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

The Object of Love

[1]

[A] I was waiting at the veterinarian's office recently with my cat when a young woman came in.[1] After she sat down next to me, she asked if I would mind if she took her pet iguana out of its carrier. It was just a baby, she said, and it liked being held. [B]

[2]

Now, I'm not fond of iguanas. [C] They're strange, unpredictable creatures that belong deep in a rain forest, walking on the ground[2] or resting high in the trees, which are[3] hidden in the canopy.

1. A. NO CHANGE
   B. into the veterinarian's office where I was.
   C. in, and there I was, waiting in the office.
   D. in while I was waiting there.

2. Which choice provides the most vivid description of iguanas on the floor of a rain forest?
   F. NO CHANGE
   G. scuttling through dank undergrowth
   H. living underneath the treetops
   J. moving about down low

3. A. NO CHANGE
   B. trees, they are
   C. trees,
   D. trees;

Wishing to be polite, but with reluctance in my voice, (4) I told the woman that I didn't mind. She thanked me as she popped open the plastic carrier and pulled the iguana out, onto her lap.

[3]

I guardedly examined the animal: A dinosaur-like thing, it was the size of a cat but armored in gray-green scales, with a black-striped, whiplike tail two feet long. It had a spine with tiny spikes, (5) and its muscular limbs ended with what resembled crinkly leather gloves drawn tightly over fine-boned human hands. When I looked more closely, I saw a tiny claw at the tip of each slender finger.

[4]

The woman began to pet the iguana under its chin, and the little dragon arched its neck and closed its eyes. The reptile's calmness amazed me, as did the caress that was given tenderly from the woman to her pet (6) and watched it peacefully rest. With a twinge of pity, I thought how sad it was for us (7) to lavish so much affection on something that couldn't love her back.

[5]

At that moment, the iguana slowly opened its eyes, which shone large and bright, from (8) its scaly face. [D]

Head slightly cocked, it regarded (9) me, steadily and fixedly, like a judge delivering (10) a verdict.

4. The writer is considering deleting the underlined portion. Should the underlined portion be kept or deleted?
   - **F.** Kept, because it suggests that the narrator had previously sat next to an iguana, out of its carrier, at the veterinarian's office.
   - **G.** Kept, because it emphasizes the narrator's feelings about the iguana being taken out of its carrier.
   - **H.** Deleted, because it characterizes the narrator in a manner that's inconsistent with how the narrator is characterized in the rest of the essay.
   - **J.** Deleted, because it detracts from the paragraph's purpose of providing background information about iguanas.

5. Given that all the choices are accurate, which one provides the most precise description of the pattern of spikes on the iguana's spine?
   - **A.** NO CHANGE
   - **B.** I saw spikes that looked like they were just beginning to develop,
   - **C.** There were small spikes on its armored back,
   - **D.** Rows of budding spikes lined its spine,

6. **F.** NO CHANGE
   - **G.** tenderness with which the woman caressed her pet
   - **H.** woman caressing her pet tenderly
   - **J.** tenderness the woman showed

7. **A.** NO CHANGE
   - **B.** the woman
   - **C.** people
   - **D.** you

8. **F.** NO CHANGE
   - **G.** large and bright from,
   - **H.** large, and bright from
   - **J.** large and bright from

9. Which of the following alternatives to the underlined portion would NOT be acceptable?
   - **A.** scrutinized
   - **B.** supposed
   - **C.** appraised
   - **D.** considered

10. **F.** NO CHANGE
    - **G.** having a delivery of
    - **H.** in deliverance with
    - **J.** deliver

[6]

"Who are you," it seemed to ask me, "to name the proper object of love?"

[7]

The veterinary assistant called for my cat, and me from the hallway (11) that leads to the examination area. A bit unsettled, I rose and picked up my cat carrier. As I walked from the waiting room into the hall, I glanced back and saw the iguana snuggle down into the young woman's lap, looking (12) as content as a kitten, and close its eyes again.

11. **A.** NO CHANGE
B. cat, and me from the hallway,
C. cat and me from the hallway,
D. cat and me from the hallway

12. **F.** NO CHANGE
G. like as if it was giving off the impression of being
H. appearing something like
J. sort of like it was

Questions 13 and 14 ask about the preceding passage as a whole.

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

> She told me that her iguana especially liked attention when it was in unfamiliar surroundings, and that this was its first trip to the veterinarian.

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

A. Point A in Paragraph 1.
B. Point B in Paragraph 1.
C. Point C in Paragraph 2.
D. Point D in Paragraph 5.

14. Suppose the writer's primary purpose had been to describe a moment in which a person notices something unexpected while observing his or her surroundings. Would this essay accomplish that purpose?

F. Yes, because it describes what the narrator, while waiting at the vet, perceived to be a surprising bond between a woman and her pet iguana.
G. Yes, because it recounts a moment when the narrator, while waiting at the vet, realized people often don't know when they're being impolite.
H. No, because it instead tells the story of why the narrator doesn't like iguanas.
J. No, because it instead focuses on providing information about the physical characteristics of iguanas and their habitat.

PASSAGE II

Billy Mills Takes the Gold

[1] Runner Billy Mills qualified to run in the 10,000-meter race in the 1964 Tokyo Olympics, but he was a long shot. [2] In Tokyo, however, Mills became the first to win an Olympic gold medal for the United States in this event. [3] His qualifying entry time lagged almost a full minute above the world-record time held by Australian Ron Clarke. [18]

Mills, an Oglala Lakota, spent his childhood on the Pine Ridge Reservation in South Dakota. He started long-distance running while attending boarding school in Kansas. Initially, running was part of his training regimen for boxing, his first love. Mills had dreamed of being a boxer since he was a child.

Mills broke numerous high school track records, earning himself an athletic scholarship to the University of Kansas. With Mills as a star runner, Kansas won the 1959 and 1960 NCAA Outdoor Track and Field Championships. After graduation, he became an officer in the Marines and assumed the duties of military life. However, Mills was soon drawn back to the track, and, while still in the Marines, races became part of his life again.

15. **A.** NO CHANGE
B. nonetheless,
C. in fact,
D. DELETE the underlined portion.

16. **F.** NO CHANGE
G. Olympic gold medal,
H. Olympic gold, medal,
J. Olympic, gold medal

17. **A.** NO CHANGE
B. around
C. behind
D. from

18. Which of the following sequences of sentences makes this paragraph most logical?
F. NO CHANGE
G. 1, 3, 2
H. 2, 1, 3
J. 2, 3, 1

19. **A.** NO CHANGE
B. Mills an Oglala Lakota
C. Mills an Oglala Lakota,
D. Mills, an Oglala Lakota

20. Given that all the choices are true, which one most effectively concludes this paragraph and provides a transition to the following paragraph?
F. NO CHANGE
G. Yet Mills didn't quite make it as a boxer.
H. Mills soon realized that he had greater potential as a runner than as a boxer.
J. Mills also tried playing basketball and football, although he didn't excel at them.

21. **A.** NO CHANGE
B. his talent raced back to him
C. he began racing
D. racing was in his life

At an important point in his training, Mills wrote the words "Gold Medal" in his journal. He was determined to win, despite being rather unknown as an athlete. [23] Because of his unremarkable qualifying time, the US Olympic shoe sponsor didn't even send him running shoes for the race. Luckily, Mills borrowed a pair and was ready to run when he hit the starting line. [25]

All eyes were on the overseers, Mohamed Gammoudi of Tunisia and Ron Clarke, as they began the last lap of the race. Suddenly, Mills, who had been in third place, broke from the pack, sprinted ahead, and won the race. Before a

22. Given that all the choices are accurate, which one most effectively introduces the paragraph by returning to the topic of the essay's opening paragraph?

F. NO CHANGE
G. A future inductee into the US Track and Field Hall of Fame,
H. Three weeks before the 1964 Olympics,
J. Committed to success,

23. If the writer were to delete the word *rather* from the preceding sentence, the sentence would primarily lose a word that:

A. implies that some people were already aware of Mills's talent.
B. helps describe Mills's approach to motivating himself for a race.
C. explains why Mills decided to take on the challenge of running in the Olympics.
D. emphasizes that Mills needed more training before he could win the race.

24. Which choice best emphasizes Mills's commitment to winning the gold medal?

F. NO CHANGE
G. Eventually,
H. Undeterred,
J. Concentrating,

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

> Bob Hayes, another US runner in the Tokyo Olympics, ran with a borrowed shoe after realizing he only had one of his two shoes with him; he then won the 100-meter race.

Should the writer make this addition here?

A. Yes, because it adds important details about two US track and field gold medalists in 1964.
B. Yes, because it reveals that two runners used other people's shoes to win their races.
C. No, because it shifts the essay's focus from the US track team members to their shoes.
D. No, because it interrupts the essay's discussion of Mills preparing for and running the 10,000-meter race.

26. **F.** NO CHANGE
G. rulers,
H. authorities,
J. leaders,

27. **A.** NO CHANGE
B. Mills who had been in third place,
C. Mills, who had been in third place
D. Mills who had been in third place

stunned crowd, Mills had run the 10,000 meters 45 seconds faster than his qualifying time. He set an Olympic record of 28 minutes 24 seconds, finishing ahead of Mohamed Gammoudi and Ron Clarke. As of 2014, he remained the only US runner to have won an Olympic gold medal in the 10,000-meter race.

28. F. NO CHANGE
G. has ran
H. has run
J. had ran

29. The writer is considering deleting the underlined portion (adjusting the punctuation as needed). Should the underlined portion be kept or deleted?
A. Kept, because it effectively connects the closing paragraph to the essay's opening paragraph.
B. Kept, because it adds a detail to the essay's retelling of Mills's victory.
C. Deleted, because it repeats a point already made clear by the paragraph.
D. Deleted, because it strays from the main point of the paragraph.

