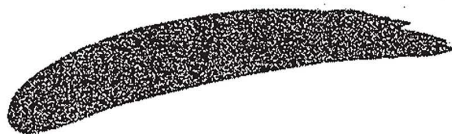


Form 66F

(April 2009)



The **ACT**[®] 2008 | 2009



In response to your recent 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 listing your answers to the ACT multiple-choice tests and the answer key.

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.

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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

Antarctic Adventure

In February 2001, polar adventurers

Liv Arnesen of Norway, and Ann Bancroft of

Minnesota became the first women to climb and

ski across the continent of Antarctica. The two former

schoolteachers completed their 2,400-mile journey

in 96 days.

[1] Months before their expedition, Arnesen

and Bancroft began training by learning to ski behind

sails—parachute-like devices that can pull a skier loaded

with supplies about six miles per hour in steady winds.

[2] On November 13, 2000, the pair boarded a small plane

in South Africa and took a six-hour flight to Blue One

Runway, it is a solid-ice airstrip on the Atlantic coast of

Antarctica. [3] They set out soon after landing. [4] Hiking

unassisted up the 10,000-foot-high Sygyn Glacier, and

each woman pulled a sled that weighed more than

1. A. NO CHANGE

B. Arnesen, of Norway, and Ann Bancroft,

C. Arnesen, of Norway and Ann Bancroft,

D. Arnesen of Norway and Ann Bancroft

2. F. NO CHANGE

G. achieved

H. finalized

J. implemented

3. A. NO CHANGE

B. Runway,

C. Runway

D. Runway, being

4. F. NO CHANGE

G. when

H. while

J. DELETE the underlined portion.

260 pounds. [5] The sleds carried all the women's supplies, including a tent, a one-burner camp stove, diaries, two sets of skis, a laptop computer, and a snow shovel. [5]

By December 1, the adventurers had skied onto the Polar Plateau, stretching for 1,000 miles a high, frozen

desert. The first week, strong winds had blew daily, and

the team sailed 210 miles in just five days. For the next

five days, accordingly, there was almost no wind, and the pair sailed only 34 miles. No matter how hard the women skied, daily mileage typically depended upon wind direction and intensity.

On January 16, Arnesen and Bancroft reached the South Pole, where they visited with scientists and replenished their food supply. In order to safely descend the glacier's sharp ice, the women attached mountaineer spikes to their boots. Two days later, they were again in bitter cold, and while climbing over a 10,200-foot-high glacier named Titan Dome.

5. If the writer were to delete Sentence 5, the essay would primarily lose details that:

- A. reveal why Arnesen and Bancroft were each limited to carrying about 260 pounds of supplies.
- B. expand upon information provided in Sentence 4 and also give readers a sense of what the women needed for their journey.
- C. suggest that the women brought more supplies than they thought they would need for their journey.
- D. contradict the information provided in Sentence 4 about the weight of Arnesen and Bancroft's supplies.

6. The best placement for the underlined phrase would be:

- F. where it is now.
- G. before the word *By* (revising the capitalization accordingly).
- H. after the word *adventurers*.
- J. after the word *desert* (ending the sentence with a period).

7. A. NO CHANGE

- B. blow
- C. blew
- D. blown

8. Which of the following alternatives to the underlined portion would be LEAST acceptable?

- F. the two
- G. Arnesen and Bancroft
- H. the women
- J. these

9. A. NO CHANGE

- B. otherwise,
- C. consequently,
- D. however,

10. F. NO CHANGE

- G. scientists and, replenished their
- H. scientists and replenished there
- J. scientists, and replenished there

11. A. NO CHANGE

- B. they climbed
- C. climbing
- D. to climb

1



1

Fortunately, the wind was with them the final few miles,
and during those last miles of the trip, they were able to

12

ski off the continent itself and onto the Ross Ice Shelf. [13]

Although the adventurers had planned to continue
across the ice shelf to McMurdo Station, 460 miles away
on the Pacific coast, the winds did not cooperate. To avoid
becoming stranded when winter arrived, the women called
a ski plane prudently to airlift them to McMurdo.

14

12. F. NO CHANGE

- G. and during those fortunate moments,
H. so the wind carried them and
J. and

13. Which of the following true statements, if added here,
would most effectively and specifically emphasize the
women's main accomplishment as described in this
essay?

- A. It had been a long journey.
B. They had crossed the Antarctic landmass.
C. They were relieved to have safely descended Titan
Dome.
D. These final miles were some of the speediest of
Arnesen and Bancroft's trip.

14. The best placement for the underlined word would be:

- F. where it is now.
G. before the word *becoming*.
H. before the word *stranded*.
J. before the word *called*.

Question 15 asks about the preceding passage
as a whole.

15. If the writer were to delete the final paragraph of this
essay, the essay would primarily lose information that:

- A. explains why Arnesen and Bancroft were unable to
ski to McMurdo Station, their final destination.
B. explains why skiing to McMurdo Station was part
of Arnesen and Bancroft's original plan.
C. describes the specific weather conditions at differ-
ent times of the year on the Ross Ice Shelf.
D. indicates Arnesen and Bancroft's reaction to
having to be airlifted to McMurdo Station.

PASSAGE II

Working at the Bait & Tackle Shop

[1]

Most folks who live in our little bayside village
work at a job having something to do with fishing or
tourism, and I'm no different.

[2]

The shop opens at six in the morning, I arrive thirty
minutes early to set up. On many mornings, the sky

16

16. F. NO CHANGE

- G. morning, however,
H. morning, but
J. morning

is adorned with peach-and-melon-colored ribbons as
17

17. Which of the following alternatives to the underlined portion would be LEAST acceptable?

- A. ribbons at the same time that
- B. ribbons in order that
- C. ribbons while
- D. ribbons, and

a blazing solar sun begins to peek over the
18 horizon. Walking toward the docks,

18. Which choice would be most consistent with the figurative description provided elsewhere in this sentence?

- E. NO CHANGE
- F. luminous
- G. radiant
- H. orange

the seagulls are wheeling and swooping. Their
19 high-pitched cries sound like rusty door hinges.

19. A. NO CHANGE
B. watching the seagulls wheel and swoop, their
C. I watch the seagulls wheel and swoop. Their
D. the seagulls wheel and swoop. Their

[3]

Usually, as I'm opening the door,

Carney, the night security guard at the marina, walks
20 by on his way home and offers me a sleepy hello.

20. F. NO CHANGE
G. Carney, the night security guard at the marina
H. Carney the night security guard at the marina,
J. Carney the night security guard at the marina

[4]

The shop smells salty, like the bay, itself
21 and the creaky oak floor is gritty with sand. I

21. A. NO CHANGE
B. bay, itself,
C. bay itself,
D. bay itself

turn on the lights in the middle of the shop
22

22. F. NO CHANGE
G. lights. In the middle
H. lights, in the center
J. lights in the center

sits wooden bins filled with sinkers, floats, and
23

23. A. NO CHANGE
B. is sitting
C. sets
D. sit

lures. The wide variety of fishing equipment attracts both
24 the serious angler and the casual vacationer. If I notice any

24. Given that all the choices are true, which one provides the most specific information about merchandise that can be found in the shop?

- E. NO CHANGE
- G. A rack of fishing rods covers one wall; shelves of reels, hooks, nets, and fishing line fill another.
- H. The dark wood-paneled walls are jam-packed with equipment that would thrill any fishing enthusiast.
- J. The shop offers gear for a range of different purposes.

merchandise out of place, I straighten it up.
25

25. A. NO CHANGE
B. straightened them
C. straightened those
D. straighten them

1

[5]

Next, I turn on the electric urn to heat water for hot tea, and I start a fresh pot of coffee. When I fill the bowl of sugar cubes, take the lid off the powdered creamer, and add tea bags to the assortment in the basket on the counter. I remove the cash drawer from the safe and put it in the cash register.

[6]

[1] Then, from the walk-in cooler, I drag bushels of bait clams to the counter. [2] I make sure the buckets of live herring, mullet, and shrimp are filled. [3] Since they're sold by the baker's dozen, I fill Styrofoam containers with a bit of the grass and thirteen worms. [4] If it's a particularly nice day, or if the fish have been biting, I might prepare extra containers. [5] I pull out a large cardboard flat of worms packed in moist grass.

[7]

By this time, it's nearly six o'clock. I open the window blinds, unlock the front door, and greet the first customers with a smile. [29] If it's nippy outside, I offer them a complimentary cup of hot coffee or tea to help them start their day.

26. F. NO CHANGE
G. As I fill
H. Filling
J. I fill

27. A. NO CHANGE
B. live, herring, mullet,
C. live, herring, mullet
D. live herring mullet,

28. For the sake of the logic and coherence of this paragraph, Sentence 5 should be placed:
- F. where it is now.
G. after Sentence 1.
H. after Sentence 2.
J. after Sentence 3.

29. If the writer were to delete the phrase "with a smile" from the preceding sentence, the sentence would primarily lose:
- A. information that contrasts the narrator's mood with that of the customers.
B. a detail that describes the narrator's attitude toward the customers.
C. a description that refers to a point made in the preceding paragraph.
D. nothing at all, since this detail is clearly stated elsewhere in this paragraph.

Question 30 asks about the preceding passage as a whole.

30. Upon reviewing the essay and realizing that some key information has been left out, the writer composes the following sentence incorporating that information:

I work at Stoney's Bait & Tackle Shop.

This sentence would most logically be placed after the last sentence in Paragraph:

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

PASSAGE III

A Few Words about Bats

The movie *Dracula*, featuring its batlike title character who feeds on human blood, is just one of many

sources of people's ideas about bats that are flawed. The

facts about bats are more interesting than the falsehoods.

Just take three of the most common misconceptions about

bats; that they are dangerous to humans, that they are rodents, and that they cannot see.

In reality, only three of the more than 850 known species of bats feed primarily on blood, and even these do not draw nourishment from human blood;

they bite cattle and horses in their sleep. Most bats eat insects; others feed on fruit, nectar, pollen, small vertebrates, and fish.

Some people believe bats are rodents; others think bats are a kind of bird. Although winged, bats are not related to birds, because even if a bat's small, furry body may appear mouselike, bats are not rodents either. Rather,

bats are a unique order of mammals called Chiroptera, the

only mammals that truly flies.

While some species of bats are blind, most are not. However, bats that hunt at night use sound more than sight to orient themselves in the dark. These bats sending out high-frequency sounds and using the echoes that bounce back from objects to locate their prey and to navigate.

31. A. NO CHANGE
B. with its
C. based on its'
D. who's

32. F. NO CHANGE
G. ideas that are mistaken about bats.
H. erroneous ideas about bats.
J. mistaken ideas they have about bats.

33. A. NO CHANGE
B. of more interest then
C. the most interesting than
D. more interesting then

34. F. NO CHANGE
G. bats,
H. bats
J. bats:

35. A. NO CHANGE
B. they bite sleeping cattle and horses.
C. they bite cattle and horses when they are asleep.
D. while asleep, they bite cattle and horses.

36. F. NO CHANGE
G. rodents, others,
H. rodents others
J. rodents and others'

37. A. NO CHANGE
B. whether
C. and although
D. seeing as

38. F. NO CHANGE
G. Chiroptera, they are
H. Chiroptera, so they are
J. Chiroptera being

39. A. NO CHANGE
B. is able to truly fly.
C. can truly fly.
D. has true flight ability.

40. F. NO CHANGE
G. sending out high-frequency sounds and use
H. sent out high-frequency sounds to use
J. send out high-frequency sounds and use

1



1

In addition to being fascinating creatures, bats are useful to humans; especially farmers. ⁴¹ They consume beetles and moths that attack crops, reducing our reliance on chemical insecticides; in addition, bat droppings are useful for fertilizing fields and gardens.

There is one sad piece of news about bats: their habitats are being destroyed by humans. For example, bat caves are being disturbed or ruined as highways and housing developments are built. ⁴² As a consequence, several bat species face extinction. We should protect bats

because, though they might seem threatening, they are an ⁴³ important and beneficial part of life.

41. Given that all the following statements are true, which one provides the most relevant information at this point in the essay?

- A. Like all wild animals, bats may bite if handled.
- B. Bats pollinate plants, including fruits we eat.
- C. Some plants have developed special mechanisms to attract bats.
- D. Bats have eyes adapted for poor lighting conditions.

42. The writer is considering deleting the preceding sentence from this paragraph. If the writer made this deletion, the paragraph would primarily lose:

- F. information that distracts from the message about the extinction of some bat species.
- G. an example of ways readers can stop the destruction of bat habitats.
- H. scientific proof of the statement that bat habitats are being destroyed.
- J. evidence for the claim that bat habitats are being destroyed.

43. The writer wants to provide a phrase here that will tie the conclusion of the essay to its beginning. Which choice does that best?

- A. NO CHANGE
- B. though they mostly come out at night,
- C. though their habitats are vanishing,
- D. even if we rarely see them,

Questions 44 and 45 ask about the preceding passage as a whole.

44. The writer is considering deleting the last sentence of the first paragraph of the essay. If the writer were to make this deletion, the essay would primarily lose a statement that:

- F. introduces the organization of the next three paragraphs.
- G. summarizes points made earlier in the paragraph.
- H. provides a list of the kinds of creatures bats have been compared to.
- J. adds a much-needed touch of humor to the essay.

