. Based on the results of the study, was the genotype of this fish more likely *EE* or *ee*?

- F. *EE*, because, on average, *EE* offspring were shorter than *ee* offspring.
G. *EE*, because, on average, *EE* offspring were longer than *ee* offspring.
H. *ee*, because, on average, *ee* offspring were shorter than *EE* offspring.
J. *ee*, because, on average, *ee* offspring were longer than *EE* offspring.

33. According to the results of Study 2, of the sexually mature offspring that were collected in May 2007, the greatest number had which of the 3 genotypes?

- A. *EE*
B. *Ee*
C. *ee*
D. Cannot be determined from the given information

34. A researcher predicted that moving a marine stickleback population to a freshwater environment would result in an increase in the fraction of offspring with the low phenotype. Do the results of Study 1 support this prediction?

- F. Yes, because the FCO for the low phenotype was about 0.13 greater in July 2007 than it was in September 2006.
G. Yes, because the FCO for the low phenotype was about 0.18 greater in July 2007 than it was in September 2006.
H. No, because the FCO for the low phenotype was about 0.21 less in July 2007 than it was in September 2006.
J. No, because the FCO for the low phenotype was about 0.28 less in July 2007 than it was in September 2006.

35. In Study 1, the most likely reason the marine sticklebacks that were placed in the pond were tagged was to ensure that the:

- A. length of each stickleback could be measured.
B. parents could be differentiated from the offspring.
C. number of plates on each stickleback could be counted.
D. offspring collected would be genotyped only once.

Passage VII

Identical spheres, X and Y, had electrical charges Q_X and Q_Y , respectively. Throughout each of 13 trials, the spheres remained fastened to the horizontal floor of a vessel a distance d apart, with X due east of Y (see Figure 1).

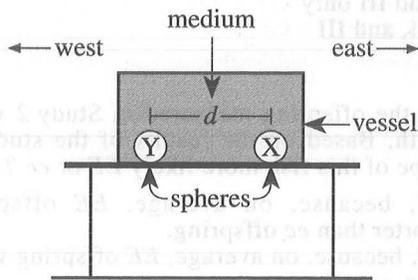


Figure 1

The vessel was filled with a medium having a *dielectric constant*, K . (K reflects a medium's ability to modify the electrical force between charges.) X exerted an electrical force of magnitude F_Y on Y, and Y exerted an electrical force of magnitude F_X on X. Each force was directed either east or west.

Table 1 lists K for 4 media. Table 2 lists Q_X , Q_Y , d , the medium, F_X , and F_Y for each trial.

Medium	K
Air	1.0
Polyethylene (PE)	2.3
Transformer oil (TO)	4.6
Neoprene (NP)	6.9

Trial	Q_X (10^{-6} C^*)	Q_Y (10^{-6} C^*)	d (m)	Medium	F_X (N^\dagger)	F_Y (N^\dagger)
1	+1.0	+1.0	0.20	air	0.23	0.23
2	+1.0	-1.0	0.20	air	0.23	0.23
3	-1.0	+1.0	0.20	air	0.23	0.23
4	-1.0	-1.0	0.20	air	0.23	0.23
5	+1.0	+2.0	0.20	air	0.45	0.45
6	+1.0	+3.0	0.20	air	0.67	0.67
7	+1.0	+4.0	0.20	air	0.90	0.90
8	+1.0	+1.0	0.05	air	3.60	3.60
9	+1.0	+1.0	0.10	air	0.90	0.90
10	+1.0	+1.0	0.15	air	0.40	0.40
11	+1.0	+1.0	0.20	PE	0.10	0.10
12	+1.0	+1.0	0.20	TO	0.05	0.05
13	+1.0	+1.0	0.20	NP	0.03	0.03

*C = coulombs
†N = newtons

36. Based on Table 1 and the results of Trial 1 and Trials 11–13, as K increased, F_x :

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

37. Suppose that Sphere X had become unfastened from the floor of the vessel during Trials 1 and 7. During which of these trials would Sphere X more likely have undergone the *lesser* amount of acceleration?

- A. Trial 1, because the magnitude of the electrical force exerted by Sphere Y on Sphere X was greater in Trial 1 than in Trial 7.
- B. Trial 1, because the magnitude of the electrical force exerted by Sphere Y on Sphere X was less in Trial 1 than in Trial 7.
- C. Trial 7, because the magnitude of the electrical force exerted by Sphere Y on Sphere X was greater in Trial 7 than in Trial 1.
- D. Trial 7, because the magnitude of the electrical force exerted by Sphere Y on Sphere X was less in Trial 7 than in Trial 1.