PASSAGE III

Hearing Is Believing

The movie scene unfolds, a boy out exploring trudges across the snow and arrives at a boarded-up house. As the lad knocks on the door, it slowly opens. Inside, dim light from a cracked and dusty window reveals an old man descending a staircase. Part of what draws an audience into scenes like this, with that in mind, is the sounds that accompany the images. The crunch, the knock, the squeak, the creak.

30. F. NO CHANGE
G. unfolds a boy,
H. unfolds. A boy
J. unfolds a boy

31. A. NO CHANGE
B. this, for the time being,
C. this, nevertheless,
D. this

In most films, such sounds are recorded after the cameras have stopped rolling, a practice named for Jack Foley, who was working in Hollywood in the late 1920s when "talkies" swept silent movies off the screen. It was Foley whom figured out that squeezing a sock full of cornstarch, a sound like that of footsteps in the snow. He put an old rocking chair to work to create the creaking of

32. Which choice best suggests that talkies swiftly and dramatically put an end to the silent-movie era?
F. NO CHANGE
G. invited the beginning of what would one day become a new era in the film industry.
H. stirred up the movie industry and delighted the general public.
J. began their entrance onto the screens of Hollywood.

33. A. NO CHANGE
B. himself whom
C. who
D. he

34. F. NO CHANGE
G. cornstarch, which makes
H. cornstarch produces
J. cornstarch to get

stairs. When a scene called for the sound of more than one person walking, Foley grabbed a cane to generate the allusion (35) of many people on foot.

35. A. NO CHANGE
B. produce the elusion
C. create the illusion
D. make the allusion

Low-budget solutions to big problems that eventually (36) earned him the status of a Hollywood legend.

36. F. NO CHANGE
G. about which they eventually
H. that eventually even so
J. eventually

Movies with sound were in their infancy at the time. (37)

37. A. NO CHANGE
B. A cane was one of the props Foley used to achieve the desired sound effects.
C. The process he pioneered is one that takes place after the actors have been filmed for the movie.
D. DELETE the underlined portion.

The need for "Foley" arises from (38) the sound clutter of real life. The job of the sound technician (whose role is distinct from that of the "Foley artist") (39) is to record dialogue without capturing all the distracting background noise. An airplane flying overhead. A phone ringing. A door. (40) Then, while viewing the film in a Foley studio: (41) a small room with a screen, a microphone, and countless props—the Foley artist re-creates the sounds of the actors' actions. It was Jack Foley who pioneered this process.

38. F. NO CHANGE
G. aroused from
H. arises
J. arise

39. If the writer were to delete the underlined portion, the essay would primarily lose information that:
A. establishes what the role of a sound technician is in making a movie.
B. clarifies the origin of the term "Foley artist."
C. indicates that various occupations were highly influenced by the work of Jack Foley.
D. reduces the chance of confusion about whether "sound technician" means "Foley artist."

40. F. NO CHANGE
G. The slamming door, which is not part of the scene.
H. The sound of a door.
J. A door slamming.

41. A. NO CHANGE
B. studio—
C. studio,
D. studio

Directors adored him. To re-create the audible ruckus of Caesar's army for the movie *Spartacus*, Foley jangled a set of keys in front of the microphone. That simple act, a Jack Foley classic, cut the movie's budget by untold (42) thousands of dollars.

42. F. NO CHANGE
G. unspeakable
H. speechless
J. endless

The director had planned to ship actors and horses, an army's worth headed to (43) a battlefield overseas to get an authentic sound recording. Instead, they all stayed home, and the audience never knew the difference. [44]

43. A. NO CHANGE
B. worth, were headed to
C. worth, to
D. worth

44. The writer is considering deleting the preceding sentence. Should the sentence be kept or deleted?
F. Kept, because it suggests that audiences eventually came to know about Foley's work.
G. Kept, because it ends the essay with a detail that suggests the impact of Foley's work on both the makers and viewers of movies.
H. Deleted, because it shifts the focus of the paragraph from Foley to the movie's director, making a weak ending to an essay about Foley.
J. Deleted, because it suggests that Foley's work was insignificant to the public.

PASSAGE IV

Talking Bacteria

In her lab at Princeton University, molecular biologist, Bonnie Bassler (45) leans over a collection of petri dishes; her face (46) illuminated by an aquamarine glow. The glow, caused by a particular species, of bacteria (47) is confirmation of a phenomenon Bassler has been investigating for years. Bacteria, the simplest forms of life, have the ability to communicate with each other.

As a student in graduate school, Bassler became intrigued with other researchers' and their (48) discoveries involving *Vibrio fischeri*; (49) a luminescent marine bacteria. Researchers found that these bacteria only begin to glow once they have formed a group. A series of experiments revealed that each bacterial cell releases an autoinducer,

45. A. NO CHANGE
B. University, molecular biologist Bonnie Bassler,
C. University, molecular biologist Bonnie Bassler
D. University molecular biologist Bonnie Bassler

46. F. NO CHANGE
G. dishes and her face is
H. dishes, her face is
J. dishes, her face

47. A. NO CHANGE
B. species, of bacteria,
C. species of bacteria,
D. species of bacteria

48. F. NO CHANGE
G. researcher's and their
H. researchers'
J. researchers

49. A. NO CHANGE
B. *fischeri* which is
C. *fischeri*,
D. *fischeri*

a type of chemical signal. A sensory protein allowed (50) other bacteria to "hear" this molecular message. Once the bacteria have released a high enough concentration of autoinducer, they (51) assemble and begin to glow. This "quorum sensing" enables the bacteria to coordinate their actions and perform their specific function.

On the contrary, (52) in her own lab, Bassler found evidence of quorum sensing in a related bacterial species called (53) *Vibrio harveyi*. She also discovered that *V. harveyi* release a second autoinducer, or AI-2. This AI-2, which Bassler has described as a chemical "trade language," makes it possible for bacteria to communicate with other species of bacteria in the same neck of the woods. (54) She found that each of the species she studied, including ones (55) that live in humans, releases AI-2.

After her 2002 discovery, Bassler began using information from her quorum-sensing studies to understand how virulent strains of bacteria found in humans communicate. (56) These disease-spreading bacteria (57) rely on quorum sensing to spread disease. Bassler is hopeful that her ongoing studies of AI-2 will enable she and her team (58) to disrupt

50. **F.** NO CHANGE
G. would have allowed
H. has allowed
J. allows

51. **A.** NO CHANGE
B. autoinducer—they
C. autoinducer. They
D. autoinducer they

52. **F.** NO CHANGE
G. Eventually,
H. Ordinarily,
J. Namely,

53. **A.** NO CHANGE
B. related, bacterial species, called
C. related, bacterial species called
D. related bacterial species called,

54. **F.** NO CHANGE
G. neighboring proximity.
H. surrounding locale.
J. vicinity.

55. Which of the following alternatives to the underlined portion would NOT be acceptable?
A. the kinds
B. species
C. those
D. them

56. **F.** NO CHANGE
G. has been communicating.
H. is communicating.
J. communicates.

57. **A.** NO CHANGE
B. bacteria that Bassler has studied
C. bacteria that live in humans
D. bacteria

58. **F.** NO CHANGE
G. her and her team
H. herself and them
J. her and them

quorum sensing [59].

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

    and ultimately develop new methods for treating bacterial infections

    Given that the information is accurate, should the writer make this addition here?

    A. Yes, because it clarifies that Bassler and her team are focusing their research on bacteria that live in humans.
    B. Yes, because it specifies how Bassler's research could directly affect humans.
    C. No, because it fails to specify which strains of bacteria are prone to attacking humans' immune systems.
    D. No, because it fails to explain how Bassler and her team plan to disrupt quorum sensing.

PASSAGE V

Mapping the London Underground

[1]

Soon after the London Underground subway lines were introduced in the late 1800s, a system for mapping these vicinities creeping beneath (60) was needed so that travelers could navigate this new mode of transportation.

As a result, early (61) maps relied on a geographically accurate scale that simply superimposed the twisting subway lines over standard maps of the city streets above. [A] These maps clearly depicted the few subway lines that extended into suburban London, but they compressed and obscured (62) the compact, heavily trafficked routes

60. F. NO CHANGE
    G. subterranean routes
    H. submerged zones
    J. low-down alleys

61. A. NO CHANGE
    B. To provide an example, early
    C. Secondly, early
    D. Early

62. Which choice is clearest and suggests the highest degree of failure of early maps to legibly depict the subway routes directly under central London?

    F. NO CHANGE
    G. in general were disappointing about
    H. made indecipherable
    J. didn't fully capture

that converged directly under central London. [63]

[2]

In the 1930s, electrical engineer Harry Beck proposed a solution that would eliminate the need for geographical accuracy. He created a map that was a scaled-down linear diagram of the subway lines. More a stylistic outline of the routes besides a [64] true-to-life sketch; it did not represent actual [65] distances between points. [B] Beck's map, modeled after electrical wiring diagrams, had a clean, grid-like structure having also color-coded routes. Focusing [66] on creating the simplest possible schema to show [67] travelers how to get from one station to another, he did away with all references to city streets above. [68]

[3]

[1] The London Passenger Transport Board, which represented the subway lines, initially resisted Beck's map. [2] Still, willing to try anything to rise subway ridership and therefore revenues, [69] a limited number of copies were printed. [70] [3] Beck's map became a huge success.

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

> Today, the Tube, as the London Underground subway is called, covers approximately 250 miles of trackway.

Should the writer make this addition here?

A. Yes, because it provides details about the London Underground that explain the significance of the subway's modern name.
B. Yes, because it suggests the need for clear, accurate maps of the expansive London Underground.
C. No, because it is only loosely related to the information about the London Underground that is provided in the first paragraph.
D. No, because it blurs the focus of the first paragraph, which is about the most recent maps of the London Underground.

64. **F.** NO CHANGE
G. than
H. instead
J. into

65. **A.** NO CHANGE
B. sketch, and it
C. sketch, it
D. sketch. It

66. **F.** NO CHANGE
G. additionally included
H. and featuring
J. and

67. **A.** NO CHANGE
B. would show
C. had shown
D. showed

68. Given that all the choices are accurate, which one gives the clearest example of how Beck created the "simplest possible schema" in his map for subway passengers?