45. Suppose the writer's goal had been to write an essay focusing on the various ways in which people are causing the extinction of some bat species. Would this essay fulfill that goal?

- A. Yes, because the essay explains in detail that bats have many enemies, including humans, who pose the greatest threat of all to bat survival.
- B. Yes, because the essay focuses on the misconceptions people have about bats.
- C. No, because the essay primarily focuses on people's mistaken ideas about bats, not on ways in which people are causing the extinction of some bat species.
- D. No, because the essay indicates that not all bat species are at risk of becoming extinct, only the ones that feed on livestock.

PASSAGE IV

In Remembrance of a Student Hero

[1] When Mario Savio died in 1996, newspaper stories recounted the events that had put him in the national spotlight more than thirty years earlier.

[2] In 1964, Savio was a philosophy major and a member of the executive committee of the Free Speech Movement at the University of California at Berkeley.

[3] During the height of the United States presidential election campaign, the Free Speech Movement had organized to fight the university's decision to limit the activities of those groups on campus. [4] The son of working-class parents, Savio grew up in Queens, New York. [5] He had volunteered to do civil rights work in

Mississippi, the twentieth state admitted to the Union,

during the Freedom Summer of 1964 before returning to classes that fall. [6] Along with many others,

Savio reacted fiercely when the university banned civil rights groups from setting up information tables on the campus plaza. [7] That stuff led to a student

strike and a sit-in protest at the main administration

building. 51

46. Given that all the choices are true, which one most effectively introduces this sentence by describing what the Free Speech Movement was?

F. NO CHANGE

G. A coalition of civil rights groups and other political organizations,

H. At the center of a conflict with university officials,

J. Prompted by university action taken that fall,

47. A. NO CHANGE

B. the state of Mississippi (also known as the Magnolia State),

C. Mississippi, admitted to the Union in 1817,

D. Mississippi

48. F. NO CHANGE

G. 1964, before,

H. 1964 before,

J. 1964; before

49. A. NO CHANGE

B. That ban

C. Which

D. It

50. F. NO CHANGE

G. it became

H. and was

J. than

51. The writer has decided to divide this opening paragraph into two. The best place to add the new paragraph break would be at the beginning of Sentence:

A. 4, because it would indicate that the essay is now going to focus on Savio's childhood.

B. 4, because it would signal the essay's shift in emphasis back to Savio.

C. 5, because it would indicate that the essay is now going to address Savio's experiences as a civil rights worker.

D. 5, because it would signal the essay's shift from Savio's childhood to his adult life.

1



7

On December 2, 1964, Savio spoke insistently to

52

a countless group of protesters: "There is a time when the

53

operation of the machine . . . makes you so sick at heart

that you can't take part . . . and you've got to make it

stop." That day, Savio and 800 other protesters were

54

taken to jail in the largest mass arrest in California

history. Days later, the California Board of Regents

voted to override the university ban and granted full

55

speech rights on the Berkeley campus. 56

The Free Speech Movement changed campus

life in the United States. It made a powerful case for the

57

students' right to freedom of speech. It also popularized

58

the sit-in, as a protest tactic, became a model for student

59

rallies and protests across the country. As for Mario Savio,

he went on to earn a master's degree in physics. He

52. Which choice would most clearly indicate that Savio succeeded in his appeal to the protesters?

- F. NO CHANGE
- G. emphatically
- H. compellingly
- J. excitably

53. A. NO CHANGE

- B. numerous group
- C. high volume
- D. large crowd

54. Which of the following alternatives to the underlined portion would be LEAST acceptable?

- F. Not long after,
- G. Besides,
- H. Soon,
- J. Then,

55. Which of the following alternatives to the underlined portion would be LEAST acceptable?

- A. ban, and this action
- B. ban, an action that
- C. ban and, thus,
- D. ban that

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

Appointed by the governor, the California Board of Regents is assigned to oversee that state's university system.

Should the writer add this sentence here?

- F. Yes, because it provides important background information concerning the vote.
- G. Yes, because it explains the makeup of this particular board to the reader.
- H. No, because it distracts the reader from the main point of this paragraph.
- J. No, because it does not provide specific enough information about the California Board of Regents.

57. A. NO CHANGE

- B. made for
- C. makes for
- D. makes

58. F. NO CHANGE

- G. For this reason, it
- H. However, it
- J. It thus

59. A. NO CHANGE

- B. sit-in as a protest tactic and
- C. sit-in, as a protest tactic, it
- D. sit-in as a protest tactic

then taught mathematics and physics in high schools
 and, for his last six years, at Sonoma State University,
 where he led protests against student fee increases.

Whether a student or a teacher, Savio applied the belief
 that ordinary people banding together can make change
 happen.

60. F. NO CHANGE
 G. then, taught, mathematics
 H. then taught mathematics,
 J. then, taught mathematics

PASSAGE V

Roberto Clemente in Right Field

[1]

Roberto Clemente, the Pittsburgh Pirates right
 fielder from 1955 to 1972, was one of baseball's most

61. A. NO CHANGE
 B. one, of baseball's
 C. one, of baseballs
 D. one of baseball's

gifted athletes. He was entitled the National League
 Batting Champion four times, the National League Most
 Valuable Player (MVP) in 1966, and the World Series
 MVP in 1971. In recognition of his fielding skills, he
 was awarded twelve consecutive Gold Gloves. In 1973,
 he was inducted into the Baseball Hall of Fame.

62. F. NO CHANGE
 G. awarded
 H. named
 J. given

63. A. NO CHANGE
 B. in 1971 was awarded to Clemente.
 C. award in 1971 went to Clemente.
 D. award was given to him in 1971.

[2]

While Clemente's achievements in the sport
 of baseball are impressive. His charity work off

64. F. NO CHANGE
 G. impressive, but his
 H. impressive and his
 J. impressive, his

the field has marked himself as one of the greatest
 humanitarians in professional sports. Tragically, it was
 during one of his goodwill missions that Clemente's life

65. A. NO CHANGE
 B. him
 C. them
 D. itself

1

was cut short. In 1972, Clemente died in a plane crash

66

66. F. NO CHANGE
G. perished in a deadly
H. fatally perished
J. died in a lethal

while delivering relief supplies to earthquake victims

67

in Nicaragua.

[3]

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

- A. while he was delivering
B. as he was delivering
C. that was delivering
D. as he delivered

[1] At the time of his death, Clemente

was planning long-term humanitarian

projects, which were designed to last for years.

68

68. F. NO CHANGE
G. projects that would help others.
H. projects of benefit to others.
J. projects.

[2] A few years later, his wife Vera, fulfilled this

69

dream by founding the Roberto Clemente Ciudad

Deportiva (Sports City) in Puerto Rico. [3] Each year,

this 304-acre sports, counseling, and education center

provides thousands of Puerto Rican youths the chance

for a better life. [4] One of them was for children a sports

70

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

- F. where it is now.
G. after the word *them*.
H. after the word *complex*.
J. after the word *homeland* (ending the sentence with a period).

complex in his homeland. [71]

[4]

71. For the sake of the logic and coherence of this paragraph, Sentence 4 should be placed:

- A. where it is now.
B. before Sentence 1.
C. after Sentence 1.
D. after Sentence 2.

In 1993, Clemente's eldest son, Roberto Clemente Jr., established the Roberto Clemente Foundation. The foundation's primary funding project, the RBI (Reviving Baseball in the Inner City) Program, offers baseball, softball, and educational opportunities for disadvantaged Pittsburgh-area teenagers.

[5]

Clemente's example has also motivated major leaguers to participate in humanitarian projects. Since 1970, Major League Baseball has presented an award annual recognizing the player

72

- 72. F. NO CHANGE
- G. annually presented an award
- H. presented an award on an annually basis
- J. presented an annually award

who best exemplifies the principals of sportsmanship and community service. In 1973, the award was renamed the Roberto Clemente Award.

[6]

While Clemente's exemplary baseball record remains fixed for the ages, the effects of his generosity continue to expand, as the story of his life is told to others.

74

- 73. A. NO CHANGE
 - B. principals for
 - C. principles in
 - D. principles of
- 74. Which choice would best help this sentence to summarize key points made in the essay?
 - F. NO CHANGE
 - G. inspiring ballplayers and improving the lives of young people.
 - H. and we can learn more about him in the Baseball Hall of Fame.
 - J. regardless of whether the Pittsburgh team makes the playoffs or not.

Question 75 asks about the preceding passage as a whole.

- 75. Upon reviewing notes for this essay, the writer comes across the following true statement:
Recent recipients of this honor include Sammy Sosa, Tony Gwynn, and Curt Schilling.
If the writer were to use this sentence, the most logical place to add it would be at the end of Paragraph:
- A. 2.
- B. 4.
- C. 5.
- D. 6.

END OF TEST 1

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



MATHEMATICS TEST

60 Minutes—60 Questions

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

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

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

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

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

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

1. On level ground, a vertical rod 12 feet tall casts a shadow 4 feet long, and at the same time a nearby vertical flagpole casts a shadow 12 feet long. How many feet tall is the flagpole?

- A. 4
- B. 8
- C. 12
- D. 20
- E. 36

2. The cost of a gym membership is a onetime fee of \$140, plus a monthly fee of \$40. Brendan wrote a \$500 check to pay his gym membership for a certain number of months, including the onetime fee. How many months of membership did he pay for?

- F. 3
- G. 4
- H. 9
- J. 12
- K. 13

3. If $x = -5$, what is the value of $\frac{x^2 - 1}{x + 1}$?

- A. -6
- B. -4
- C. 4
- D. $5\frac{4}{5}$
- E. 19

4. A museum offers a 2-hour guided group tour. For groups with fewer than 25 people the cost is \$9.25 per person; for groups with 25 people or more the cost is \$8.50 per person. The 27 people in the 9:00 a.m. tour group each paid \$9.25 in advance. What is the total refund that the museum owes the 9:00 a.m. group?

- F. \$12.50
- G. \$13.00
- H. \$18.75
- J. \$20.25
- K. \$25.00

DO YOUR FIGURING HERE.



DO YOUR FIGURING HERE.

5. The 13-member math club needs to choose a student government representative. They decide that the representative, who will be chosen at random, CANNOT be any of the 3 officers of the club. What is the probability that Samara, who is a member of the club but NOT an officer, will be chosen?

- A. 0
- B. $\frac{1}{13}$
- C. $\frac{1}{10}$
- D. $\frac{3}{13}$
- E. $\frac{1}{3}$

6. What is the perimeter, in centimeters, of a rectangle with length 15 cm and width 6 cm?

- F. 21
- G. 30
- H. 42
- J. 90
- K. 180

7. Tickets for a community theater production cost \$6 each when bought in advance and \$8 each when bought at the door. The theater group's goal is at least \$2,000 in ticket sales for opening night. The theater group sold 142 opening-night tickets in advance. What is the minimum number of tickets they need to sell at the door on opening night to make their goal?

- A. 143
- B. 144
- C. 192
- D. 250
- E. 357

8. For what value of r is the equation $\frac{8}{12} = \frac{10}{r}$ true?

- F. 3
- G. 6
- H. 14
- J. 15
- K. 18

9. If $12(x - 11) = -15$, then $x = ?$

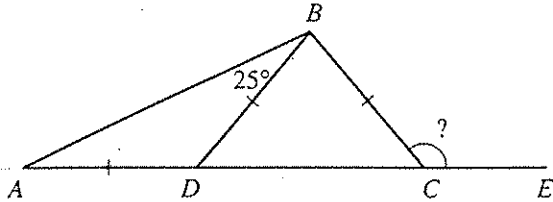
- A. $-\frac{49}{4}$
- B. $-\frac{13}{6}$
- C. $-\frac{5}{4}$
- D. $-\frac{1}{3}$
- E. $\frac{39}{4}$

2



2

10. In the figure below, A , D , C , and E are collinear. \overline{AD} , \overline{BD} , and \overline{BC} are all the same length, and the angle measure of $\angle ABD$ is as marked. What is the degree measure of $\angle BCE$?



- F. 50°
 G. 100°
 H. 105°
 J. 130°
 K. 160°

11. If $f(x) = 9x^2 + 5x - 8$, then $f(-2) = ?$

- A. -54
 B. -18
 C. 18
 D. 36
 E. 38

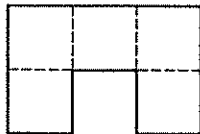
12. What is the least common multiple of 30, 20, and 70?

- F. 40
 G. 42
 H. 120
 J. 420
 K. 42,000

13. While doing a problem on his calculator, Tom meant to divide a number by 2, but instead he accidentally multiplied the number by 2. Which of the following calculations could Tom then do to the result on the calculator screen to obtain the result he originally wanted?

- A. Subtract the original number
 B. Multiply by 2
 C. Multiply by 4
 D. Divide by 2
 E. Divide by 4

14. The 8-sided figure below is divided into 5 congruent squares. The total area of the 5 squares is 125 square inches. What is the perimeter, in inches, of the figure?



- F. 25
 G. 60
 H. 80
 J. 100
 K. 125

DO YOUR FIGURING HERE.



DO YOUR FIGURING HERE.

15. In $\triangle ABC$, $\angle A$ measures greater than 43° and $\angle B$ measures exactly 90° . Which of the following phrases best describes the measure of $\angle C$?