38. In each of the 13 trials, how did the magnitude of the electrical force exerted by Sphere X on Sphere Y compare to the magnitude of the electrical force exerted by Sphere Y on Sphere X?

- F. The magnitude of the electrical force exerted by Sphere X on Sphere Y was greater than the magnitude of the electrical force exerted by Sphere Y on Sphere X.
- G. The magnitude of the electrical force exerted by Sphere X on Sphere Y was less than the magnitude of the electrical force exerted by Sphere Y on Sphere X.
- H. The magnitude of the electrical force exerted by Sphere X on Sphere Y was the same as the magnitude of the electrical force exerted by Sphere Y on Sphere X.
- J. Cannot be determined from the given information

39. Suppose that, in each trial, either electrons or protons had been added to each sphere to produce its charge. In Trial 3, which of the 2 types of particles would have been added to Sphere X, and which of the 2 types of particles would have been added to Sphere Y?

- | | Sphere X | Sphere Y |
|----|-----------|-----------|
| A. | electrons | protons |
| B. | protons | electrons |
| C. | electrons | electrons |
| D. | protons | protons |

40. In Trial 9, the electrical force exerted by Sphere Y on Sphere X and the electrical force exerted by Sphere X on Sphere Y were exerted in which direction(s)?

- | | electrical force on Sphere X | electrical force on Sphere Y |
|----|------------------------------|------------------------------|
| F. | east | east |
| G. | east | west |
| H. | west | west |
| J. | west | east |

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.

Explanation of Procedures Used to Obtain Scale Scores from Raw Scores

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

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

ACT Test 71H	Your Scale Score
English	_____
Mathematics	_____
Reading	_____
Science	_____

Sum of scores _____

Composite score (sum ÷ 4) _____

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

Scale Score	Raw Scores				Scale Score
	Test 1 English	Test 2 Mathematics	Test 3 Reading	Test 4 Science	
36	75	59-60	40	39-40	36
35	74	58	—	38	35
34	72-73	56-57	39	37	34
33	71	55	37-38	36	33
32	69-70	54	36	35	32
31	68	53	35	—	31
30	67	51-52	34	34	30
29	66	49-50	33	33	29
28	64-65	47-48	32	32	28
27	63	45-46	31	31	27
26	61-62	42-44	30	30	26
25	58-60	40-41	29	28-29	25
24	55-57	37-39	28	26-27	24
23	53-54	35-36	26-27	25	23
22	50-52	34	25	23-24	22
21	47-49	32-33	23-24	21-22	21
20	44-46	30-31	22	20	20
19	41-43	28-29	20-21	18-19	19
18	39-40	26-27	19	17	18
17	38	22-25	18	15-16	17
16	35-37	17-21	16-17	14	16
15	32-34	13-16	15	13	15
14	29-31	10-12	13-14	12	14
13	27-28	8-9	12	11	13
12	25-26	7	10-11	10	12
11	22-24	5-6	9	9	11
10	19-21	4	7-8	8	10
9	16-18	—	6	6-7	9
8	14-15	3	—	5	8
7	11-13	—	5	4	7
6	9-10	2	4	—	6
5	7-8	—	3	3	5
4	5-6	1	—	2	4
3	4	—	2	—	3
2	2-3	—	1	1	2
1	0-1	0	0	0	1

Explanation of Procedures Used to Obtain Scale Subscores from Raw Scores

For each of the seven subscore areas, the total number of correct responses yields a raw score. Use the table below to convert your raw scores to scale subscores. For each of the seven subscore areas, locate and circle either the raw score or the range of raw scores that includes it in the table below. Then, read across to either outside column of the table and circle the scale subscore that corresponds to that raw score. As you determine your scale subscores, enter them in the blanks provided on the right. The highest possible scale subscore is 18. The lowest possible scale subscore is 1.

If you left a test completely blank and marked no items, do not list any scale subscores for that test.