F. NO CHANGE
G. had been irritated with the curving lines on early maps of the London Underground.
H. knew that if his map were to become popular, it had to be easy to use.
J. created a map that has iconic status today.

69. **A.** NO CHANGE
B. increase
C. enlarge
D. upend

70. **F.** NO CHANGE
G. the board printed a limited number of copies.
H. copies in a limited number were printed.
J. copies printed in a limited number.

[4] Over a million copies were in circulation within six months. [5] Board members felt that not showing relative distances between stations was too radical. [71]

[4]

For most of his life, Beck continued to make small refinements to "the diagram," as he called his map, but he retained it's (72) basic elements. [C] His deceptively simple diagrammatic approach to mapping, (73) remains standard in the field of information design not only in London but also around the world. From Sydney, Australia, to Chicago, Illinois, urban transit maps continue to model this (74) to navigate the spaces below. [D]

71. For the sake of logic and cohesion, Sentence 5 should be placed:

A. where it is now.
B. after Sentence 1.
C. after Sentence 2.
D. after Sentence 3.

72. **F.** NO CHANGE
G. their
H. its
J. its'

73. **A.** NO CHANGE
B. diagrammatic, approach to mapping,
C. diagrammatic approach to mapping
D. diagrammatic approach, to mapping,

74. **F.** NO CHANGE
G. this means Beck created, which remains standard in the field,
H. Beck's deceptively simple approach to mapping
J. Beck's innovative method

Question 75 asks about the preceding passage as a whole.

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

> Actual distances shouldn't matter to subway passengers, he believed, because they didn't have to make navigational decisions, such as choosing when to turn.

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

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

END OF TEST 1

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

MATHEMATICS TEST

60 Minutes—60 Questions

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

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

You are permitted to use a calculator on this test. You may use your calculator for any problems you choose, but some of the problems may best be done without using a calculator.

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

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

DO YOUR FIGURING HERE.

1. The top surface of a rectangular table has an area of 100 square feet and a width of 5 feet. What is the length, in feet, of the surface?

   A. 10
   B. 15
   C. 20
   D. 95
   E. 500

2. A wallet containing 2 five-dollar bills, 9 ten-dollar bills, and 5 twenty-dollar bills is found and returned to its owner. The wallet's owner will reward the finder with 1 bill drawn randomly from the wallet. What is the probability that the bill drawn will be a twenty-dollar bill?

   F. $\frac{1}{16}$
   G. $\frac{1}{10}$
   H. $\frac{1}{5}$
   J. $\frac{5}{16}$
   K. $\frac{5}{11}$

3. In his costume supplies, Elmo the clown has 4 noses, 3 pairs of lips, and 2 wigs. A clown costume consists of 1 nose, 1 pair of lips, and 1 wig. How many different clown costumes can Elmo make?

   A. 3
   B. 9
   C. 12
   D. 14
   E. 24

DO YOUR FIGURING HERE.

4. Esteban and his family are making care packages to send to children at summer camp. Each complete care package contains 5 pens, 2 notebooks, 3 envelopes, 12 cookies, and 5 candy bars. Esteban and his family have already made 7 complete care packages and the following materials remain:

3 boxes of pens (10 pens per box)

4 boxes of notebooks (5 notebooks per box)

2 boxes of envelopes (12 envelopes per box)

84 cookies

$4\frac{1}{2}$ boxes of candy bars (10 candy bars per box)

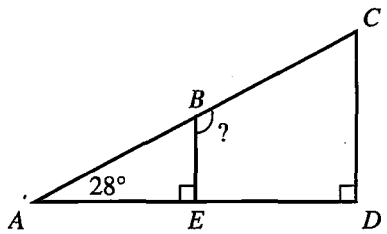
How many additional complete care packages can Esteban and his family make with the remaining materials?

F. 6
G. 7
H. 8
J. 10
K. 15

5. A formula for the volume of a right circular cone is $V = \frac{1}{3}\pi r^2 h$, where r is the radius of the base and h is the height of the cone. Using $\frac{22}{7}$ as an approximate value for π, which of the following values is closest to the volume, in cubic inches, of a cone with height 28 inches and radius 6 inches?

A. 264
B. 352
C. 1,056
D. 4,224
E. 4,928

6. In $\triangle ACD$ below, B is on $\overline{AC}$, E is on $\overline{AD}$, the measure of $\angle CAD$ is 28°, and $\overline{AD}$ is perpendicular to both $\overline{BE}$ and $\overline{CD}$. What is the measure of $\angle CBE$?



F. 104°
G. 118°
H. 124°
J. 146°
K. 152°

DO YOUR FIGURING HERE.

7. What is the sum of $0.1x^2 + 3x + 80$ and $0.5x^2 - 2x + 60$ for all x ?

A. $-0.4x^2 + 5x + 20$
B. $0.6x^2 + x + 140$
C. $0.6x^2 + 5x + 140$
D. $x^2 + 5x + 140$
E. $5.6x^2 + 140$

8. Students studying motion observed a cart rolling at a constant rate along a straight line. The table below gives the distance, d feet, the cart was from a reference point at 1-second intervals from $t = 0$ seconds to $t = 5$ seconds.

t	0	1	2	3	4	5
d	15	18	21	24	27	30

Which of the following equations represents this relationship between d and t ?

F. $d = t + 15$
G. $d = 3t + 12$
H. $d = 3t + 15$
J. $d = 15t + 3$
K. $d = 33t$

9. Dmitry bought a pair of pants at the discounted price of \$30. The original price of the pants was \$40. What was the percent of the discount?

A. 4%
B. 10%
C. 25%
D. $33\frac{1}{3}\%$
E. 75%

10. What is the value of $|-6| - |7 - 4|$?

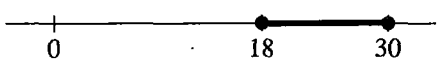
F. −40
G. −28
H. 28
J. 40
K. 54

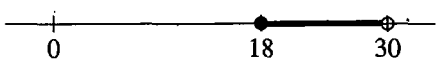
11. Samantha, Nyla, and Jerry own shares of stock in the Triumph Hotels company. The shares of stock that they own have a combined value of \$6,880. Samantha owns 70 shares, Nyla owns 50 shares, and Jerry owns 40 shares. What is the value of the shares Samantha owns?

A. \$ 98
B. \$ 301
C. \$3,010
D. \$4,816
E. \$5,351

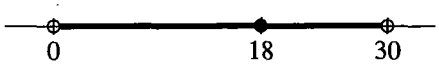
DO YOUR FIGURING HERE.

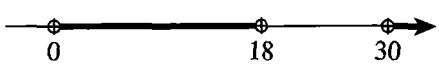
12. A new club wants to attract customers who are at least 18 but less than 30 years of age. One of the number lines below illustrates the range of ages, in years, of the customers the club wants to attract. Which number line is it?

F. 

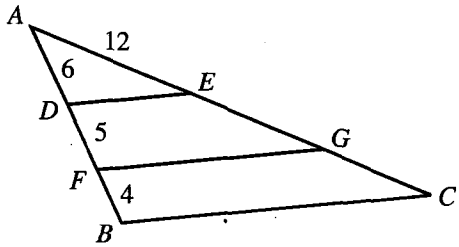
G. 

H.

J. 

K. 

13. In the figure shown below, E and G lie on $\overline{AC}$, D and F lie on $\overline{AB}$, $\overline{DE}$ and $\overline{FG}$ are parallel to $\overline{BC}$, and the given lengths are in feet. What is the length of $\overline{AC}$, in feet?



A. 9
B. 18
C. 21
D. 30
E. 36

14. Which of the following integers is closest to $\frac{\sqrt{50}}{2}$?

F. 3
G. 4
H. 5
J. 13
K. 14

15. The ratio of Jane's age to her daughter's age is 9:2. The sum of their ages is 44. How old is Jane?

A. 22
B. 33
C. 35
D. 36
E. 40

DO YOUR FIGURING HERE.

16. For the next school year, a college will use $\frac{1}{9}$ of the money in its operating budget for library books and $\frac{1}{6}$ of the money in its operating budget for scholarships. What fraction of the operating budget remains for other uses?

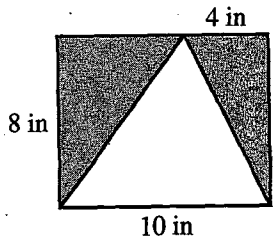
F. $\frac{1}{18}$
G. $\frac{5}{18}$
H. $\frac{13}{18}$
J. $\frac{20}{27}$
K. $\frac{8}{9}$

17. What value of x makes the proportion below true?

$$\frac{10}{10+x} = \frac{35}{42}$$

A. 2
B. 7
C. 12
D. 17
E. 32

18. The rectangle shown in the figure below is partitioned into 3 triangles, 2 of which are shaded. What is the total area, in square inches, of the 2 shaded regions?



F. 20
G. 24
H. 32
J. 40
K. 80

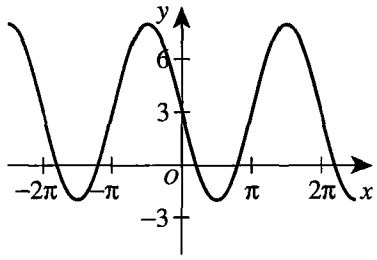
19. Which of the following ordered pairs in the standard (x,y) coordinate plane satisfies the system of inequalities below?

$$x > 2$$
$$y > 0$$
$$x + y < 5$$

A. (1,3)
B. (2,2)
C. (3,1)
D. (3,2)
E. (4,0)

DO YOUR FIGURING HERE.

20. The graph of $y = 3 - 5\sin(x - \pi)$ is shown in the standard (x,y) coordinate plane below. What is the range of y ?