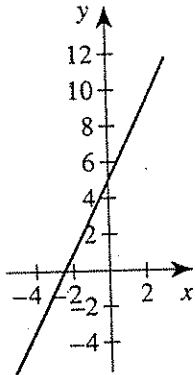
- A. Greater than 47°
- B. Equal to 47°
- C. Equal to 60°
- D. Equal to 133°
- E. Less than 47°

16. Among the following arithmetic operations, which could the symbol \diamond represent given that the equation $(2 \diamond 1)^4 + (6 \diamond 3)^2 = 10$ is true?

- I. Addition
- II. Subtraction
- III. Division

- F. I only
- G. II only
- H. III only
- J. I and II only
- K. I, II, and III

17. One of the following is an equation of the linear relation shown in the standard (x,y) coordinate plane below. Which equation is it?



- A. $y = 5x$
- B. $y = 2x$
- C. $y = 5x + 2$
- D. $y = 2x - 5$
- E. $y = 2x + 5$

18. An integer, n , is added to 4. That sum is then multiplied by 8. This result is 10 less than twice the original integer. Which of the following equations represents this relationship?

- F. $8(n + 4) = 2n - 10$
- G. $8(n + 4) - 10 = 2n$
- H. $8(n + 4) = 10 - 2n$
- J. $n + 4 \times 8 = 2n - 10$
- K. $4 + 8 = 2n - 10$

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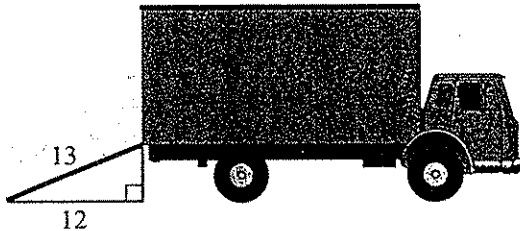


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19. Two workers were hired to begin work at the same time. Worker A's contract called for a starting salary of \$20,000 with an increase of \$800 after each year of employment. Worker B's contract called for a starting salary of \$15,200 with an increase of \$2,000 after each year of employment. If x represents the number of full years' employment (that is, the number of yearly increases each worker has received), which of the following equations could be solved to determine the number of years until B's yearly salary equals A's yearly salary?

- A. $20,000 + 800x = 15,200 + 2,000x$
 B. $20,000 + 2,000x = 15,200 + 800x$
 C. $(20,000 + 800)x = (15,200 + 2,000)x$
 D. $(2,000 + 800)x = 20,000 - 15,200$
 E. $(2,000 - 800)x = 20,000 + 15,200$

20. A ramp for loading trucks is 13 feet long and covers 12 feet along the level ground, as shown below. How many feet high is the highest point on the ramp?

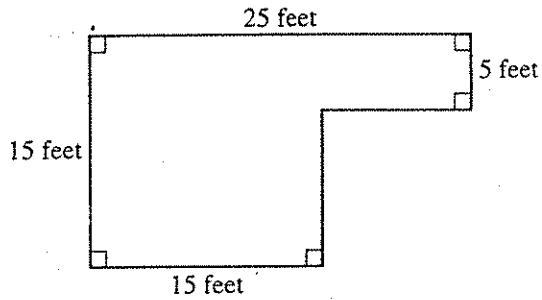


- F. 1
 G. 2
 H. 4
 J. 5
 K. $6\frac{1}{4}$
21. The expression $7(x + 3) - 3(2x - 2)$ is equivalent to:
- A. $x + 1$
 B. $x + 15$
 C. $x + 19$
 D. $x + 23$
 E. $x + 27$
22. If $x + y = 32$, and $x - y = 12$, then $y = ?$
- F. 6
 G. 10
 H. 20
 J. 22
 K. 44
23. When $(2x - 3)^2$ is written in the form $ax^2 + bx + c$, where a , b , and c are integers, $a + b + c = ?$
- A. -17
 B. -5
 C. 1
 D. 13
 E. 25

DO YOUR FIGURING HERE.



24. What is the area, in square feet, of the figure below?



- F. 60
G. 80
H. 275
J. 375
K. 450
25. The table below gives the values of 2 functions, f and g , for various values of x . One of the functions expresses a linear relationship. What is the value of that function at $x = 4$?

x	$f(x)$	$g(x)$
-2	1.4	0.6
-1	1.2	0.9
0		
1	0.8	1.3
2	0.6	1.6
3		
4		

- A. 0.2
B. 0.4
C. 1.9
D. 2.0
E. 2.2
26. What is the slope of the line represented by the equation $6y - 14x = 5$?
- F. -14
G. $\frac{5}{6}$
H. $\frac{7}{3}$
J. 6
K. 14
27. What is the sum of the 2 solutions of the equation $x^2 + x - 12 = 0$?
- A. -12
B. -4
C. -1
D. 0
E. 3

DO YOUR FIGURING HERE.

2



2

28. Two similar triangles have perimeters in the ratio 3:5. The sides of the smaller triangle measure 3 cm, 5 cm, and 7 cm, respectively. What is the perimeter, in centimeters, of the larger triangle.

DO YOUR FIGURING HERE.

- F. 15
- G. 18
- H. 20
- J. 25
- K. 36

29. At a certain location, the low temperatures, in degrees Fahrenheit, for each of 7 consecutive days in January were -2°F , 4°F , -3°F , 1°F , 2°F , -5°F , and -6°F . What was the median of these low temperatures?

- A. -2°F
- B. -1°F
- C. 1°F
- D. 3°F
- E. 4°F

30. When asked his age, the algebra teacher said, "If you square my age, then subtract 23 times my age, the result is 50." How old is he?

- F. 23
- G. 25
- H. 27
- J. 46
- K. 50

31. The distance, d , an accelerating object travels in t seconds can be modeled by the equation $d = \frac{1}{2}at^2$, where a is the acceleration rate, in meters per second per second. If a car accelerates from a stop at the rate of 20 meters per second per second and travels a distance of 80 meters, about how many seconds did the car travel?

- A. Between 1 and 2
- B. Between 2 and 3
- C. Between 3 and 4
- D. 4
- E. 8

32. Let a , b , c , and d be distinct positive integers. What is the 4th term of the geometric sequence below?

$$bcd, abc^2d, a^2bc^3d, \dots$$

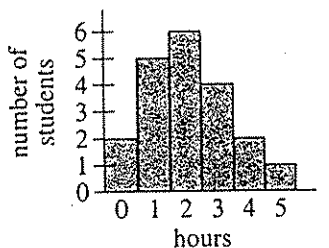
- F. a^3bc^4d
- G. $a^3b^2c^3d$
- H. $a^3b^2c^4d^2$
- J. a^4bc^6d
- K. a^4bc^9d



DO YOUR FIGURING HERE.

Use the following information to answer questions 33–35.

A survey in a study skills class asked the 20 students enrolled in the class how many hours (rounded to the nearest hour) they had spent studying on the previous evening. The 20 responses are summarized by the histogram below.



33. What fraction of the students responded that they had spent less than 3 hours studying?

- A. $\frac{13}{100}$
- B. $\frac{1}{5}$
- C. $\frac{3}{10}$
- D. $\frac{13}{20}$
- E. $\frac{17}{20}$

34. The teacher decides to show the data in a circle graph (pie chart). What should be the measure of the central angle of the sector for 3 hours?

- F. 18°
- G. 20°
- H. 36°
- J. 72°
- K. 90°

35. To the nearest tenth of an hour, what is the average number of hours for the 20 survey responses?

- A. 2.0
- B. 2.1
- C. 2.3
- D. 2.5
- E. 3.0

2



2

36. For all $x > 21$, $\frac{(x^2 + 8x + 7)(x - 3)}{(x^2 + 4x - 21)(x + 1)} = ?$

DO YOUR FIGURING HERE.

F. 1

G. $\frac{9}{7}$

H. $\frac{x-3}{x+3}$

J. $\frac{2(x-3)}{x+1}$

K. $-\frac{4(x-3)}{x+1}$

37. The bottom of the basket of a hot-air balloon is parallel to the level ground. One taut tether line 144 feet long is attached to the center of the bottom of the basket and is anchored to the ground at an angle of 72° , as shown in the figure below. Which of the following expressions gives the distance, in feet, from the center of the bottom of the basket to the ground?

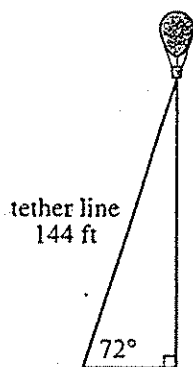
A. $\frac{144}{\cos 72^\circ}$

B. $\frac{144}{\sin 72^\circ}$

C. $144 \tan 72^\circ$

D. $144 \cos 72^\circ$

E. $144 \sin 72^\circ$



38. The coordinates of the endpoints of \overline{GH} , in the standard (x,y) coordinate plane, are $(-8,-3)$ and $(2,3)$. What is the x -coordinate of the midpoint of \overline{GH} ?

F. -6

G. -3

H. 0

J. 3

K. 5

39. On a map in the standard (x,y) coordinate plane, the towns of Arlington and Betelwood are represented by the points $(-2,-3)$ and $(-6,-7)$, respectively. Each unit on the map represents an actual distance of 10 miles. Which of the following is closest to the distance, in miles, between these 2 towns?

A. 128

B. 57

C. 42

D. 40

E. 28



DO YOUR FIGURING HERE.

40. Which of the following statements is true about rational and/or irrational numbers?

- F. The product of any 2 irrational numbers is irrational.
- G. The quotient of any 2 irrational numbers is rational.
- H. The product of any 2 rational numbers is irrational.
- J. The quotient of any 2 rational numbers is irrational.
- K. The sum of any 2 rational numbers is rational.

41. For the complex number i and an integer x , which of the following is a possible value of i^x ?

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

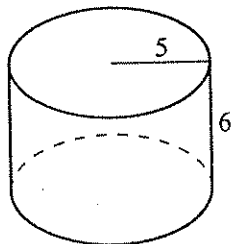
42. Consider the equation $y = (x - 3)^2 + 2$ where x and y are both real numbers. The table below gives the values of y for selected values of x .

x	y
-6	83
-4	51
-2	27
0	11
2	3
4	3
6	11

For the equation above, which of the following values of x gives the least value of y ?

- F. 1
- G. 2
- H. 3
- J. 4
- K. 5

43. The height and radius of the right circular cylinder below are given in meters. What is the volume, in cubic meters, of the cylinder?



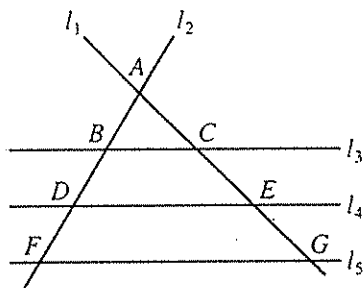
- A. 30π
- B. 31π
- C. 150π
- D. 180π
- E. 900π

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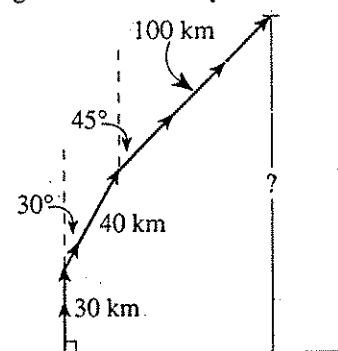
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44. Lines l_1 and l_2 intersect each other and 3 parallel lines, l_3 , l_4 , and l_5 , at the points shown in the figure below. The ratio of the perimeter of $\triangle ABC$ to the perimeter of $\triangle AFG$ is 1:3. The ratio of DE to FG is 2:3. What is the ratio of AC to CE ?



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

45. A rocket lifted off from a launch pad and traveled vertically 30 kilometers, then traveled 40 kilometers at 30° from the vertical, and then traveled 100 kilometers at 45° from the vertical, as shown in the figure below. At that point, the rocket was how many kilometers above the height of the launch pad?



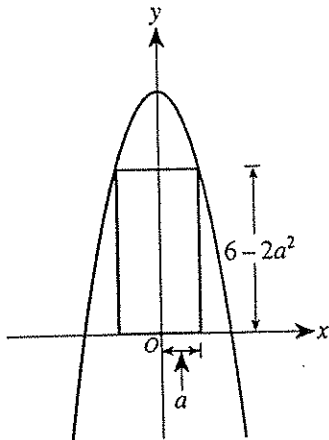
- A. 100
B. 170
C. 190
D. $20\sqrt{3} + 50\sqrt{2}$
E. $30 + 20\sqrt{3} + 50\sqrt{2}$
46. In the standard (x,y) coordinate plane, what is the area of the circle $x^2 + y^2 = 16$?
- F. 4π
G. 8π
H. 16π
J. 64π
K. 256π

DO YOUR FIGURING HERE.



DO YOUR FIGURING HERE.

47. In the standard (x,y) coordinate plane below, 1 side of a rectangle is on the x -axis, and the vertices of the opposite side of the rectangle are on the graph of the parabola $y = 6 - 2x^2$. Let a represent any value of x such that $0 < x < \sqrt{3}$. Which of the following is an expression in terms of a for the area, in square coordinate units, of any such rectangle?