ACT Test 71H

Your Scale Subscore

English

Usage/Mechanics _____

Rhetorical Skills _____

Mathematics

Pre-Algebra/Elementary Algebra _____

Intermed. Algebra/Coord. Geometry _____

Plane Geometry/Trigonometry _____

Reading

Social Studies/Sciences _____

Arts/Literature _____

53

Scale Subscore	Raw Scores							Scale Subscore
	Test 1 English		Test 2 Mathematics			Test 3 Reading		
	Usage/Mechanics	Rhetorical Skills	Pre-Algebra/Elem. Algebra	Inter. Algebra/Coord. Geometry	Plane Geometry/Trigonometry	Social Studies/Sciences	Arts/Literature	
18	39-40	35	23-24	18	18	20	20	18
17	36-38	—	22	—	—	18-19	19	17
16	35	33-34	21	17	16-17	17	18	16
15	33-34	31-32	20	15-16	15	16	17	15
14	32	30	19	13-14	13-14	15	16	14
13	30-31	27-29	17-18	11-12	12	13-14	15	13
12	28-29	25-26	16	10	11	12	14	12
11	26-27	22-24	15	8-9	9-10	11	13	11
10	24-25	20-21	14	7	8	10	12	10
9	22-23	17-19	12-13	5-6	6-7	9	10-11	9
8	19-21	15-16	10-11	4	4-5	8	9	8
7	17-18	13-14	8-9	3	3	6-7	8	7
6	15-16	11-12	6-7	—	—	5	7	6
5	13-14	9-10	4-5	2	2	4	5-6	5
4	11-12	6-8	3	—	—	3	4	4
3	8-10	4-5	2	1	1	2	3	3
2	5-7	2-3	1	—	—	1	1-2	2
1	0-4	0-1	0	0	0	0	0	1

Form 19H
ACT® Writing Test Prompt
(April 2014)

Educators debate whether high schools should provide students with frequent learning opportunities away from school, such as field trips to explore a museum, visit a local business, or attend a play. Some educators support providing students with frequent field trips because they think such trips can offer students interactive experiences that relate to what students are studying in school. Other educators do not support providing students with frequent field trips because they think such trips can be costly and that school funds are better spent on improving schools' academic resources or facilities. In your opinion, should high schools provide students with frequent learning opportunities away from school?

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.

Six-Point Holistic Scoring Rubric for the ACT Writing Test

Papers at each level exhibit *all* or *most* of the characteristics described at each score point.

Score = 6

Essays within this score range demonstrate effective skill in responding to the task.

The essay shows a clear understanding of the task. The essay takes a position on the issue and may offer a critical context for discussion. The essay addresses complexity by examining different perspectives on the issue, or by evaluating the implications and/or complications of the issue, or by fully responding to counterarguments to the writer's position. Development of ideas is ample, specific, and logical. Most ideas are fully elaborated. A clear focus on the specific issue in the prompt is maintained. The organization of the essay is clear: the organization may be somewhat predictable or it may grow from the writer's purpose. Ideas are logically sequenced. Most transitions reflect the writer's logic and are usually integrated into the essay. The introduction and conclusion are effective, clear, and well developed. The essay shows a good command of language. Sentences are varied and word choice is varied and precise. There are few, if any, errors to distract the reader.

Score = 5

Essays within this score range demonstrate competent skill in responding to the task.

The essay shows a clear understanding of the task. The essay takes a position on the issue and may offer a broad context for discussion. The essay shows recognition of complexity by partially evaluating the implications and/or complications of the issue, or by responding to counterarguments to the writer's position. Development of ideas is specific and logical. Most ideas are elaborated, with clear movement between general statements and specific reasons, examples, and details. Focus on the specific issue in the prompt is maintained. The organization of the essay is clear, although it may be predictable. Ideas are logically sequenced, although simple and obvious transitions may be used. The introduction and conclusion are clear and generally well developed. Language is competent. Sentences are somewhat varied and word choice is sometimes varied and precise. There may be a few errors, but they are rarely distracting.

Score = 4

Essays within this score range demonstrate adequate skill in responding to the task.

The essay shows an understanding of the task. The essay takes a position on the issue and may offer some context for discussion. The essay may show some recognition of complexity by providing some response to counterarguments to the writer's position. Development of ideas is adequate, with some movement between general statements and specific reasons, examples, and details. Focus on the specific issue in the prompt is maintained throughout most of the essay. The organization of the essay is apparent but predictable. Some evidence of logical sequencing of ideas is apparent, although most transitions are simple and obvious. The introduction and conclusion are clear and somewhat developed. Language is adequate, with some sentence variety and appropriate word choice. There may be some distracting errors, but they do not impede understanding.

Score = 3

Essays within this score range demonstrate some developing skill in responding to the task.