F. $-5 \le y \le 5$
G. $-2 \le y \le 2$
H. $-2 \le y \le 8$
J. $3 \le y \le 8$
K. $3 \le y \le 10$

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

A. −29
B. −25
C. −19
D. 11
E. 21

22. A fabric store sells flannel and calico fabrics. Joan pays \$25 for 3 yards of flannel and 4 yards of calico. Chris pays \$11 for 1 yard of flannel and 2 yards of calico. What is the price of 1 yard of calico?

F. \$3
G. \$4
H. \$5
J. \$6
K. \$7

23. The scores given below were earned by 10 students on a recent biology test. What is the median score?

71, 94, 86, 77, 88, 94, 88, 80, 78, 94

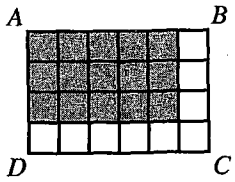
A. 85
B. 86
C. 87
D. 88
E. 91

24. A parallelogram has a perimeter of 84 inches, and 1 of its sides measures 16 inches. If it can be determined, what are the lengths, in inches, of the other 3 sides?

F. 16, 16, 36
G. 16, 18, 18
H. 16, 26, 26
J. 16, 34, 34
K. Cannot be determined from the given information

DO YOUR FIGURING HERE.

25. In the figure below, all of the small squares are equal in area, and the area of rectangle $ABCD$ is 1 square unit. Which of the following expressions represents the area, in square units, of the shaded region?



A. $\frac{1}{6} \cdot \frac{1}{4}$

B. $\frac{1}{6} \cdot \frac{3}{4}$

C. $\frac{1}{6} \cdot \frac{5}{6}$

D. $\frac{5}{6} \cdot \frac{1}{4}$

E. $\frac{5}{6} \cdot \frac{3}{4}$

26. A bag contains 16 red marbles, 7 yellow marbles, and 19 green marbles. How many additional red marbles must be added to the 42 marbles already in the bag so that the probability of randomly drawing a red marble is $\frac{3}{5}$?

F. 18
G. 23
H. 37
J. 42
K. 52

27. For all $a > 0$, which of the following expressions is equal to a^{-2} ?

A. $-2a$

B. $-a^2$

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

D. $\frac{1}{\sqrt{a}}$

E. $\frac{1}{a^2}$

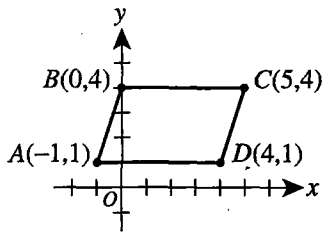
28. Jamie claims, "If a triangle is in Set A, then it is not isosceles." Later, Jamie discovers that $\triangle MNP$ is a counterexample proving this claim false. Which of the following statements *must* be true about $\triangle MNP$?

F. It is isosceles and in Set A.
G. It is scalene and in Set A.
H. It is obtuse and not in Set A.
J. It is scalene and not in Set A.
K. It is isosceles and not in Set A.

DO YOUR FIGURING HERE.

Use the following information to answer questions 29–32.

Parallelogram $ABCD$ is graphed in the standard (x,y) coordinate plane below. Sides $\overline{AB}$ and $\overline{CD}$ are each $\sqrt{10}$ coordinate units long. Sides $\overline{AD}$ and $\overline{BC}$ are each 5 coordinate units long. The distance between $\overline{AD}$ and $\overline{BC}$ is 3 coordinate units.



29. What is the area, in square coordinate units, of $ABCD$?

A. 5
B. 7.5
C. 10
D. 15
E. 20

30. What is the distance, in coordinate units, from B to D ?

F. 3
G. 4
H. 5
J. 7
K. 8

31. What is the slope of $\overleftrightarrow{BC}$?

A. 0
B. 1
C. 4
D. 5
E. Undefined

32. Parallelogram $ABCD$ will be reflected over the y-axis. What will be the coordinates of the image of A ?

F. (−4, 1)
G. (−1,−1)
H. (1,−1)
J. (1, 1)
K. (4,−1)

---

33. Which of the following is equivalent to $8^2 \cdot 4^{0.5}$?

A. 2^7
B. $4^{4.5}$
C. $8^{2.5}$
D. 16^2
E. 32

DO YOUR FIGURING HERE.

34. A school admissions office accepts 2 out of every 7 applicants. Given that the school accepted 630 students, how many applicants were NOT accepted?

F. 140
G. 180
H. 490
J. 1,260
K. 1,575

35. What is the value of $\log_2 \sqrt{8}$?

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

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

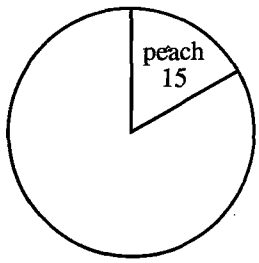
C. $\sqrt{2}$

D. 1

E. 3

36. Jie asked 90 students to choose 1 favorite fruit from 4 options. Jie has begun to represent the results in the circle graph below. Peaches were chosen as the favorite of 15 students. Apples, bananas, and strawberries were each chosen as favorites by an equal number of the remaining students. What must be the measure of the central angle in the circle graph for bananas?

Favorite Fruit



F. 100°
G. 102°
H. 105°
J. 112.5°
K. 115°

37. For all real numbers x such that $x \neq 0$, $\frac{4}{5} + \frac{7}{x} = ?$

A. $\frac{11}{5x}$

B. $\frac{28}{5x}$

C. $\frac{11}{5+x}$

D. $\frac{7x+20}{5+x}$

E. $\frac{4x+35}{5x}$

DO YOUR FIGURING HERE.

Use the following information to answer questions 38–40.

The Harrisburg Recreation Center recently changed its hours to open 1 hour later and close 3 hours later than it had previously. Residents of Harrisburg age 16 or older were given a survey, and 560 residents replied. The survey asked each resident his or her student status (high school, college, or nonstudent) and what he or she thought about the change in hours (approve, disapprove, or no opinion). The results are summarized in the table below.

Student status	Approve	Disapprove	No opinion
High school	30	4	11
College	14	10	6
Nonstudent	85	353	47
Total	129	367	64

38. What fraction of these nonstudent residents replied that they disapproved of the change in hours?

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

G. $\frac{4}{45}$

H. $\frac{14}{75}$

J. $\frac{353}{367}$

K. $\frac{353}{485}$

39. Suppose a person will be chosen at random from these 560 residents. Which of the following values is closest to the probability that the person chosen will NOT be a high school student and will NOT have replied with no opinion?

A. 0.06
B. 0.09
C. 0.44
D. 0.83
E. 0.98

40. After constructing the table, it was discovered that the student status of 15 residents who replied that they approved had been incorrectly classified as nonstudents. After correcting the errors, exactly 60% of the college students had replied that they approved. To the nearest 1%, what percent of high school students replied that they approved?

F. 60%
G. 67%
H. 70%
J. 75%
K. 82%

DO YOUR FIGURING HERE.

41. Set A and Set B each consist of 5 distinct numbers. The 2 sets contain identical numbers with the exception of the number with the least value in each set. The number with the least value in Set B is greater than the number with the least value in Set A. The value of which of the following measures *must* be greater for Set B than for Set A ?

A. Mean only
B. Median only
C. Mode only
D. Mean and median only
E. Mean, median, and mode

42. For all x such that $0 \le x \le 90$, which of the following expressions is NOT equal to $\sin x°$?

F. $-\sin(-x°)$

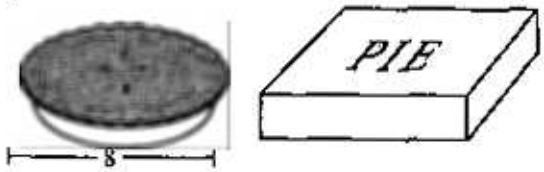
G. $\sin(-x°)$

H. $\cos(90 - x)°$

J. $\cos(x - 90)°$

K. $\sqrt{1 - (\cos x°)^2}$

43. A 3-inch-tall rectangular box with a square base is constructed to hold a circular pie that has a diameter of 8 inches. Both are shown below. What is the volume, in cubic inches, of the smallest such box that can hold this pie?



A. 24
B. 64
C. 72
D. 192
E. 512

44. Quadrilateral $ABCD$ is shown in the figure below with the lengths of the 4 sides given in meters. The measure of $\angle C$ is 90°. What is $\tan A$?

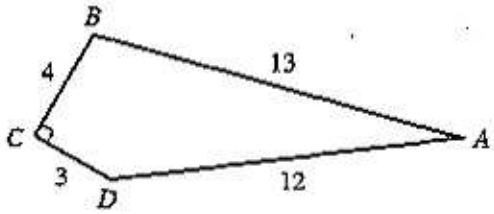
F. $\frac{4}{12}$

G. $\frac{5}{12}$

H. $\frac{4}{13}$

J. $\frac{5}{13}$

K. $\frac{12}{13}$

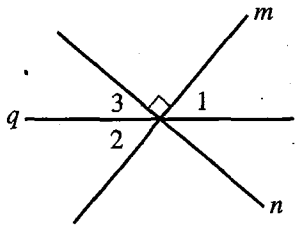


DO YOUR FIGURING HERE.

45. Given today is Tuesday, what day of the week was it 200 days ago?

A. Monday
B. Tuesday
C. Wednesday
D. Friday
E. Saturday

46. In the figure below, line m is perpendicular to line n, and both lines intersect line q at the same point. The measure of $\angle 1$ is $(3x - 10)°$, and the measure of $\angle 2$ is $(2x + 10)°$. What is the measure of $\angle 3$?



F. 36°
G. 40°
H. 44°
J. 45°
K. 54°

47. The greatest common factor of 2 whole numbers is 10. The least common multiple of these same 2 numbers is 120. What are the 2 numbers?

A. 6 and 20
B. 10 and 12
C. 10 and 20
D. 20 and 60
E. 30 and 40

48. The side lengths of a certain triangle are 4, 5, and 7 centimeters. Which of the following descriptions best classifies this triangle?