- A. $-4a^3 + 12a$
 B. $-2a^3 + 6a$
 C. $-4a^2 + 4a + 12$
 D. $-2a^2 + 2a + 6$
 E. $4a^4 - 24a^2 + 36$
48. If n is a positive integer, which of the following expressions must be an odd integer?
- F. 3^n
 G. n^3
 H. $3n$
 J. $\frac{n}{3}$
 K. $3 + n$
49. The value of $\log_5\left(5^{\frac{13}{2}}\right)$ is between which of the following pairs of consecutive integers?
- A. 0 and 1
 B. 4 and 5
 C. 5 and 6
 D. 6 and 7
 E. 9 and 10



Use the following information to answer questions 50–52.

DO YOUR FIGURING HERE.

The table below shows the weekly sales totals (in thousands of dollars) for 4 departments at Pinky's Megamarket during the 5 most recent weeks. Data is missing due to a computer virus that infected the supermarket's database. The data in the table has been verified as being accurate.

Department	Week number				
	1	2	3	4	5
Meat	145	144	156	145	140
Produce	30				
Canned goods	54	62	69	75	
Dry goods	86	82		77	85

50. Which of the following is closest to the percent increase in meat department sales for Pinky's Megamarket from Week 2 to Week 3?

- F. 1.1%
- G. 6.0%
- H. 7.7%
- J. 8.3%
- K. 12.0%

51. Prior to Week 3, the manager set the goal for meat department sales to average 150 thousand dollars per week from the beginning of Week 3 through the end of Week 6. To meet this goal, what must be the minimum meat department sales for Week 6, in thousands of dollars?

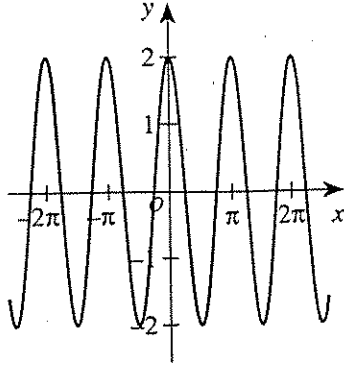
- A. 146
- B. 147
- C. 156
- D. 159
- E. 170

52. The assistant manager recalls that produce department sales increased at a very high rate during the 5 weeks, due to a projected shortage of fruit. She says that for each week from Week 2 to Week 5, produce department sales increased 10% from the previous week. Which of the following values, in thousands of dollars, is closest to produce department sales for Week 5?

- F. 48
- G. 44
- H. 42
- J. 40
- K. 33

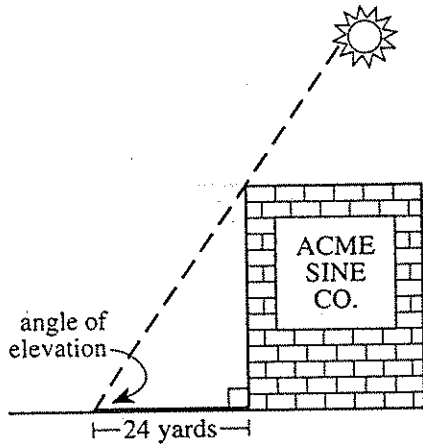
DO YOUR FIGURING HERE.

53. A trigonometric function with equation $y = a \sin(bx + c)$, where a , b , and c are real numbers, is graphed in the standard (x, y) coordinate plane below. The *period* of this function $f(x)$ is the smallest positive number p such that $f(x + p) = f(x)$ for every real number x . One of the following is the period of this function. Which one is it?



- A. $\frac{\pi}{2}$
- B. π
- C. 2π
- D. 4π
- E. 2

54. The building below casts a shadow 24 yards long, and the angle of elevation from the tip of the shadow to the top of the building has a sine of $\frac{4}{5}$. What is the height of the building in yards?



- F. 14.4
 - G. 18.0
 - H. 19.2
 - J. 30.0
 - K. 32.0
55. Which of the following is an irrational number that is a solution to the equation $|x^2 - 12| - 4 = 0$?
- A. 4
 - B. $\sqrt{2}$
 - C. $2\sqrt{2}$
 - D. $4\sqrt{2}$
 - E. $2\sqrt{3}$

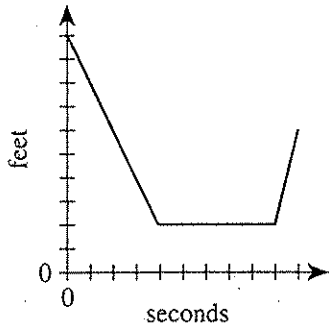
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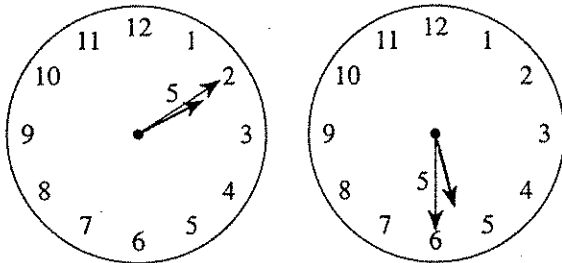
56. The graph below shows the distance Malika is from a motion detector for a period of 10 seconds. A certain order of 3 of the following 5 actions describes Malika's movement in relation to the position of the motion detector. Which order is it?

DO YOUR FIGURING HERE.



- I. Stands still for 5 seconds
 - II. Walks away at 4 feet per second
 - III. Walks toward at 4 feet per second
 - IV. Walks away at 2 feet per second
 - V. Walks toward at 2 feet per second
- F. I, II, V
 - G. II, I, V
 - H. III, I, IV
 - J. IV, I, III
 - K. V, I, II

57. As shown in the figure below, a clock has a minute hand that measures 5 cm from its tip to the center of the clock. To the nearest centimeter, what is the distance traveled by the tip of the minute hand between 2:10 p.m. and 5:30 p.m. ?



- A. 31
- B. 68
- C. 101
- D. 105
- E. 173



DO YOUR FIGURING HERE.

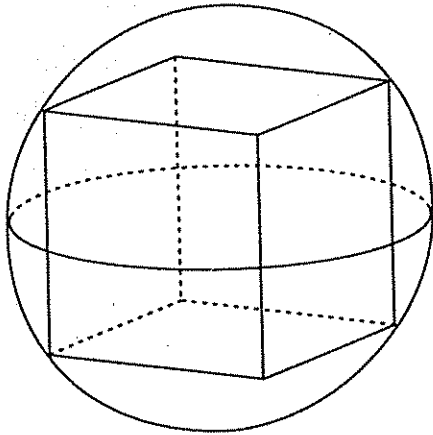
58. For ϕ , an angle whose measure is between 90° and 180° , $\tan \phi = -\frac{7}{24}$. Which of the following equals $\sin \phi$?

- F. $-\frac{24}{7}$
 G. $-\frac{24}{25}$
 H. $-\frac{7}{25}$
 J. $\frac{24}{25}$
 K. $\frac{7}{25}$

59. Consider all pairs of positive integers w and z whose sum is 5. For how many values of w does there exist a positive integer x that satisfies both $2^w = x$ and $x^z = 64$?

- A. 0
 B. 2
 C. 4
 D. 8
 E. Infinitely many

60. A cube with edges 4 cm long is inscribed in a sphere, as shown below. What is the radius of the sphere, in centimeters?



- F. $2\sqrt{3}$
 G. $2\sqrt{2}$
 H. $4\sqrt{3}$
 J. $4\sqrt{2}$
 K. 2

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 *The Fisher King* by Paule Marshall. ©2000 by Paule Marshall).

It was nearing the end of the second set, the jazz show winding down when Hattie heard Abe Kaiser at the microphone call Everett Payne's name. Heard his name and, to her surprise, saw him slowly stand up in the bullpen up front. She hadn't seen him join the other local musicians, including Shades Bowen with his tenor sax, in what was called the bullpen, which was simply a dozen or so chairs grouped near the bandstand. The young locals gathered there each Sunday evening, hoping for a chance to perform. Because toward the end of the final set, the custom was to invite one or two of them to sit in with the band. They sometimes even got to choose the tune they wanted to play.

This Sunday, Everett Payne, not long out of the army, was the one being invited to sit in.

Breath held, Hattie watched him separate himself from the hopefuls and approach the stand, taking his time, moving with what almost seemed a deliberate pause between each step. The crowd waiting.

That was his way, Hattie knew. His body moving absentmindedly through space, his head, his thoughts on something other than his surroundings, and his eyes like a curtain he occasionally drew aside a fraction of an inch to peer out at the world. A world far less interesting than the music inside his head.

She watched now as he slowly mounted the bandstand and conferred with the bassist and drummer, those two were all he would need. Then, without announcing the name of the tune he intended playing, without in any way acknowledging the audience, he sat down at the piano and brought his hands—large hands, the fingers long and splayed and slightly arched—down on the opening bars of "Sonny Boy Blue."

"Sonny Boy Blue!" That hokey-doke tune!

Around her, the purists looked askance at each other from behind their regulation shades and slouched deeper in their chairs in open disgust.

At first, hokey though it was, he played the song straight through as written, the rather long introduction, verse, and chorus. And he did so with great care, although at a slower tempo than was called for and with a formality that lent the Tin Pan Alley tune a depth and thoughtfulness no one else would have accorded it.

Quickly taking their cue from him, the bassist reached for his bow, the drummer for his brushes, the two of them also treating the original as if it were a serious piece of music.

Everett Payne took his time paying his respects to the tune as written, and once that was done, he hunched closer to the piano, angled his head sharply to the left, completely closed the curtain of his gaze, and with his hands commanding the length and breadth of the keyboard he unleashed a dazzling pyrotechnic of chords (you could almost see their colors), polyrhythms, seemingly unrelated harmonies, and ideas—fresh, brash, outrageous ideas. It was an outpouring of ideas and feelings informed by his own brand of lyricism and lit from time to time by flashes of the recognizable melody. He continued to acknowledge the little simple-minded tune, while at the same time furiously recasting and reinventing it in an image all his own.

A collective in-suck of breath throughout the club.

Where, Hattie wondered, did he come by the dazzling array of ideas and wealth of feeling? What was the source? It had to do, she speculated, listening intently, with the way he held his head, angled to the left like that, tilted toward both heaven and earth. His right side, his right ear directed skyward, hearing up there, in the Upper Room among the stars Mahalia sang about, a new kind of music: splintered, atonal, profane, and possessing a wonderful dissonance that spoke to him, to his soul-case. For him, this was the true music of the spheres, of the maelstrom up there. When at the piano, he kept his right ear tuned to it at all times, letting it guide him, inspire him. His other ear? It remained earthbound, trained on the bedrock that for him was Bach and the blues.

Again and again he took them on a joyous, terrifying roller coaster of a ride it seemed to Hattie, and when he finally deposited them on terra firma after close to twenty minutes, everyone in Putnam Royal

could only sit there as if they were in church and weren't supposed to clap. Overcome. Until finally Alvin Edwards lived on Decatur Street played trumpet 85 in the school band leaped to his feet and renamed him.

Alvin brought everyone up with him. Including the purists who normally refused to applaud even genius. They too stood up in languid praise of him.

1. It can reasonably be inferred from the passage that Shades Bowen:

- A. did not accompany Everett Payne as he played "Sonny Boy Blue."
- B. had been in the army with Everett Payne.
- C. was the oldest musician in the bullpen.
- D. did not usually allow the local musicians to play with the band.

2. The main purpose of the statement in line 62 is to:

- F. illustrate the high expectations the audience initially had for Everett Payne's performance.
- G. inform the reader of the audience's reaction to Everett Payne's performance.
- H. counteract the narrator's description of Everett Payne's performance.
- J. provide proof that Everett Payne was well known to the audience.

3. The passage most strongly suggests that the second set of the jazz shows at the club is:

- A. the final set.
- B. much longer than the first set.
- C. followed by a third set on Sunday nights.
- D. performed solely by the musicians in the bullpen.

4. Which of the following details is used in the passage to indicate how the purists in the audience initially reacted to Everett Payne's choice of music?

- F. The overall silence of the audience, including the purists
- G. The description of the audience's collective in-suck of breath
- H. The posture the purists assumed in their seats
- J. The fact that the purists stood up

5. According to the narrator, what did Hattie see Everett Payne do prior to playing "Sonny Boy Blue"?

- A. Move quickly from his seat to the bandstand
- B. Study the audience around him
- C. Confer with the bassist and the drummer
- D. Announce the name of the tune he was going to play

6. The passage initially portrays the purists most nearly as:

- F. knowledgeable and open minded.
- G. snobbish and intolerant.
- H. rational and well educated.
- J. inexperienced and uninhibited.

7. It can reasonably be inferred from the passage that Hattie believed Bach and the blues were the:

- A. musical influences that Everett Payne tried to avoid representing when he played piano.
- B. foundation of Everett Payne's inventive piano playing.
- C. true music of the heavens that inspired Everett Payne's creativity as a piano player.
- D. reason why Everett Payne's piano-playing abilities limited him to Tin Pan Alley tunes.

8. According to the passage, when Everett Payne first played "Sonny Boy Blue" straight through, he did so:

- F. more slowly than was intended by the composer.
- G. after it had been suggested by Abe Kaiser.
- H. against the wishes of the bassist and drummer.
- J. without following the original tune.

9. According to the passage, Hattie speculated that the source of Everett Payne's musical ideas and feelings during "Sonny Boy Blue" was in:

- A. the way he tilted his head.
- B. the simplemindedness of the song.
- C. his ability to play with great formality.
- D. his connection with the silent audience.