The essay shows some understanding of the task. The essay takes a position on the issue but does not offer a context for discussion. The essay may acknowledge a counterargument to the writer's position, but its development is brief or unclear. Development of ideas is limited and may be repetitious, with little, if any, movement between general statements and specific reasons, examples, and details. Focus on the general topic is maintained, but focus on the specific issue in the prompt may not be maintained. The organization of the essay is simple. Ideas are logically grouped within parts of the essay, but there is little or no evidence of logical sequencing of ideas. Transitions, if used, are simple and obvious. An introduction and conclusion are clearly discernible but underdeveloped. Language shows a basic control. Sentences show a little variety and word choice is appropriate. Errors may be distracting and may occasionally impede understanding.

Score = 2

Essays within this score range demonstrate inconsistent or weak skill in responding to the task.

The essay shows a weak understanding of the task. The essay may not take a position on the issue, or the essay may take a position but fail to convey reasons to support that position, or the essay may take a position but fail to maintain a stance. There is little or no recognition of a counterargument to the writer's position. The essay is thinly developed. If examples are given, they are general and may not be clearly relevant. The essay may include extensive repetition of the writer's ideas or of ideas in the prompt. Focus on the general topic is maintained, but focus on the specific issue in the prompt may not be maintained. There is some indication of an organizational structure, and some logical grouping of ideas within parts of the essay is apparent. Transitions, if used, are simple and obvious, and they may be inappropriate or misleading. An introduction and conclusion are discernible but minimal. Sentence structure and word choice are usually simple. Errors may be frequently distracting and may sometimes impede understanding.

Score = 1

Essays within this score range show little or no skill in responding to the task.

The essay shows little or no understanding of the task. If the essay takes a position, it fails to convey reasons to support that position. The essay is minimally developed. The essay may include excessive repetition of the writer's ideas or of ideas in the prompt. Focus on the general topic is usually maintained, but focus on the specific issue in the prompt may not be maintained. There is little or no evidence of an organizational structure or of the logical grouping of ideas. Transitions are rarely used. If present, an introduction and conclusion are minimal. Sentence structure and word choice are simple. Errors may be frequently distracting and may significantly impede understanding.

No Score

Blank, Off-Topic, Illegible, Not in English, or Void



ACT ASSESSMENT TEST INFORMATION RELEASE REPORT
 TEST DATE = 04/14 TEST FORM = 71H TEST CENTER = [REDACTED]

ITEM 1 1111111112 222222223 333333334 444444445 555555556 666666667 77777
 NUMBER 1234567890 1234567890 1234567890 1234567890 1234567890 1234567890 1234567890 12345

ENGLISH
 CORRECT ANSWER
 YOUR ANSWER
 SUBSCORE

BFBJCGAJAG CHBFAFBJCJ BHAGAHCJDH DGCFCFCGCH BJAGAJBHDF AGCJDJBJBH CFCJBJBDFD DFBGA
 [REDACTED]
 UUUURRRRUR UURURRRURU UUUURRRRRR UUUUUURUUR URRRURRUUU RUURUURURR UUUURURURR RRURR

MATHEMATICS
 CORRECT ANSWER
 YOUR ANSWER
 SUBSCORE

AKDKDGEGEH CGCHCJAJBH AJAGCFBKAK CFEJCFAGCG DFCFDJEGAG CGCKDGEFDK
 [REDACTED]
 AAGTAAAAAA ATAGGAAATT TTTAGGTTGA TAAGTGGTAT GAAAAGAGGT AGGGTTTTGG

READING
 CORRECT ANSWER
 YOUR ANSWER
 SUBSCORE

CJCHDGCEDG AJCHBFBGBJ BHAJCHBJAJ AGBEBEDJCH
 [REDACTED]
 LLLLLLLLLL SSSSSSSSSS LLLLLLLLLL SSSSSSSSSS

SCIENCE
 CORRECT ANSWER
 YOUR ANSWER

DFCJDGCHDF DFAJAJCGCF CGDGCFAJAG DJCFBGBHAG
 [REDACTED]

1st Row: Correct responses to the items on the ACT tests.

2nd Row: Your Responses:

- A plus (+) indicates your response was correct.
- A letter (A through K) is the response you chose, if your answer was incorrect.
- A dash (-) indicates you omitted the item.
- An asterisk (*) indicates you gridded more than one response.

3rd Row: If the test includes subscores, one of the letters below indicates the category to which each item belongs:

- English: U = Usage/Mechanics
 R = Rhetorical Skills
- Math: A = Pre-Algebra/Elementary Algebra
 G = Intermediate Algebra/Coordinate Geometry
 T = Plane Geometry/Trigonometry
- Reading: S = Social Studies/Sciences
 L = Arts/Language

PLUS WRITING TEST FORM: 19H
 1st RATER: [REDACTED] 2nd RATER: [REDACTED]