F. Scalene acute
G. Scalene right
H. Scalene obtuse
J. Isosceles obtuse
K. Isosceles right

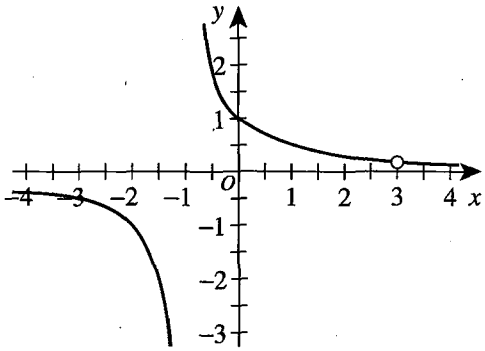
49. A professional baseball team will play 1 game Saturday and 1 game Sunday. A sportswriter estimates the team has a 60% chance of winning on Saturday but only a 35% chance of winning on Sunday. Using the sportswriter's estimates, what is the probability that the team will *lose* both games?

(Note: Neither game can result in a tie.)

A. 14%
B. 21%
C. 25%
D. 26%
E. 39%

DO YOUR FIGURING HERE.

50. The graph of $f(x) = \dfrac{x-3}{x^2-2x-3}$ is shown below. What is the domain of $f(x)$?



F. $\{x \mid x \neq -1\}$
G. $\{x \mid x \neq 2\}$
H. $\{x \mid x \neq 3\}$
J. $\{x \mid x \neq -1 \text{ and } x \neq 3\}$
K. $\{x \mid x \neq 0 \text{ and } x \neq 2\}$

51. Get-A-Great-Read Books is adding a new phone line. The phone company says that the first 3 digits of the phone number must be 555, but the remaining 4 digits, where each digit is a digit from 0 through 9, can be chosen by Get-A-Great-Read Books. How many phone numbers are possible?

A. $5(9^4)$
B. $5^3(9^4)$
C. $5^3(10^4)$
D. 9^4
E. 10^4

52. In the standard (x,y) coordinate plane, the circle centered at (1,3) that passes through (4,7) is the set of all points that are:

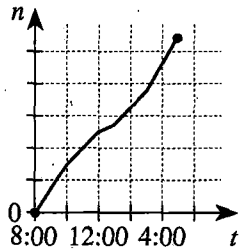
F. 5 coordinate units from (1,3).
G. 5 coordinate units from both (1,3) and (4,7).
H. 5 coordinate units from the line segment with endpoints (1,3) and (4,7).
J. equidistant from (1,3) and (4,7).
K. equidistant from the line segment with endpoints (1,3) and (4,7).

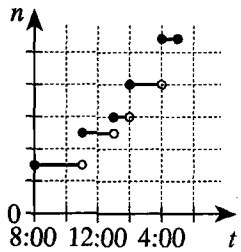
53. Which of the following values is the x-coordinate of the point in the standard (x,y) coordinate plane where the graph of the line $y = 7$ intersects the graph of the function $y = \ln(x-2) + 3$?

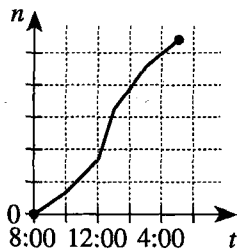
A. 6
B. $e^4 + 2$
C. $4e + 2$
D. $\ln(4) + 2$
E. $\ln(5) + 3$

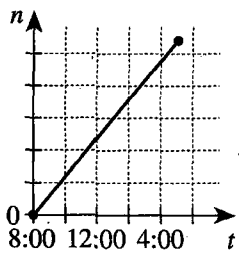
DO YOUR FIGURING HERE.

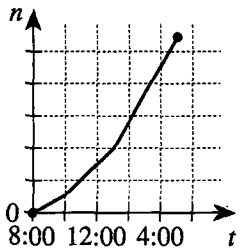
54. Three copy machines—A, B, and C—copy at the same rate and will all be used to make copies of a report. At 8:00 a.m., all 3 machines begin copying. Machine A breaks down at 10:00 a.m. and is back in service at 1:00 p.m. Machine B breaks down at 12:00 p.m. (noon) and begins copying again at 3:00 p.m. All 3 machines finish copying at 5:00 p.m. when the copying of the report is complete. One of the following graphs shows n, the number of copies made, as a function of t, the time at any given point during the copying. Which graph is it?

F.


J.


G.


K.


H.


55. A sporting-goods store sells baseball caps for $22 each. At this price, 40 caps are sold per week. For every $1 decrease in price, the store will sell 4 more caps per week. The store will adjust the price to maximize revenue. What will be the maximum possible revenue for 1 week?

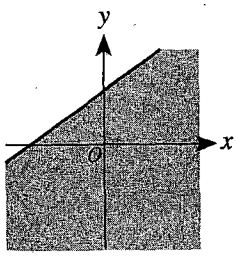
(Note: The revenue equals the number of caps sold times the price per cap.)

A. $ 880
B. $ 882
C. $ 924
D. $ 960
E. $1,024

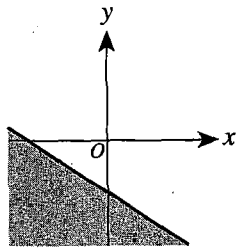
DO YOUR FIGURING HERE.

56. Each of the following graphs in the standard (x,y) coordinate plane has the same scale on both axes. One graph is the graph of $ax + by \leq c$, where $0 < a < b < c$. Which one is it?

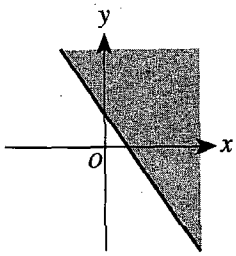
F.



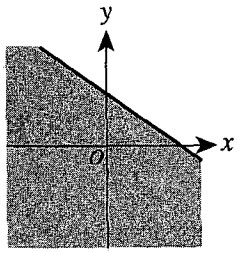
J.



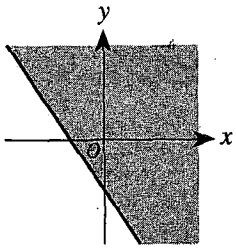
G.



K.



H.



57. The art club designed and made banners of the school colors, blue and white, for their fund-raiser. Each banner required $\frac{1}{4}$ yard of blue material and $\frac{3}{8}$ yard of white material. The club originally planned to purchase exactly enough material to make 500 banners, but found the material to be cheaper if purchased in full bolts—the blue material in 10-yard bolts and the white material in 12-yard bolts. How many extra banners was the club able to make if they purchased enough full bolts to make at least 500 banners?

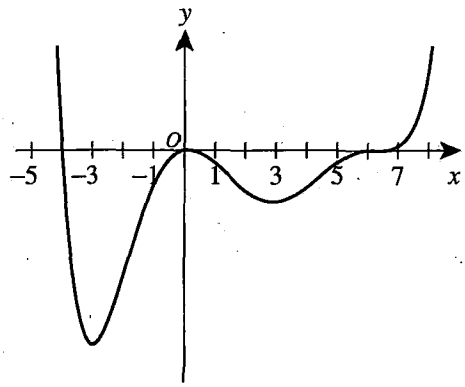
A. 12
B. 13
C. 15
D. 16
E. 20

DO YOUR FIGURING HERE.

58. For all real numbers x and the imaginary number i, which of the following expressions is equivalent to $(x-3i)^3$?

F. $x^3 - 9x^2i - 27x + 27i$
G. $x^3 + 9x^2i - 27x - 27i$
H. $x^3 + 3x^2i - 9x - 27i$
J. $x^3 - 3x^2i - 9x + 27i$
K. $x^3 + 27i$

59. The graph in the standard (x,y) coordinate plane below is the graph of one of the following functions. Which one?



A. $g(x) = x(x-6)(x+4)$
B. $h(x) = x^2(x+6)(x-4)$
C. $n(x) = x^2(x+6)^3(x-4)$
D. $p(x) = x^2(x-6)^3(x+4)$
E. $q(x) = x^3(x-6)^2(x+4)$

60. The table below shows the numbers of rows and columns in each of 5 matrices.

Matrix	Number of rows	Number of columns
A	m	n
B	m	m
C	k	n
D	m	k
E	n	m

For distinct values of k, m, and n, which of the following matrix products is NOT possible?

F. ED
G. DC
H. CE
J. AE
K. AC

END OF TEST 2

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

DO NOT RETURN TO THE PREVIOUS TEST.

READING TEST

35 Minutes—40 Questions

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

Passage I

LITERARY NARRATIVE: Passage A is adapted from the short story "Leaving Memphis" by Lauren Birden (©2008 by Narrative Magazine, Inc.). Passage B is adapted from the short story "Mandarins" by Ryunosuke Akutagawa (©2006 by Fiction, Inc.).

Passage A by Lauren Birden

You see her first in the Memphis bus station on a two-hour layover. You pretend you haven't because she looks ready to talk. "Stonewashed jeans," you think, watching her tap her platform sandals at the front of the boarding line. When she catches you staring, you pull your lips tight and stare at the floor in front of her. She starts toward you anyway. She plops down in the hard plastic seat next to you, moving her purse to her lap. You motion to your open novel and shrug as if to say, "Can't stop now," but she asks, "Where you from?" and now you can't shake her.

You're not a bad person. You just wish Greyhound assigned seating. It's not the straw-blond hair teased up around her face, not even the sad, neglected teeth that make you want to turn off the overhead reading lamp and smile at her in the dark. "I have a sneaking suspicion that we're the same person," she says, and you say, "That's funny," because you know you've been inventing yourself this whole time. She smiles and waits for you to agree how similar the two of you are.

She tells you about the man she's taking the bus to see. "Left for a construction job in Palm Beach. Says my eyes are as blue as the Atlantic Ocean, and he can't bear to look at the thing but one more time if I'm not there with him. You can't trust a man with a gun or a heart, but he swears he loves me." She waits for you to tell her of a better love. You can't think of a story to compare.