10. The narrator states that to Hattie, Everett Payne's performance was:

- F. overly slow and formal.
- G. deliberate yet absentminded.
- H. like a song played in a church.
- J. a roller coaster of a ride.

Passage II

SOCIAL SCIENCE: This passage is adapted from Richard Moe's article "Mindless Madness Called Sprawl," based on a speech he gave on November 30, 1996, in Fresno, California (©1996 by Richard Moe).

At the time he gave the speech, Moe was president of the National Trust for Historic Preservation.

Drive down any highway leading into any town in the country, and what do you see? Fast-food outlets, office parks and shopping malls rising out of vast barren plains of asphalt. Residential subdivisions spreading like inkblots obliterating forests and farms in their relentless march across the landscape. Cars moving sluggishly down the broad ribbons of pavement or halting in frustrated clumps at choked intersections. You see communities drowning in a destructive, soulless, ugly mess called sprawl.

Many of us have developed a frightening form of selective blindness that allows us to pass by the appalling mess without really seeing it. We've allowed our communities to be destroyed bit by bit, and most of us have shrugged off this destruction as "the price of progress."

Development that destroys communities isn't progress. It's chaos. And it isn't inevitable, it's merely easy. Too many developers follow standard formulas, and too many government entities have adopted laws and policies that constitute powerful incentives for sprawl.

Why is an organization like the National Trust for Historic Preservation so concerned about sprawl? We're concerned because sprawl devastates older communities, leaving historic buildings and neighborhoods underused, poorly maintained or abandoned. We've learned that we can't hope to revitalize these communities without doing something to control the sprawl that keeps pushing further and further out from the center.

But our concern goes beyond that, because preservation today is about more than bricks and mortar. There's a growing body of grim evidence to support our belief that the destruction of traditional downtowns and older neighborhoods—places that people care about—is corroding the very sense of community that helps bind us together as a people and as a nation.

One form of sprawl—retail development that transforms roads into strip malls—is frequently spurred on by discount retailers, many of whom are now concentrating on the construction of superstores with more than 200,000 square feet of space. In many small towns, a single new superstore may have more retail space than the entire downtown business district. When a store like that opens, the retail center of gravity shifts away from Main Street. Downtown becomes a ghost town.

Sprawl's other most familiar form—spread-out residential subdivisions that "leapfrog" from the urban

50 fringe into the countryside—is driven largely by the American dream of a detached home in the middle of a grassy lawn. Developers frequently claim they can build more "affordable" housing on the edge of town—but "affordable" for whom?

55 The developer's own expenses may be less, and the home buyer may find the prices attractive—but who picks up the extra costs of fire and police protection, new roads and new utility infrastructure in these outlying areas? We all do, in the form of higher taxes for needless duplication of services and infrastructure that already exist in older parts of our cities and towns.

60 People who say that sprawl is merely the natural product of marketplace forces at work fail to recognize that the game isn't being played on a level field. Government at every level is riddled with policies that mandate or encourage sprawl.

By prohibiting mixed uses and mandating inordinate amounts of parking and unreasonable setback requirements, most current zoning laws make it impossible—even illegal—to create the sort of compact walkable environment that attracts us to older neighborhoods and historic communities all over the world. These codes are a major reason why 82 percent of all trips in the United States are taken by car. The average American household now allocates more than 18 percent of its budget to transportation expenses, most of which are auto-related. That's more than it spends for food and three times more than it spends for health care.

80 Our communities should be shaped by choice, not by chance. One of the most effective ways to reach this goal is to insist on sensible land-use planning. The way we zone and design our communities either opens up or forecloses alternatives to the automobile. Municipalities should promote downtown housing and mixed-use zoning that reduce the distances people must travel between home and work. The goal should be an integrated system of planning decisions and regulations that knit communities together instead of tearing them apart. We should demand land-use planning that exhibits a strong bias in favor of existing communities.

11. The principal aim of the passage can best be classified as:
- A. persuasive.
 - B. explanatory.
 - C. descriptive.
 - D. narrative.

12. Among the following quotations from the passage, the one that best summarizes what the author would like to see happen is:
- F. "laws and policies that constitute powerful incentives for sprawl" (lines 20–22).
 - G. "the destruction of traditional downtowns" (line 34).
 - H. "'affordable' housing on the edge of town" (line 53).
 - J. "an integrated system of planning decisions and regulations" (lines 87–88).
13. The last paragraph differs from the first paragraph in that in the last paragraph the author:
- A. asks a question and then answers it.
 - B. uses more statistics to support his arguments.
 - C. incorporates more emotional language.
 - D. offers solutions rather than stating a problem.
14. In the passage, the author answers all of the following questions EXCEPT:
- F. How long has sprawl been happening in U.S. cities?
 - G. Is development synonymous with progress?
 - H. What is one major reason that people in the United States use automobiles so much?
 - J. What should communities do to combat sprawl?
15. The author states that one superstore may do all of the following EXCEPT:
- A. have more retail space than an entire downtown.
 - B. lead to serious downtown renovations.
 - C. make the downtown area into a ghost town.
 - D. shift the center of gravity away from downtown.
16. The statistics cited by the author in the tenth paragraph (lines 67–79) are used to illustrate the concept that:
- F. allowing mixed uses of land leads to environmental destruction.
 - G. current zoning laws help create a compact, walkable environment.
 - H. land-use regulations now in effect increase the overall costs of transportation.
 - J. Americans spend too much of their budgets on food and health care.
17. One form of sprawl the author describes is retail development that:
- A. adjoins existing downtown areas.
 - B. utilizes historic buildings.
 - C. turns roads into strip malls.
 - D. promotes a sense of community around a superstore.
18. As it is used in line 51, the word *detached* most nearly means:
- F. objective.
 - G. set apart.
 - H. broken apart.
 - J. taken away.
19. The author uses the statement "The game isn't being played on a level field" (line 64) most nearly to mean that:
- A. cities needlessly duplicate essential services.
 - B. higher taxes for some people make their lives more difficult.
 - C. marketplace forces are at work.
 - D. governmental decisions influence marketplace forces.
20. The phrase *mixed uses* (line 67) most likely refers to:
- F. having large parking lots around even larger stores.
 - G. preserving and restoring historic neighborhoods.
 - H. ensuring that automobiles cannot be driven to the various local businesses.
 - J. allowing one area to contain various types of development.

Passage III

HUMANITIES: This passage is adapted from the essay "My Life with a Field Guide" by Diana Kappel-Smith (©2002 by Phi Beta Kappa Society).

I was seventeen when it started. My family was on vacation, and one day we went on a nature walk led by a young man a few years older than I. Probably I wanted to get his attention—I'm sure I did—so I pointed to a flower and asked, "What's that?"

"Hmmm? Oh, just an aster," he said.

Was there a hint of a sniff as he turned away? There was! It was just an aster and I was just a total ignoramus!

10 And I remember the aster. Its rays were a brilliant purple, its core a dense coin of yellow velvet. It focused light as a crystal will. It faced the sun; it was the sun's echo.

15 Later that day, a book with a green cover lay on the arm of a chair under an apple tree. It was the same volume that our guide had carried as he marched us through the woods. The book had been left there, by itself. It was a thing of power. In the thin summer shadow of the tree, quivering, like a veil, the book was revealed, and I reached for it. A FIELD GUIDE TO WILD FLOWERS—PETERSON & McKENNY, its cover said. Its backside was ruled like a measuring tape, its inside was full of drawings of flowers. By the end of that week I had my own copy. I have it still.

25 Over the next several years this field guide would become my closest companion, a slice of worldview, as indispensable as eyes or hands. I didn't arrive at this intimacy right away, however. This wasn't going to be an easy affair for either of us.

30 I'll give you an example of how it went. After I'd owned the Peterson's for about a week, I went on a hike with some friends up a little mountain, taking the book along. Halfway up the mountain, there by the trailside was a yellow flower, a nice opportunity to take my new guide for a test drive. "Go on ahead!" I said to my hiking companions, "I'll be a minute . . ." Famous last words.

I had already figured out the business of the book's colored tabs. I turned in an authoritative way to the Yellow part and began to flip through. By the time the last of my friends had disappeared up the trail, I'd arrived at a page where things looked right. Five petals? Yes. Pinnate leaves? Whatever. Buttercup? There are, amazingly, *eleven* buttercups. Who would have thought? However hard I tried to make it so, my item was not one of them. Next page. Aha! this looked more like it. Bushy cinquefoil? Nope, leaves not *quiiite* right, are they? As the gnats descended, I noticed that there were six more pages ahead, each packed with five-petaled yellow flowers—St. Johnsworts, loose-strifes, puccoons.

Why I persisted in carrying it around and consulting its crowded pages at every opportunity, I have no idea. The book was stubborn; well, I was stubborn, too; that was part of it. And I had no choice, really, not if I wanted to *get in*. A landscape may be handsome in the aggregate, but this book led to the particulars, and that's what I wanted. A less complete guide would have been easier to start with, but more frustrating in the end. A more complete book would have been impossible for me to use. So I persisted in wrestling with the Peterson's, and thus by slow degrees the crowd of plant stuff in the world became composed of individuals. As it did, the book changed: its cover was stained by water and snack food, the spine grew invitingly lax, and some of the margins sprouted cryptic annotations.

By the time the next summer came, I had fully discovered the joy of the hunt, and every new species had its trophy of data—name and place and date—to be jotted down. If I'd found a flower before, I was happy to see it again. I often addressed it with enthusiasm: *Hi there, Solidago hispida!* I discovered early on that a plant's Latin name is a name of power by which the plant can be uniquely identified among different spoken tongues, across continents, and through time. The genus name lashes it firmly to its closest kin, while its species name describes a personal attribute—*rubrum* meaning red, *officinale* meaning medicinal, *odoratus* meaning smelly, and so on. It all makes such delightful sense!

My friend Julie and I identified individual plants in our rambles, but from the particulars we began to know wholes. Bogs held one community, montane forests held another, and the plants they held in common were clues to intricate dramas of climate change and continental drift. So from plant communities it followed that the grand schemes of things, when they came our way, arrived rooted in real place and personal experience: quaternary geology, biogeography, evolutionary biology all lay on the road that we had begun to travel.

21. The passage is best described as being told from the point of view of someone who is:
- tracing her developing interest in identifying flowers and in the natural world.
 - reexamining the event that led her to a lifelong fascination with asters.
 - reviewing her relationships with people who have shared her interest in flowers.
 - describing how her hobby of identifying flowers became a profitable career.

22. As portrayed by the author, the young man responded to her question about the flower with what is best described as:
- F. acceptance.
 - G. surprise.
 - H. condescension.
 - J. anger.
23. What name, if any, does the author report assigning to the yellow flower she came across during a mountain hike?
- A. St. Johnswort
 - B. Loosestrife
 - C. Puccoon
 - D. The passage doesn't name the flower.
24. Looking back at her early experiences with the Peterson's, the author most strongly implies that the guide was:
- F. daunting at first, but in retrospect preferable to either a more or a less complete guide.
 - G. easy to use in the beginning, but more frustrating in the end than a more complete guide would have been.
 - H. impossible for her to follow until she started pairing it with a different guide written for beginners.
 - J. appealing initially until she realized how poorly illustrated its crowded pages were.
25. As it is used in line 56, the phrase *get in* most nearly means:
- A. arrive at a physical location.
 - B. be chosen for group membership.
 - C. truly understand the subject.
 - D. be friendly with someone.
26. The passage best supports which of the following conclusions about Julie?
- F. She has more experience than the author has in identifying flowers.
 - G. She owns a house that's close to either a bog or a montane forest.
 - H. She sees value in understanding the various communities of plants.
 - J. She stopped using the Peterson's as her primary source of flower information.
27. The author states that the Peterson's became her closest companion over a period of several:
- A. days.
 - B. weeks.
 - C. months.
 - D. years.
28. In the context of the passage, the author's statement in lines 56–58 most nearly means that she:
- F. learned to understand landscapes by looking at their overall patterns rather than their details.
 - G. found that landscapes lost their appeal the more she tried to understand them logically.
 - H. hoped to paint attractive portraits of landscapes by paying careful attention to details.
 - J. sought a deeper knowledge of landscapes through learning about their individual parts.
29. The details in lines 64–66 primarily serve to suggest the:
- A. poor craftsmanship the publishing company used in producing the Peterson's.
 - B. transformation the author's copy of the Peterson's underwent as a result of heavy use.
 - C. strange writing the author often encountered in reading the Peterson's.
 - D. carelessness with which the author used the Peterson's, much to her later regret.
30. The author refers to *Solidago hispida* as an example of a flower that she:
- F. had great trouble identifying the first time she stumbled upon it.
 - G. hopes to finally come across on one of her nature walks.
 - H. was pleased to encounter again after she had learned to identify it.
 - J. feels has an inappropriate name given the plant's characteristics.

Passage IV

NATURAL SCIENCE: This passage is adapted from the article "When Research Is a Snow Job" by Sarah Boyle (©2002 by National Wildlife).

The figure is beyond comprehension: Every year, 1,000,000,000,000,000,000,000 (1 septillion) snowflakes fall worldwide. As the crystals fall, they encounter different atmospheric conditions that produce 5 flakes with unique attributes. The more complex those conditions are, the more elaborate the crystals.

Kenneth Libbrecht is a physicist at the California Institute of Technology. Along with the work of scientists at the U.S. Department of Agriculture's Agricultural Research Service (ARS), his research is uncovering new information about the magical world of snow crystals—information that has practical applications in such diverse areas as agriculture and the production of electricity.

Snow crystals are individual crystals—usually in a hexagonal form—while snowflakes are collections of two or more snow crystals. Beginning as condensed water vapor, a crystal typically grows around a nucleus of dust. Its shape depends on how the six side facets—or faces—grow in relation to the top and bottom facets. If they grow relatively tall, the crystal appears column-like; if the side facets are short compared to the length of the bottom and top facets, the crystal looks platelike.

Currently Libbrecht is trying to crack the problem of why the crystal facets' growth varies with temperature. He believes this may have something to do with the ice surface's "quasi-liquid" layer, which affects how water molecules stick to the surface.

By manipulating the temperature and humidity within an incubation chamber (and by adding an electric current or various gases at times), Libbrecht creates "designer" snowflakes in his lab. Such experiments are helping him determine how crystals form.

William Wergin, a retired ARS research biologist, and a colleague, Eric Erbe, were using scanning electron microscopy to look at biological problems relating to agriculture. To avoid the laborious procedure that using such equipment usually entails, the two scientists decided to freeze the tissue they were working with and look at it in the frozen state.

"One day it happened to be snowing," says Wergin, "and we were looking for a specimen. We imaged some snowflakes and were very surprised to see what we did." It was the first time anyone had attempted to image snow crystals with scanning electron microscopy, which provides precise detail about the crystals' shape, structural features and metamorphosed conditions (crystals often change once on the ground depending on the surrounding environment).

Wergin called another ARS colleague, hydrologist Albert Rango, to see if the snow crystal magnifications

had any applications for his research. Rango now uses Wergin's electron microscopy data, along with microwave satellite data, in the Snowmelt Runoff Model to predict the amount of water available in a winter snowpack. For western states such as Colorado, Montana, Utah and Wyoming, about 75 percent of the annual water supply comes from snowmelt. Snowmelt water is critical to crop irrigation and hydroelectric power, as well as recreation and domestic water supplies, fisheries management and flood control.

Before employing the scanning electron microscopy results, the forecasted amounts of snowpack water were inaccurate whenever the size and shape of the snow crystals varied much from the norm. "The more we know about crystals," notes Rango, "the easier it will be to use microwave satellite data for predictions of the snow water equivalent."

Currently, forecasts using the model are about 70 to 90 percent accurate. A 1980 study estimated that improving the prediction by 1 percent would save \$38 million in irrigation and hydropower in the western United States.

Rango is also looking ahead at climate change predictions. "Following the estimates that have been made about what will happen by 2100, things are definitely warming up," he says. Temperature increases will likely result in a reduction in stream flow as overall snow accumulation decreases, winter precipitation runs off as rain, and water evaporates at a quicker rate. The gap between water supply and demand will magnify even more, greatly increasing water's economic value, anticipates Rango.

Not only does the crystal research help gauge snowmelt, it is also useful in predicting avalanches, designing artificial snow, and, perhaps in the near future, examining air pollution. "You can put snow in a scanning electron microscope and tell which elements are present, such as sulfur and nitrogen," says Wergin. "You can then see what kind of pollution is in the area and possibly track the source."

31. It can reasonably be inferred from the passage that the information about the scientific study of snow is presented primarily to:
- emphasize the importance of communication among scientists.
 - explain how snow crystal facets influence the snowpack in some western states.
 - showcase the varied uses of the scanning electron microscope.
 - demonstrate some of the practical applications of the study of snow crystals.

32. According to the passage, the use of scanning electron microscopy can save money by:
- F. encouraging scientists to make estimates of water requirements far into the future.
 - G. allowing forecasters to predict more accurately the quantity of water in the snowpack.
 - H. helping agricultural researchers to identify biological problems.
 - J. increasing the water supply for Colorado, Montana, Utah, and Wyoming by 75 percent.
33. It can reasonably be inferred that the phrase *metamorphosed conditions* (lines 47–48) refers to the:
- A. temperature and humidity at which crystals form.
 - B. process by which snow crystals develop from a speck of dust and water vapor.
 - C. state of snow crystals after they reach the ground.
 - D. major changes in environmental conditions.
34. According to the passage, the addition of electron microscopy data to the Snowmelt Runoff Model allows scientists using the model to include in their predictions detailed information about:
- F. microwave satellite data.
 - G. structural variations of snow crystals.
 - H. locations having the most snowfall.
 - J. biological problems related to agriculture.
35. According to Rango, one reason that water's economic value is likely to increase by the year 2100 is that:
- A. more water will be polluted by then.
 - B. less water will be wasted due to more accurate predictions of the water supply.
 - C. the sulfur and nitrogen content in snow is likely to increase.
 - D. predicted climate changes will reduce overall snow accumulation.
36. According to the passage, snowflakes have infinite variety because:
- F. enormous numbers of snow crystals fall worldwide.
 - G. falling snow crystals meet with varied atmospheric conditions.
 - H. snow crystals fall at various rates, creating unique snowflakes.
 - J. complexities in the atmosphere slow snow crystal development.
37. The passage states that snowflakes differ from snow crystals in that snowflakes:
- A. grow around a nucleus of dust.
 - B. combine to form snow crystals.
 - C. grow in relation to top and bottom facets.
 - D. are composed of more than one crystal.
38. The term "*designer*" snowflakes (line 32) refers directly to the fact that:
- F. no two snowflakes are alike.
 - G. Libbrecht produces the snowflakes in his lab.
 - H. snowflakes are part of the grand design of nature.
 - J. Libbrecht's snowflakes exhibit special beauty.
39. As it is used in line 59, the word *critical* most nearly means:
- A. evaluative.
 - B. faultfinding.
 - C. vital.
 - D. acute.
40. The passage states that research about snow crystals has helped scientists do all of the following EXCEPT:
- F. extract pollutants from snow.
 - G. gauge snowmelt.
 - H. design artificial snow.
 - J. predict avalanches.

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

Two measures of water quality are the number of *Escherichia coli* bacteria present and the *biotic index*, BI (a numerical value based on the type, diversity, and pollution tolerance of aquatic invertebrate animals). Both of these measures can be affected by water flow.

E. coli levels that are above 100 colonies formed per 100 mL of water indicate reduced water quality. Figure 1 shows the *E. coli* levels on 5 collection days at Sites 1 and 2 in a river.

Location	Average BI
Site 1	6.3
Site 2	2.5

Figure 2 shows the water flow at each site on the 5 collection days.

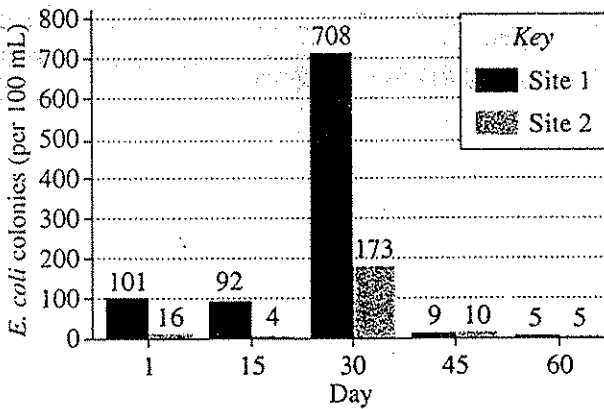


Figure 1

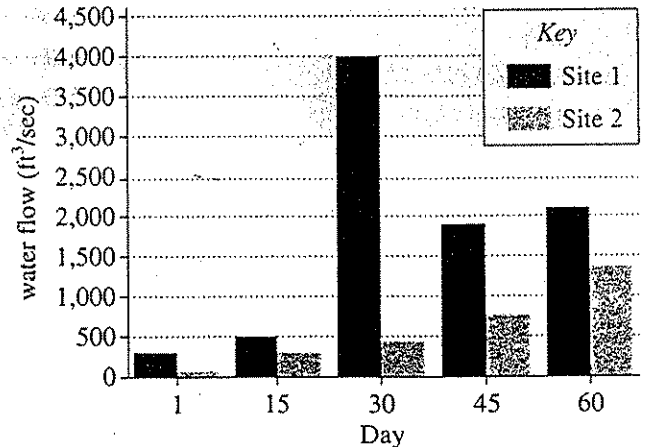


Figure 2

Table 1 shows how water quality rating varies with BI. Table 2 shows the average BI of each site during the collection period.

BI	Water quality rating
≥ 3.6	excellent
2.6 to 3.5	good
2.1 to 2.5	fair
1.0 to 2.0	poor

Figures adapted from Stephen C. Landry and Michele L. Tremblay, "State of the Upper Merrimack 1995–1997: A River Quality Report." ©2000 by Upper Merrimack River Local Advisory Committee.

- If an *E. coli* level of over 400 colonies formed per 100 mL of water is unsafe for swimming, on which of the following collection days and at which site would it have been unsafe to swim?
 - A. Day 1 at Site 1
 - B. Day 30 at Site 1
 - C. Day 1 at Site 2
 - D. Day 30 at Site 2

2. Based on Figures 1 and 2, consider the average water flow and the average *E. coli* level for Site 1 and Site 2 over the collection period. Which site had the higher average water flow, and which site had the higher average *E. coli* level?

	Higher water flow	Higher <i>E. coli</i> level
F.	Site 1	Site 1
G.	Site 1	Site 2
H.	Site 2	Site 1
J.	Site 2	Site 2

3. As water quality improves, the number of *stone fly larvae* (a type of aquatic invertebrate) increases. Students hypothesized that more stone fly larvae would be found at Site 1 than at Site 2. Are the data presented in Table 2 consistent with this hypothesis?

- A. Yes; based on BI, Site 1 had a water quality rating of good and Site 2 had a water quality rating of poor.
 B. Yes; based on BI, Site 1 had a water quality rating of excellent and Site 2 had a water quality rating of fair.
 C. No; based on BI, Site 1 had a water quality rating of poor and Site 2 had a water quality rating of good.
 D. No; based on BI, Site 1 had a water quality rating of fair and Site 2 had a water quality rating of excellent.

4. Which set of data best supports the claim that Site 1 has lower water quality than Site 2?

- F. Figure 1
 G. Figure 2
 H. Table 1
 J. Table 2

5. Suppose large amounts of fertilizer from adjacent fields begin to enter the river at Site 1. The BI of this site will most likely change in which of the following ways? The BI will:

- A. increase, because water quality is likely to increase.
 B. increase, because water quality is likely to decrease.
 C. decrease, because water quality is likely to increase.
 D. decrease, because water quality is likely to decrease.

Passage II

Aluminum water-based paints (AWPs) contain aluminum (Al) flakes that give surfaces a shiny, metallic appearance. If the flakes corrode, a dull coating of aluminum hydroxide forms on them:

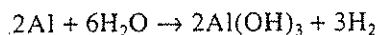


Table 1 shows the volume of H_2 gas produced over time (at 25°C and 1 atm) from 100 mL samples of freshly made AWPs 1–3 in 3 separate trials. AWPs 1–3 were identical except that each had a different concentration of DMEA, an AWP ingredient that increases pH.

AWP	pH of AWP	Volume (mL) of H_2 produced by:			
		Day 2	Day 4	Day 6	Day 8
1	8	4	33	81	133
2	9	21	187	461	760
3	10	121	1,097	2,711	4,480

The AWP 3 trial was repeated 4 times, but for each trial, the sample had the same concentration of 1 of 4 corrosion inhibitors (see Figure 1).

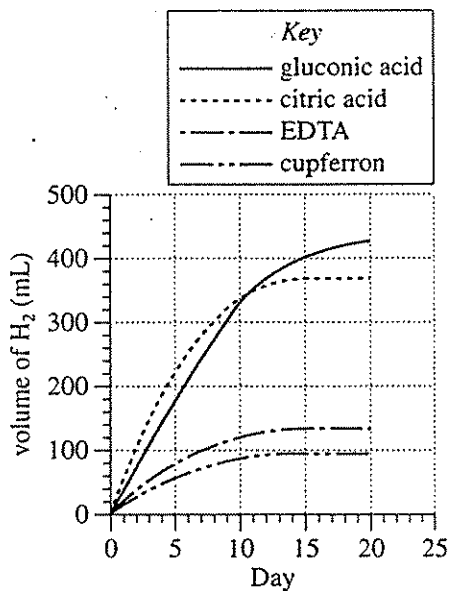
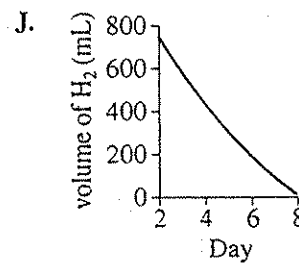
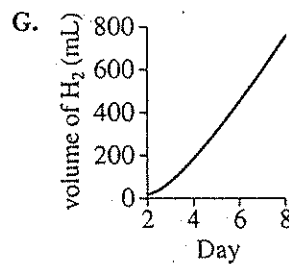
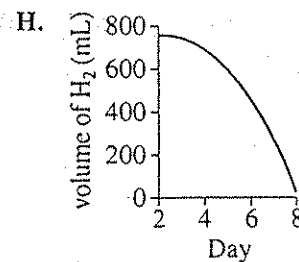
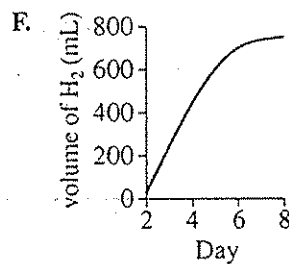


Figure 1

Figure 1 adapted from Bodo Müller, "Corrosion Inhibitors for Aluminum." ©1995 by Division of Chemical Education, Inc., American Chemical Society.