She says, "We're the same person." She's waiting for you to tell her yes, that you both have had the same heartache and know about scars and love the same. But you're thinking at the window again as a radio tower passes that reminds you of the Eiffel Tower.

Firefly porch lights are perched, fat and throbbing, outside every occasional home you pass. You say, "You know, you're so very right," and then, nothing more. The woman resigns herself to turning away in the quiet. You're telling the truth for once.

Passage B by Ryunosuke Akutagawa

Evening was falling one cloud-covered winter's day, as I boarded a Tokyo-bound train departing from Yokosuka. I found a seat in the corner, sat down, and leaned my head back against the window frame, half-consciously watching for the station to recede slowly into the distance. But then I heard coming from the ticket-gate the clattering of dry-weather clogs, followed immediately by the cursing of the conductor. The door of the second-class carriage was flung open, and a 13- or 14-year-old girl came bursting in.

At that moment, with a shudder, the train began to lumber slowly forward. I raised my eyes to look for the first time at the girl seated now on the opposite side. She wore her lusterless hair drawn up into a bun, in the traditional shape of a gingko leaf. Apparently from constant rubbing of her nose and mouth with the back of her hand, her cheeks were chapped and red. A grimy woolen scarf of yellowish green hung loosely down to her knees, on which she held a large bundle wrapped in cloth. To blot her existence, I took out my newspaper, and began to read.

The girl feverishly endeavored to open the window, the glass apparently proving to be too heavy for her. Gazing coldly at her desperate struggle as she fought with chilled hands, I hoped that she would fail, and at that very moment, the window at last came down with a thud. I would surely have barked at this unknown girl to reclose the window, had it not been for the outside view, which was now growing ever brighter, and for the smell, borne in on the cold air, of earth, dry grass, and water.

Just then I saw standing behind the barrier of a desolate crossing three red-cheeked boys. Looking up to see the train as it passed, they raised their hands as one and let out with all the strength of their young voices a high pitched cheer. And at that instant the girl, the full upper half of her body leaning out of the window, abruptly extended her hands and began moving them briskly left and right. Five or six mandarin oranges, radiating the color of the warm sun and filling my heart with sudden joy, descended on the children standing there to greet the passing train.

I knew immediately the meaning of it all. This girl, perhaps leaving home now to go into service as a

maid or an apprentice, had been carrying in her bundle these oranges and tossed them to her younger brothers
85 as a token of gratitude for coming to see her off.

Elated, I raised my head and gazed at the girl with very different eyes. For the first time I was able to forget, at least for a moment, my unspeakable fatigue and this tedious life.

Questions 1–3 ask about Passage A.

1. Which of the following questions is specifically answered in Passage A?
   A. Why is the character referred to as "you" leaving Memphis?
   B. Why is the blond woman traveling to Palm Beach?
   C. What is the blond woman thinking about at the end of the passage?
   D. Where is the blond woman from originally?

2. As they are used in line 24, what do the words *the thing* refer to?
   F. A construction job
   G. The blond woman's eyes
   H. The Atlantic Ocean
   J. A bus

3. As it is used in line 35, the phrase "every occasional home" most nearly suggests that on the bus trip, the main characters of Passage A are passing through an area in which:
   A. the porches of some homes intermittently glow from the light of fireflies.
   B. most homes do not have a porch light on.
   C. particularly large and bright fireflies swarm around a few of the homes.
   D. the few homes built there are situated far apart.

Questions 4–7 ask about Passage B.

4. Throughout Passage B, the girl's reaction to the narrator is to:
   F. pay no attention to him.
   G. engage him in conversation.
   H. view him as an annoying intruder.
   J. express surprise to discover she's not alone.

5. The narrator of Passage B hopes that the girl will fail at opening the window. Based on Passage B as a whole, this hope most strongly captures the:
   A. girl's helplessness and her uncertain future.
   B. narrator's typical foul mood and dark state of mind.
   C. three young boys' pleasure in seeing their sister off.
   D. train conductor's impatience with the girl's behavior.

6. It can most reasonably be inferred from Passage B that the girl frantically tries to open the window because she needs to:
   F. be able to throw oranges to her brothers.
   G. prove to herself that she would be able to open the heavy window in an emergency.
   H. create space between herself and the narrator.
   J. freshen the stagnant air in the train with a cool breeze.

7. In Passage B, which of the following pairs of actions most clearly cues the narrator that someone is about to board the train at the last minute?
   A. The cursing of the conductor and the screech of the train's brakes
   B. The bursting open of the second-class-carriage door and the rustle of paper parcels
   C. The clattering of clogs and the cursing of the conductor
   D. The shouting of a young girl and the clattering of clogs

Questions 8–10 ask about both passages.

8. Which of the following elements is most clearly similar in the two passages?
   F. The occasional use of the second person point of view
   G. The time period in which each passage is set
   H. The inclusion of key bits of dialogue between characters
   J. The situational premise of the plot

9. Among the characters in both passages, which one is portrayed as being most interested in having a conversation?
   A. "You"
   B. The 13- or 14-year-old girl
   C. The narrator of Passage B
   D. The blond woman

10. Which of the following statements best describes how both "you" of Passage A and the narrator of Passage B react when they first see the blond woman and the young girl, respectively?
   F. They consider the other character to be somewhat pitiful looking.
   G. They are angry that the other character has delayed their departure.
   H. They are surprised by the other character's reason for traveling.
   J. They believe the other character is enviable because life seems so easy for her.

Passage II

SOCIAL SCIENCE: This passage is adapted from the article "Travels with R.L.S." by James Campbell (©2000 by The New York Times Company).

Robert Louis Stevenson (1850–1894) preferred to circumnavigate civilization, with its increasing reliance on contraptions, and steer toward the rougher fringes. He self-consciously turned his back on the Victorian idol, progress. In similar spirit, he chose the past more often than the present as a setting for fiction. His most popular novels—*Treasure Island*, *Kidnapped*, *The Master of Ballantrae*—are set in a semimythical realm, where the fire of adventure catches on every page. Stevenson loved the sound of clashing swords; he didn't want them getting tangled up in telephone wires overhead.

Stevenson, though, was destined to be a modern man. He was born into a Scottish family of civil engineers, esteemed for its technological genius. His grandfather, also Robert, was Britain's greatest builder of lighthouses, and his graceful towers continue to guide sailors today. Three of Robert's sons followed him into the profession, including Robert Louis Stevenson's father, Thomas, who made his own mark in the field of optics—his louvre-boarded screens for the protection of thermometers are still in use today.

It was expected that Robert Louis would enter the family business in turn, and a great wringing of hands greeted his announcement to the contrary. He told his father that he wanted to be a writer, which Thomas Stevenson regarded as no profession at all. We can imagine the consternation when Stevenson's letters arrived bearing pleas such as "Take me as I am . . . I *must* be a bit of a vagabond." And a vagabond was precisely what he set out to be: longhaired, careless about food, walking through France or planning an epic ocean voyage, a far cry from the offices of D. & T. Stevenson, Engineers. He was forging the template for generations of college-educated adventurers to come. "I travel not to go anywhere, but to go," he wrote in *Travels With a Donkey* (1879). "I travel for travel's sake. The great affair is to move."

Stevenson would not be an engineer, but he left his own lights, in Scotland and across the world, by which it is possible to trace his unceasing movement. No other writer, surely, is as much memorialized by the words "lived here" as he is. There are five houses with Stevenson associations in Edinburgh alone, not to mention the little schoolhouse he attended as a child and the lavish gardens opposite the family home in Heriot Row, where he played and, the fanciful will have you believe, first acted out the quest for Treasure Island. I have shadowed Stevenson up to the northeast of Scotland, where he tried his hand at being an apprentice engineer, back down to the Hawes Inn at South Queensferry, where David Balfour is tricked into going to sea in *Kidnapped*. There are landmarks in Switzerland, France and on the Pacific Islands where the adventure of his final years took place.

Recently, I stumbled across Abernethy House where Stevenson lived briefly in London when he was 23. It stands in a secluded corner of Hampstead, high up on a hill, and separated from foggy London by farms and heath. It was while standing on Hampstead Hill one night that he gazed down on London and imagined a technological miracle of the future, "when in a moment, in the twinkling of an eye, the design of the monstrous city flashes into vision—a glittering hieroglyph." He is anticipating the effects of electricity and a time when the streetlamps would be lighted "not one by one" by the faithful old lamplighter, but all at once, by the touch of a button. Not for him improvements in optics; give him the flickering gas lamp and the "skirts of civilization" any day.

Lamps occur frequently in Stevenson's writing. There are the essays "A Plea for Gas Lamps" and "The Lantern Bearers," and his poem for children, "The Lamplighter," which celebrates an old custom: "For we are very lucky, with a lamp before the door, / And Leerie stops to light it as he lights so many more." Then there is his memoir in which he describes how, when a child and sick, his nurse would take him to the window, "whence I might look forth into the blue night starred with street lamps, and see where the gas still burned behind the windows of other sickrooms." And the lights shine again, with a subdued glow, in the obituary he wrote of his father. Thomas Stevenson's name may not have been widely known, yet "all the time, his lights were in every part of the world, guiding the mariner."

A year later, Stevenson chartered a schooner and became a mariner himself, sailing circuitously through the South Seas. He had, in a sense, entered the family business at last.

11. As it is used in line 3, the phrase "the rougher fringes" most nearly means the same as which of the following phrases?

A. "The fire of adventure" (line 9)
B. "An epic ocean voyage" (lines 32–33)
C. "A glittering hieroglyph" (line 64)
D. "Skirts of civilization" (lines 69–70)

12. It can reasonably be concluded that the passage author is a credible source of biographical information about Stevenson because the passage author:

F. traveled to several towns and countries where Stevenson lived and worked to research him.
G. has read Stevenson's two most popular novels, *Kidnapped* and *Treasure Island*.
H. worked for a time in the offices of D. & T. Stevenson, Engineers, as Stevenson had.
J. comes from Edinburgh, where the adventure of Stevenson's final years took place.