6. Based on Table 1, which of the following graphs best shows how the volume of H_2 produced by AWP 2 changed over time?



7. Based on Table 1, if the volume of H_2 produced by Day 10 from the AWP 1 sample had been measured, it would most likely have been:

- A. less than 133 mL.
 B. between 133 mL and 461 mL.
 C. between 461 mL and 760 mL.
 D. greater than 760 mL.

8. According to Table 1, what volume of H_2 was produced by AWP 1 from the time the volume was measured on Day 6 until the time the volume was measured on Day 8?

- F. 52 mL
 G. 81 mL
 H. 133 mL
 J. 214 mL



9. In the trials represented in Table 1 and Figure 1, by measuring the volume of H_2 , the experimenters were able to monitor the rate at which:
- A. H_2O is converted to Al.
 - B. Al is converted to H_2O .
 - C. Al is converted to $Al(OH)_3$.
 - D. $Al(OH)_3$ is converted to Al.
10. Consider the volume of H_2 produced by Day 2 from the AWP 3 sample that contained no corrosion inhibitor. Based on Table 1 and Figure 1, the AWP 3 sample containing EDTA produced approximately the same volume of H_2 by which of the following days?
- F. Day 1
 - G. Day 4
 - H. Day 7
 - J. Day 10

Passage III

Students studied forces by using 2 identical platform scales, Scale A and Scale B, one of which is shown in Figure 1.

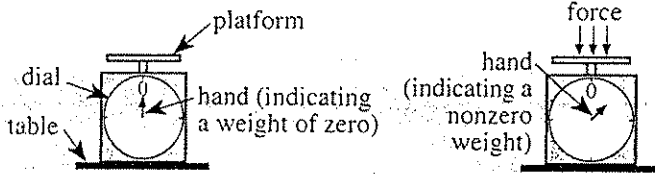


Figure 1

The weight of the platform of each scale was insignificant. When a force (such as that produced by a weight) was exerted on the surface of the platform, the hand rotated clockwise away from the zero point on the dial. The amount of rotation was directly proportional to the strength of the force.

Study 1

Prior to each of Trials 1–3, the students set the dial readings of both Scales A and B to zero. In each of these 3 trials, Scale A was stacked on top of Scale B (see Figure 2). In Trial 1, no weight was placed on the platform of Scale A; in Trial 2, a 5.0 newton (N) weight was placed on the platform of Scale A; and in Trial 3, a 10.0 N weight was placed on the platform of Scale A. The dial readings for the 3 trials are also shown in Figure 2.

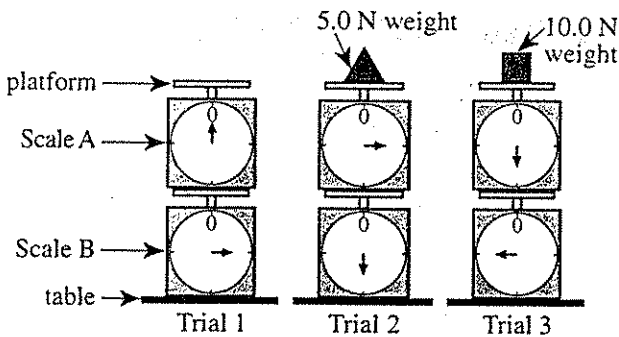


Figure 2

Study 2

The students placed a pencil on the platform of each scale and positioned on top of the pencils a board that spanned the 0.40 m distance between the 2 scales. Prior to each of Trials 4–6, the students set the dial readings of Scales A and B to zero (see Figure 3).

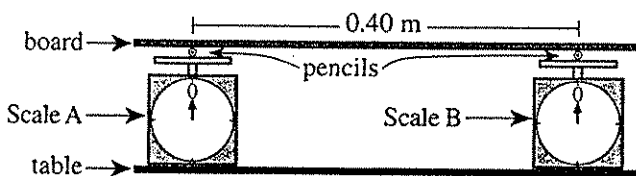
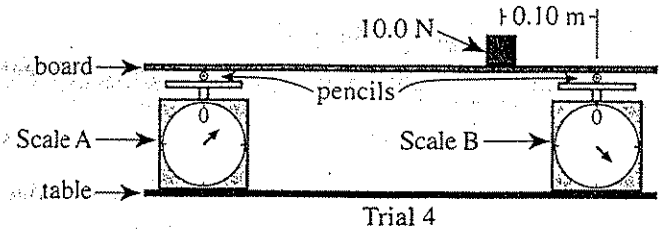
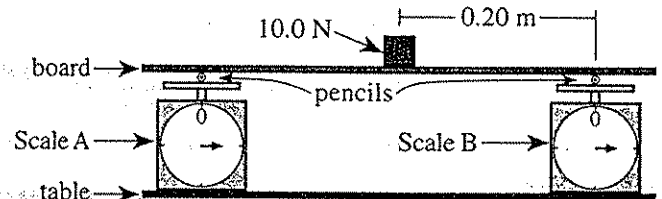


Figure 3

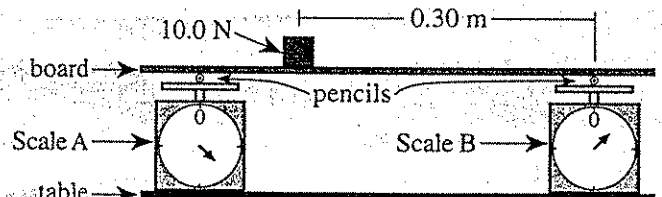
In each of these 3 trials, a 10.0 N weight was placed on the board at various distances from the pencil on Scale B (see Figure 4). In Trial 4, the weight was 0.10 m from the pencil; in Trial 5, the weight was 0.20 m from the pencil; and in Trial 6, the weight was 0.30 m from the pencil. The dial readings for the 3 trials are also shown in Figure 4.



Trial 4



Trial 5



Trial 6

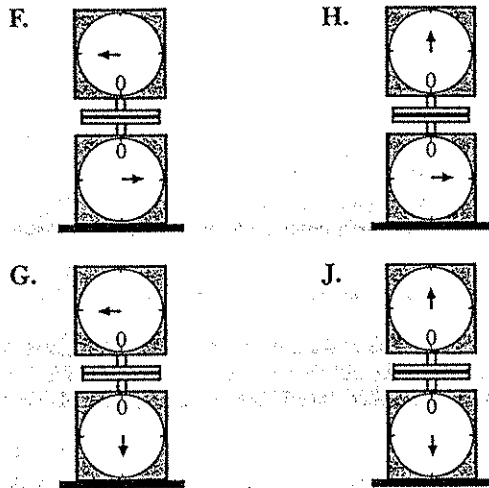
Figure 4

11. In which of the trials in Study 2, if any, was the force of the 10.0 N weight equally distributed between Scales A and B ?
 - A. Trial 4
 - B. Trial 5
 - C. Trial 6
 - D. None of the trials
12. Based on the results of Trials 1 and 2, Scale A and Scale B each weighed:
 - F. 2.5 N.
 - G. 5.0 N.
 - H. 7.5 N.
 - J. 10.0 N.

13. Assume that whenever a weight was placed on a scale's platform, a spring inside the scale was compressed. Assume also that the greater the added weight, the greater the amount of compression. Was the amount of potential energy stored in Scale A's spring greater in Trial 1 or in Trial 3?

- A. In Trial 1, because the amount of weight on the platform of Scale A was greater in Trial 1.
- B. In Trial 1, because the amount of weight on the platform of Scale A was less in Trial 1.
- C. In Trial 3, because the amount of weight on the platform of Scale A was greater in Trial 3.
- D. In Trial 3, because the amount of weight on the platform of Scale A was less in Trial 3.

14. In a new study, suppose Scale A were placed upside down atop Scale B, so that the platform of Scale A rested directly on the platform of Scale B. Which of the following drawings best represents the results that would most likely be obtained for this arrangement?



15. In Study 2, as the distance between the 10.0 N weight and the pencil on Scale B increased, the amount of force exerted on the surface of Scale B's platform:

- A. remained the same.
- B. increased only.
- C. decreased only.
- D. varied, but with no general trend.

16. Which of the following statements most likely describes an important reason for setting the dial readings of both scales to zero after Study 1, prior to each of Trials 4-6?

- F. To add the weights of the scales to each weight measurement
- G. To add the weights of the board and pencils to each weight measurement
- H. To subtract the weights of the scales from each weight measurement
- J. To subtract the weights of the board and pencils from each weight measurement

Passage IV

The *octane number* of a fuel is a measure of how smoothly the fuel burns in a gasoline engine. Lower octane fuels *knock* (explode) when burned, which lowers fuel efficiency and can cause engine damage. Heptane knocks considerably when burned and is given an octane number of 0. Isooctane knocks very little and is given an octane number of 100.

Different proportions of heptane and isooctane were mixed to obtain mixtures with octane numbers between 0 and 100 (see Table 1).

Volume of heptane (mL)	Volume of isooctane (mL)	Octane number
0	100	100
10	90	90
25	75	75
50	50	50
90	10	10
100	0	0

Experiment 1

A sample of each fuel mixture listed in Table 1 was burned in a test engine at an engine speed of 600 revolutions per minute (rpm). The number of knocks per minute was determined for each mixture. This was done so that an octane number could be assigned to any fuel by measuring its knock rate.

Experiment 2

Adding tetraethyllead (TEL) to a fuel changes its octane number. Different amounts of TEL were added to 1,000 mL samples of isooctane. Each fuel mixture was tested under the same conditions used in Experiment 1, and the measured knock rate was used to determine the octane number (see Figure 1).

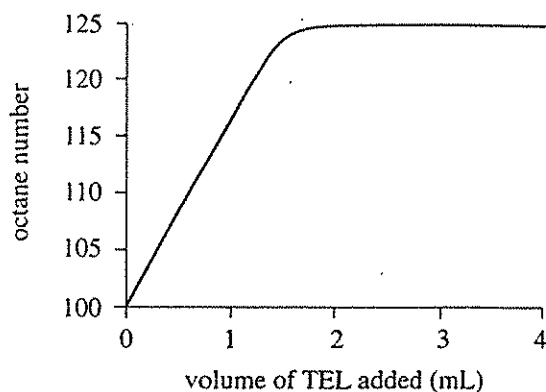


Figure 1

Experiment 3

The *engine octane requirement* (EOR) is the minimum octane number of a fuel required for an engine to operate without becoming damaged. Fuels A and B were burned separately in an engine at different speeds. Table 2 shows the octane number determined for each fuel at each engine speed and the known EOR of the engine at each speed.

Engine speed (rpm)	EOR	Octane number in engine of:	
		Fuel A	Fuel B
1,500	97.4	98.4	96.7
2,000	95.3	96.6	96.1
2,500	93.5	95.0	95.4
3,000	91.9	92.3	93.8
3,500	90.6	90.9	92.5

17. Based on Experiment 3, as engine speed increases, the minimum octane number of fuel required for an engine to operate without becoming damaged:
- increases only.
 - decreases only.
 - increases, then decreases.
 - decreases, then increases.

18. Suppose a trial had been performed in Experiment 3 at an engine speed of 2,200 rpm. At this engine speed, which of the following sets of octane numbers would most likely have been determined for Fuel A and Fuel B?

	Fuel A	Fuel B
F.	95.0	95.4
G.	96.1	95.8
H.	96.6	96.1
J.	97.6	96.4

19. Which of the following expressions is equal to the octane number of each fuel mixture listed in Table 1?

A. $\frac{\text{volume of isooctane}}{\text{volume of heptane}} \times 100$

B. $\frac{\text{volume of heptane}}{\text{volume of isooctane}} \times 100$

C. $\frac{\text{volume of isooctane}}{(\text{volume of heptane} + \text{volume of isooctane})} \times 100$

D. $\frac{\text{volume of heptane}}{(\text{volume of heptane} + \text{volume of isooctane})} \times 100$

20. Based on Table 1 and Experiment 2, if 3 mL of TEL were added to a mixture of 100 mL of heptane and 900 mL of isooctane, the octane number of the resulting fuel would most likely be:

F. less than 55.

G. between 55 and 90.

H. between 90 and 125.

J. greater than 125.

21. Which of the 2 fuels from Experiment 3 would be better to use in an engine that will run at all engine speeds between 1,500 rpm and 3,500 rpm?

A. Fuel A, because its octane number was lower than the EOR at each of the engine speeds tested.

B. Fuel A, because its octane number was higher than the EOR at each of the engine speeds tested.

C. Fuel B, because its octane number was lower than the EOR at each of the engine speeds tested.

D. Fuel B, because its octane number was higher than the EOR at each of the engine speeds tested.

22. Based on Table 1, if 2 mL of heptane were mixed with 8 mL of isooctane, the octane number of this mixture would be:

F. 2.

G. 8.

H. 20.

J. 80.

Passage V

Scientist B

Introduction

Comets are complex mixtures of ices and dust that orbit the Sun. They can be classified by orbital period as either *long-period comets* or *short-period comets*.