13. The main idea of the second paragraph (lines 13–22) is that:
    A. Stevenson's grandfather insisted his sons become educated in civil engineering.
    B. Stevenson was a modern man whose engineering talents were suppressed by his desire to be a writer.
    C. Stevenson's father earned greater esteem for his louvre-boarded screens than Stevenson's grandfather did for his lighthouses.
    D. Stevenson was the grandson, son, and nephew of men respected for their technological genius.

14. The main idea of the fifth paragraph (lines 56–70) is that:
    F. the plot of one of Stevenson's books was inspired by his vision of electric lights in London.
    G. Stevenson envisioned the use of electric streetlights in London before they became reality.
    H. Stevenson longed for a time when electricity would replace flickering gas lamps.
    J. Stevenson realized that his father's improvements in optics would become the "technological miracle of the future."

15. According to the passage, which of the professions listed below did Stevenson enter into?
    I. Apprentice engineer
    II. Lamplighter
    III. Mariner
    IV. Writer
    V. Builder
    A. IV only
    B. I, II, and IV only
    C. I, III, and IV only
    D. III, IV, and V only

16. The passage author most likely uses the description in lines 10–12 in order to:
    F. emphasize how little technological progress had taken place during Stevenson's lifetime.
    G. stress that Stevenson was increasingly dependent on modern inventions.
    H. create a visual image that helps make Stevenson's opinion about progress more vivid.
    J. illustrate that Stevenson was an avid sword fighter.

17. As it is used in line 24, the phrase "a great wringing of hands" most nearly refers to the Stevenson family's:
    A. dismay over Stevenson's announcement that he wasn't joining the family business.
    B. disapproval of Stevenson's slovenly appearance and poor diet.
    C. humiliation at Stevenson publicly renouncing the family business in favor of traveling.
    D. consternation at receiving Stevenson's letters pleading to have his family accept his choice.

18. It can most reasonably be inferred from the passage that as a traveler, Stevenson:
    F. thought reaching the destination was what made the trip worthwhile.
    G. encouraged other young men to take up traveling rather than pursue an education.
    H. was searching for a model for the character David Balfour in *Kidnapped*.
    J. was happiest when he was on an adventure with no itinerary.

19. As it is used in line 56, the phrase *stumbled across* most nearly means:
    A. found by accident.
    B. staggered toward.
    C. unearthed.
    D. tripped over.

20. According to the passage, at the time of his death, Thomas Stevenson was:
    F. estranged from Robert Louis, who had refused to join the family business.
    G. unaware that his name would become associated with lighthouses.
    H. more famous than his son, who was by that time a popular author.
    J. not widely known himself, but the results of his work were familiar the world over.

Passage III

HUMANITIES: This passage is adapted from the article "Proceed with Caution: Using Native American Folktales in the Classroom" by Debbie Reese (©2007 by the National Council of Teachers of English).

Traditional stories include myths, legends, and folktales rooted in the oral storytelling traditions of a given people. Through story, people pass their religious beliefs, customs, history, lifestyle, language, values, and the places they hold sacred from one generation to the next. As such, stories and their telling are more than simple entertainment. They matter—in significant ways—to the well-being of the communities from which they originate. Acclaimed Laguna Pueblo writer Leslie Marmon Silko writes that the oral narrative, or story, was the medium by which the Pueblo people transmitted "an entire culture, a worldview complete with proven strategies for survival." In her discussion of hunting stories, she says:

> These accounts contained information of critical importance about the behavior and migration patterns of mule deer. Hunting stories carefully described key landmarks and locations of fresh water. Thus, a deer-hunt story might also serve as a map. Lost travelers and lost piñon-nut gatherers have been saved by sighting a rock formation they recognize only because they once heard a hunting story describing this rock formation.

Similarly, children's book author Joseph Bruchac writes,

> . . . rather than being 'mere myths,' with 'myth' being used in the pejorative sense of 'untruth,' those ancient traditional tales were a distillation of the deep knowledge held by the many Native American nations about the workings of the world around them.

Thus, storytelling is a means of passing along information, but it does not mean there is only one correct version of any given story. During a telling, listeners can speak up if they feel an important fact or detail was omitted, or want to offer a different version of the story. In this way, the people seek or arrive at a communal truth rather than an absolute truth. A storyteller may revise a story according to his or her own interpretation, or according to the knowledge of the audience, but in order for it to be acceptable to the group from which the story originated, it should remain true to the spirit and content of the original.

Traditional stories originate from a specific people, and we expect them to accurately reflect those people, but do they? As a Pueblo Indian woman, I wonder, what do our stories look like when they are retold outside our communities, in picture book format, and marketed as "Native American folktales" for children? Are our religious, cultural, and social values presented accurately? Are children who read these folktales learning anything useful about us?

Much of what I bring to bear on my research emanates from my cultural lens and identity as a Pueblo Indian woman from Nambe Pueblo. I was born at the Indian hospital in Santa Fe, New Mexico, and raised on our reservation. As a Pueblo Indian child, I was given a Tewa (our language) name and taught to dance. I went to religious ceremonies and gatherings, and I learned how to do a range of things that we do as Pueblo people. This childhood provided me with "cultural intuition." Cultural intuition is that body of knowledge anyone acquires based upon their lived experiences in a specific place. As a scholar in American Indian studies, I know there are great distinctions between and across American Indian tribal nations. For instance, my home pueblo is very different from the other pueblos in New Mexico, among which there are several different language groups.

I draw upon both my cultural intuition and knowledge when reading a book about Pueblo Indians. For example, when I read Gerald McDermott's *Arrow to the Sun: A Pueblo Indian Tale* (1974), I wondered what Pueblo the book is about. There are 19 different Pueblos in New Mexico, and more in Arizona. In which Pueblo did this story originate? That information is not included anywhere in the book, and there are other problems as well. In the climax of the story, the boy must prove himself by passing through "the Kiva of Lions, the Kiva of Serpents, the Kiva of Bees, and the Kiva of Lightning" where he fights those elements. McDermott's kivas are frightening places of trial and battle, but I know kivas are safe places of worship and instruction.

Depictions that are culturally acceptable at one Pueblo are not necessarily acceptable at a different Pueblo. As such, elders at one Pueblo would say the book could be used with their children, while elders at another Pueblo would disagree. This is not a question of cultural authenticity; it is one of appropriateness in teaching, given a specific audience.

21. The passage author's reaction to which of the following experiences best exemplifies the point that she brings her own cultural intuition to her reading and research?

A. Learning about Bruchac's perspective on ancient traditional tales
B. Reading a portrayal of kivas in a Pueblo book
C. Presenting her research to a Pueblo community other than her own
D. Discussing the oral narrative with Silko

22. The main purpose of the first paragraph (lines 1–24) is to:
    F. explain how traditional stories change as they are passed from one generation to the next.
    G. discuss the value of traditional stories and their functions within a community.
    H. contrast the purposes of folktales with those of myths and legends.
    J. demonstrate that folktales measure how a culture's worldview has changed over time.

23. The passage author most strongly suggests that a particular group would deem one of its own stories to be unacceptable if, during a telling, the storyteller:
    A. incorporated new details into the story.
    B. used his or her own experiences to interpret one event in the story.
    C. agreed with an audience member's adding a detail to the story.
    D. significantly changed the spirit of the story.

24. One function of the passage author's statement that her home pueblo is very different from the other pueblos in New Mexico is to:
    F. describe the culture and traditions of her home pueblo.
    G. help support her later analysis and critique of McDermott's book.
    H. directly compare the stories of several American Indian tribal nations to those of her tribe.
    J. list the criteria she uses to evaluate books marketed as "Native American folktales."

25. The passage author most strongly implies that whether Pueblo elders will approve a book for the children of their community depends on the book's:
    A. entertainment value compared to similar books.
    B. popularity among other tribal members.
    C. appropriateness and relevance to that community's cultural values.
    D. successful representation of the worldview of many cultural groups.

26. As she is presented in the passage, Silko indicates that one purpose of Laguna Pueblo hunting stories was to help hunters:
    F. locate and rescue lost hunters from other tribes.
    G. document the number of successful hunts from one season to the next.
    H. identify the behavior and migration patterns of game.
    J. find caches of food by following trails made by piñon-nut gatherers.

27. The passage author most directly connects her knowledge of the distinctions between and across American Indian tribal nations to her experiences as:
    A. a scholar in American Indian studies.
    B. a friend of McDermott.
    C. an editor of picture books marketed as "Native American folktales."
    D. an elder in her Nambe Pueblo community.

28. As it is used in line 66, the word *great* most nearly means:
    F. excessive.
    G. significant.
    H. exuberant.
    J. splendid.

29. Which of the following characteristics among the several Pueblo communities in New Mexico does the passage author most directly use as evidence of their diversity?
    A. Their vast geographic differences
    B. Their disparity in resources
    C. Their varied approaches to parenting
    D. Their several different language groups

30. The passage author states that kivas are places she associates with:
    F. fear and trial.
    G. mystery and excitement.
    H. rest and healing from illness.
    J. worship and instruction.

Passage IV

NATURAL SCIENCE: This passage is adapted from the article "The Asphalt Jungle" by Peter Del Tredici (©2010 by Natural History Magazine, Inc.).

The ecology of the city is defined not only by the cultivated plants that require maintenance and the protected remnants of natural landscapes, but also by the spontaneous vegetation that dominates the neglected interstices. Greenery fills the vacant spaces between our roads, homes, and businesses; lines ditches and chain-link fences; sprouts in sidewalk cracks and atop neglected rooftops. Some of those plants, such as box elder, quaking aspen, and riverside grape, are native species present before humans drastically altered the land. Others, including chicory, Japanese knotweed, and Norway maple, were brought in intentionally or unintentionally by people. And still others—among them common ragweed, path rush (*Juncus tenuis*), and tufted lovegrass (*Eragrostis pectinacea*)—arrived on their own, dispersed by wind, water, or wild animals. Such species grow and reproduce in many American cities without being planted or cared for. They can provide important ecological services at very little cost to taxpayers, and if left undisturbed long enough they may even develop into mature woodlands.