Long-period comets have orbital periods of more than 200 yr and originate within our solar system in the *Oort Cloud*, a spherical shell of many icy bodies located at an average distance of 40,000 A.U. from the Sun (1 A.U. = average distance of Earth from the Sun). Long-period comets approach the Sun from all directions.

Short-period comets have orbital periods of 200 yr or less, and their orbital planes have *inclinations* 30° or less with respect to the *ecliptic plane*, the plane of Earth's orbit around the Sun. Portions of these planes are shown in Figure 1.

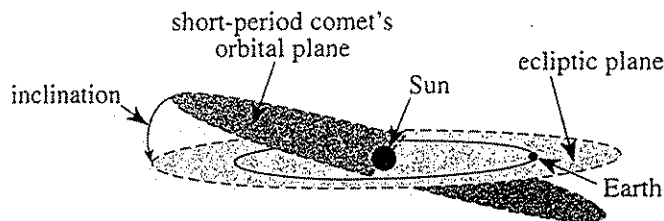


Figure 1

Two scientists present their viewpoints about the origin of short-period comets.

Scientist A

Short-period comets in our solar system originate within a thin ring-shaped region called the *Kuiper Belt* (KB). The KB has a small inclination with respect to the ecliptic plane and is located in the solar system between 30 A.U. and 50 A.U. from the Sun. The KB contains billions of icy bodies with diameters between 10 km and 30 km. These comet-size objects are too small to be clearly discerned at that distance with telescopes located on Earth's surface. Such telescopes have gathered indirect evidence, but not clear images, of much larger icy bodies that are part of the KB. The small inclinations of short-period comets' orbital planes with respect to the ecliptic plane are consistent with an origin in the KB. It has been discovered that other nearby stars have similar regions of icy bodies surrounding them.

The KB does not exist. Short-period comets were once long-period comets. Some long-period comets pass close enough to the giant planets (for example, Jupiter) to be influenced by the gravitational fields of the giant planets and are forced into orbits with orbital periods less than 200 yr. These altered orbits have orbital planes that have small inclinations with respect to the ecliptic plane. Also, most of the studied short-period comets have orbital planes with small inclinations with respect to the orbital planes of the giant planets, which, in turn, have small inclinations with respect to the ecliptic plane.

23. Which of the following generalizations about comets is most consistent with Scientist B's viewpoint?

- A. Long-period comets cannot become short-period comets.
 - B. Short-period comets cannot become long-period comets.
 - C. Long-period comets can become short-period comets.
 - D. No long-period comets or short-period comets orbit the Sun.
24. Scientist A would most likely suggest that a new telescope more powerful than previous telescopes be used to search which of the following regions of space for objects in the KB ?
- F. The region 100,000 A.U. beyond our solar system
 - G. The region 30 A.U. to 50 A.U. from the Sun at an angle of 90° with respect to the ecliptic plane
 - H. The region 30 A.U. to 50 A.U. from the Sun at angles of 0° to 30° with respect to the ecliptic plane
 - J. The region closely surrounding the planet Jupiter
25. Given the information about short-period comets in the introduction, which of the following inclinations with respect to the ecliptic plane would most likely NOT be observed for the orbital planes of short-period comets?
- A. 5°
 - B. 15°
 - C. 30°
 - D. 45°



26. According to Scientist B, which of the following planets in our solar system is most likely capable of changing the orbit of a long-period comet over time?
- F. Mercury
 - G. Earth
 - H. Mars
 - J. Saturn
27. Comet Halley currently has an orbital period of 76 yr. According to the information provided, Scientist B would most likely currently classify Comet Halley as a:
- A. short-period comet that originated in the Oort Cloud.
 - B. short-period comet that originated in the KB.
 - C. long-period comet that originated in the Oort Cloud.
 - D. long-period comet that originated in the KB.
28. Based on Scientist A's viewpoint, the "much larger icy bodies" in the KB most likely have diameters of:
- F. less than 10 km.
 - G. between 10 km and 20 km.
 - H. between 20 km and 30 km.
 - J. greater than 30 km.
29. Suppose a study of 1 nearby star revealed that it had no spherical shell of material similar to the Oort Cloud surrounding it. How would this discovery most likely affect the scientists' viewpoints, if at all?
- A. It would weaken Scientist A's viewpoint only.
 - B. It would strengthen Scientist B's viewpoint only.
 - C. It would strengthen both scientists' viewpoints.
 - D. It would have no effect on either scientist's viewpoint.

Passage VI

Tomato plants grow poorly in high-salt environments. This effect is caused by 2 processes:

- A net movement of H_2O between the cytoplasm of the plants' cells and the environment via osmosis
- An increase in the cytoplasmic Na^+ concentration

The plant *Arabidopsis thaliana* carries a gene, *AtNHX1*. The product of this gene, *VAC*, facilitates uptake of cytoplasmic Na^+ by the plant's vacuoles.

A researcher created 4 genetically identical lines of tomato plants (L1–L4). An *AtNHX1* gene from *Arabidopsis thaliana* was isolated and 2 identical copies of this gene were incorporated into L1's genome. This process was repeated with L2 and L3 using a different *AtNHX1* allele for each line, so that L1, L2, and L3 had different genotypes for *AtNHX1*. The researcher then did an experiment.

Experiment

Fifty seedlings from each of the 4 lines were grown in 10 L of nutrient solution for 80 days. The 10 L nutrient solution contained H_2O , 12 g of fertilizer, and 3 g of NaCl. The nutrient solution was replaced every 5 days. After 80 days, average height, average mass (without fruit), and average fruit mass (per plant) were measured (see Table 1).

Table 1			
3 g of NaCl/10 L nutrient solution			
Line	Height (cm)	Mass (kg)	Fruit mass (kg)
L1	124	1.2	2.1
L2	128	1.2	2.0
L3	120	1.2	2.1
L4	124	1.2	2.0

This process was repeated except the 10 L nutrient solution contained 60 g of NaCl instead of 3 g of NaCl (see Table 2).

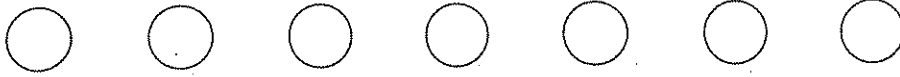
Table 2			
60 g of NaCl/10 L nutrient solution			
Line	Height (cm)	Mass (kg)	Fruit mass (kg)
L1	119	1.1	1.9
L2	121	1.1	1.9
L3	61	0.4	1.1
L4	63	0.5	1.0

The process was repeated again except the 10 L nutrient solution contained 120 g of NaCl instead of 3 g of NaCl (see Table 3).

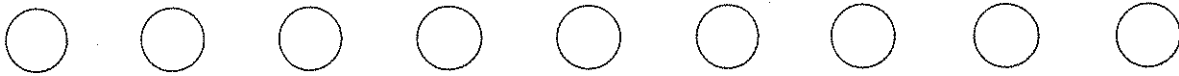
Table 3			
120 g of NaCl/10 L nutrient solution			
Line	Height (cm)	Mass (kg)	Fruit mass (kg)
L1	118	1.0	1.8
L2	115	1.0	1.7
L3	34	0.2	0
L4	36	0.3	0

Tables 1–3 adapted from Hong-Xia Zhang and Eduardo Blumwald, "Transgenic Salt-Tolerant Tomato Plants Accumulate Salt in Foliage But Not in Fruit." ©2001 by Nature Publishing Group.

30. One plant produced no fruit and had a height of 21 cm. Which of the following most likely describes this plant?
- F. It was from L2 and was grown in a 10 L nutrient solution containing 60 g of NaCl.
- G. It was from L2 and was grown in a 10 L nutrient solution containing 120 g of NaCl.
- H. It was from L4 and was grown in a 10 L nutrient solution containing 60 g of NaCl.
- J. It was from L4 and was grown in a 10 L nutrient solution containing 120 g of NaCl.
31. During osmosis, water migrates through a semipermeable barrier. The osmosis referred to in the passage occurs through which of the following structures?
- A. Chromosomes
- B. Nuclear envelope
- C. Cell membrane
- D. Rough endoplasmic reticulum



32. For each line, as the concentration of salt in the nutrient solutions increased, average plant mass:
- F. increased only.
 - G. decreased only.
 - H. increased, then decreased.
 - J. decreased, then increased.
33. Which of the following was an independent variable in the experiment?
- A. Whether a line received *AtNHX1*
 - B. Whether a tomato plant was used
 - C. Plant mass without fruit
 - D. Plant height
34. Suppose the data for all of the plants were plotted on a graph with height on the x-axis and mass (without fruit) on the y-axis. Suppose also that the best-fit line for these data was determined. Which of the following would most likely characterize the slope of this line?
- F. The line would not have a slope, because the line would be vertical.
 - G. The slope of the line would be zero.
 - H. The slope of the line would be negative.
 - J. The slope of the line would be positive.
35. The researchers included 1 of the 4 lines to serve as a control. This line was most likely which one?
- A. L1
 - B. L2
 - C. L3
 - D. L4



Passage VII

When a temperature difference (ΔT) exists between the ends of an insulated metal rod (see Figure 1), heat flows from one end of the rod to the other. ($\Delta T = T_H - T_C$, where T_H and T_C represent the temperature of the hotter end and the colder end, respectively.)

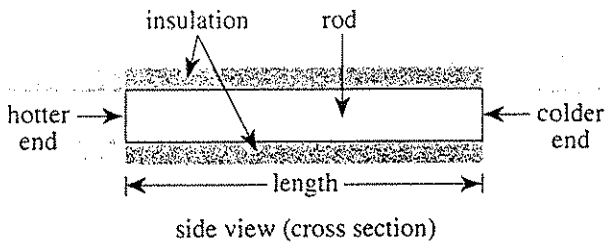


Figure 1

The rate at which heat flows is called the *heat transfer rate*, R .

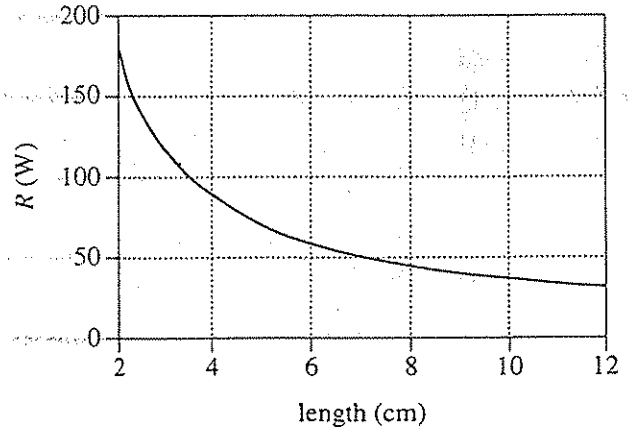


Figure 2

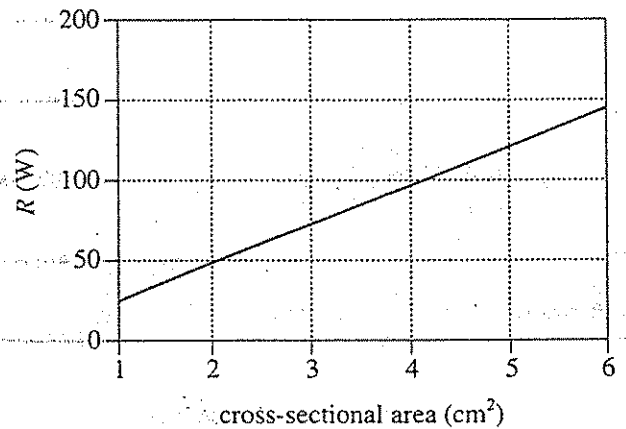


Figure 3

The following data apply to insulated copper rods. Table 1 gives R versus ΔT for a 5 cm long rod with a cross-sectional area of 3 cm^2 . In Figure 2, R is plotted against length for rods having a ΔT of 30°C and a cross-sectional area of 3 cm^2 . In Figure 3, R is plotted against cross-sectional area for 5 cm long rods with a ΔT of 30°C .

Table 1	
ΔT ($^\circ\text{C}$)	R (W^*)
10	24
20	48
30	71
40	95
50	118

*W = watt = joule/sec

36. The data in the passage best support the hypothesis that the value of R decreases as which of the following properties of insulated copper rods increases?
- F. Length
 - G. Cross-sectional area
 - H. ΔT
 - J. Radius
37. A and B are both insulated copper rods. Based on Figure 3, if B has the same length and ΔT as A, but B has double the cross-sectional area of A, the ratio of R for B to R for A will be:
- A. 1:4.
 - B. 1:2.
 - C. 2:1.
 - D. 4:1.




38. For any of the rods described in the passage, most heat is transferred between the ends of the rod by which of the following processes?

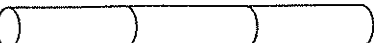
- I. Radiation
- II. Convection
- III. Conduction


- F. I only
- G. II only
- H. III only
- J. I and II only

39. Which of the following arrangements of identical insulated copper rods, all having the same ΔT between the hotter end (H) and the colder end (C), will have the highest value of R ?

A. H  C

B. H  C

C. H  C

D. H  C

40. Based on the data in the passage, which of the following pairs of temperatures at the ends of identical insulated copper rods will result in the highest value of R ?

	T_H (°C)	T_C (°C)
F.	280	250
G.	280	260
H.	300	280
J.	310	300

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.