There is no denying that most people consider many such plants to be "weeds." From a utilitarian perspective, a weed is any plant that grows on its own where people do not want it to grow. From the biological perspective, weeds are opportunistic plants that are adapted to disturbance in all its myriad forms, from bulldozers to acid rain. Their pervasiveness in the urban environment is simply a reflection of the continual disruption that characterizes that habitat—they are not its cause. In an agricultural context, the competition of weeds with economic crops is the primary reason for controlling them. In an urban area, a weed is any plant growing where people are trying to cultivate something else, or keep clear of vegetation altogether. The complaints of city dwellers are usually based on aesthetics (the plants are perceived as ugly, or as signs of blight and neglect) or on security concerns (they shield human activity or provide habitat for vermin).

From a plant's perspective, it is not the density of the human population that defines the urban environment, but the abundance of paving (affecting access to soil and moisture) and prevalence of disturbance. In other words, a sidewalk crack is a sidewalk crack whether it is in a city or a suburb. Urbanization is a process, not a place—a process that tends to leave the soil in a compacted, impoverished, and often contaminated state.

The plants that grow and survive in derelict urban wastelands are famous (or infamous) for their ability to grow under extremely harsh conditions. Through a quirk of evolutionary fate, they developed traits in their native habitats that seem to have "preadapted" them to flourish in cities. One study, by biologist Jeremy T. Lundholm of St. Mary's University in Halifax, Nova Scotia, and his then student Ashley Marlin, concluded that many successful urban plants are native to exposed cliffs, disturbed rock outcrops, or dry grasslands, all of which are characterized by soils with a relatively high pH. Cities, with their tall, granite-faced buildings and concrete foundations, are in a sense the equivalent of the natural limestone cliff habitats where those species originated. Similarly, as the British ecologist and "lichen hunter" Oliver L. Gilbert noted in his classic book *The Ecology of Urban Habitats*, the increased use of deicing salts on our roads and highways has resulted in the development of microhabitats along their margins that are typically colonized by calcium-loving grassland species adapted to limestone soils or by salt-loving plants from coastal habitats.

In general, the successful urban plant needs to be *flexible* in all aspects of its life history, from seed germination through flowering and fruiting; *opportunistic* in its ability to take advantage of locally abundant resources that may be available for only a short time; and *tolerant* of the stressful growing conditions caused by an abundance of pavement and a paucity of soil. The plants that grow in our cities managed to survive the transition from one land use to another as cities developed. The sequence starts with native species adapted to ecological conditions before the city was built. Those are followed, more or less in order, by species preadapted to agriculture and pasturage, to pavement and compacted soil, to lawns and landscaping, to infrastructure edges and environmental pollution—and ultimately to vacant lots and rubble.

31. The passage as a whole can best be described as:

A. an argument for eradicating weeds in urban areas.
B. a discussion of the factors that contribute to the survival of weeds in urban environments.
C. a report on the need for increased vegetation in cities and suburbs.
D. a discussion of how environmentalists are changing their attitudes toward so-called weeds.

32. Based on how the following four perspectives are outlined in the second paragraph (lines 22–39), which one would the author most likely share?

F. A utilitarian perspective
G. An agricultural perspective
H. A biological perspective
J. A city dweller's perspective

33. It is reasonable to infer that, in the author's opinion, *spontaneous vegetation* (line 4) is most unlike which of the following types of plants mentioned in the passage?

A. Common ragweed (line 14)
B. Economic crops (line 32)
C. Urban plants (line 57)
D. Calcium-loving grassland species (lines 68–69)

34. Which of the following opinions regarding weeds adapting to rather than causing a changing habitat is most clearly implied by the passage?

F. Removing weeds from places they are considered undesirable is simpler than people realize.
G. Weeds have wrongly been blamed for contributing to certain kinds of deterioration in urban areas.
H. Changing people's minds about weeds has caused a pervasive acceptance of them in urban areas.
J. City vegetation reflects that the life cycle of weeds is simpler than that of cultivated plants.

35. As it is used in line 5, the word *greenery* most nearly refers to:

A. cultivated plants.
B. protected natural landscapes.
C. weeds.
D. crops.

36. Based on the passage, in comparison to Gilbert's observation in his book, the scientific study by Lundholm and Marlin can best be described as:

F. complementary; Gilbert reached a conclusion similar to the one reached by Lundholm and Marlin.
G. contrasting; Lundholm and Marlin conducted a more recent study that questions the note in Gilbert's book.
H. interdependent; Lundholm and Marlin used Gilbert's book as a foundation for their study.
J. irrelevant; Gilbert was studying the ecology of urban habitats, while Lundholm and Marlin studied natural environments with high pH soils.

37. The last paragraph most strongly suggests that the author's attitude toward so-called weeds in urban areas is one of:

A. alarm due to the threat they pose to native plants.
B. concern as he fears they will not survive in their new habitat.
C. annoyance over the manner in which they contribute to urban decay.
D. respect for their ability to adapt to a wide array of challenging conditions.

38. According to the passage, Norway maple was first brought into the urban environment by:

F. people.
G. wind.
H. water.
J. birds.

39. As it is used in lines 15–16, the phrase *on their own* most nearly means:

A. one at a time.
B. without human aid.
C. in a self-propelled fashion.
D. voluntarily.

40. According to the passage, if people stopped disturbing weeds in an urban environment, eventually the weeds might:

F. compete for space and start to die out.
G. enhance landscaped gardens.
H. dry out the soil.
J. develop into woodlands.

END OF TEST 3

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

DO NOT RETURN TO A PREVIOUS TEST.

SCIENCE TEST

35 Minutes—40 Questions

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

You are NOT permitted to use a calculator on this test.

Passage I

A teacher asked each of 4 students to describe the *molecular shape* (the geometrical arrangement of the atoms in a molecule) of each of 4 molecules: arsenic trifluoride (AsF_3), arsenic trichloride ($AsCl_3$), arsenic tribromide ($AsBr_3$), and arsenic triiodide (AsI_3).

Student 1

An AsF_3 molecule is *T-shaped*, with the As atom in the center. All the atoms in AsF_3 lie in the same plane, and there are 2 unique angles—90° and 180°—between adjacent As–F bonds (see Figure 1).

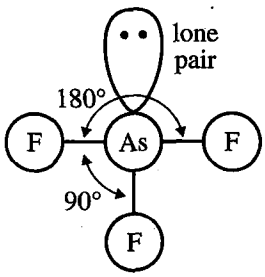


Figure 1

The As atom has a *lone pair* (an outer pair of electrons not involved in chemical bonding) that lies in the same plane as the As and F atoms. These electrons strongly repel the 3 As–F bonds, resulting in the 2 unique bond angles of 90° and 180°.

$AsCl_3$, $AsBr_3$, and AsI_3 are also T-shaped.

Student 2

The shape of an AsF_3 molecule is *trigonal planar*, with the As atom in the center. All the atoms in AsF_3 lie in the same plane, and there is only 1 unique angle—120°—between adjacent As–F bonds (see Figure 2).

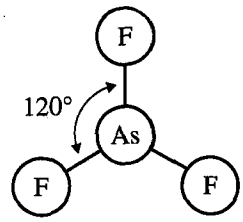


Figure 2

The As atom does not have a lone pair. The 3 As–F bonds repel each other equally, resulting in the 1 unique bond angle of 120°.

$AsCl_3$, $AsBr_3$, and AsI_3 are also trigonal planar.

Student 3

The shape of an AsF_3 molecule is *trigonal pyramidal*, with the As atom in the center. All the atoms in AsF_3 do not lie in the same plane, and there is only 1 unique angle—109°—between adjacent As–F bonds (see Figure 3).

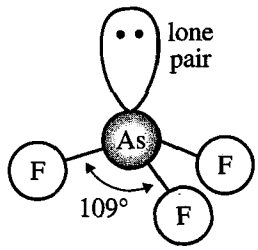


Figure 3

The As atom has a lone pair. The lone pair and the 3 As–F bonds repel each other equally, resulting in the 1 unique bond angle of 109°.

$AsCl_3$, $AsBr_3$, and AsI_3 are also trigonal pyramidal.

Student 4

Student 3 is correct that, due to the lone pair, AsF_3, $AsCl_3$, $AsBr_3$, and AsI_3 molecules are all trigonal pyramidal. AsF_3, $AsCl_3$, $AsBr_3$, and AsI_3 each have only 1 unique bond angle, but that bond angle is different for each of the 4 molecules. The bond angle depends on the size of the atom that is bound to the As atom: the larger the atom that is bound to the As atom, the larger the bond angle. The atoms bound to the As atom, listed by size from smallest to largest, are F, Cl, Br, and I.

After the 4 descriptions were offered, the teacher used a computer program that (1) determined that in each of the 4 molecules, there is only 1 unique bond angle and (2) calculated the bond angle for each molecule (see Table 1).

Table 1

Molecule	Calculated bond angle
AsF_3	100°
$AsCl_3$	101°
$AsBr_3$	103°
AsI_3	111°

Table adapted from Ian J. McNaught, "Testing and Extending VSEPR with WebMO and MOPAC or GAMESS." ©2011 by Division of Chemical Education, Inc., American Chemical Society.

1. The table below gives the atomic mass (in atomic mass units, amu) of the elements F, Cl, Br, and I.

Element	Atomic mass (amu)
F	19.00
Cl	35.45
Br	79.90
I	126.9

Based on Student 4's description, among the elements listed in the table, as atomic mass increases, *atomic radius*:

A. increases only.
B. decreases only.
C. increases, then decreases.
D. decreases, then increases.

2. Which of the students claimed that the As atom in an AsF_3 molecule has a lone pair?

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

3. Which of the students would be likely to agree with the statement "All 4 atoms in an AsF_3 molecule lie in the same plane"?

A. Student 1 only
B. Student 3 only
C. Students 1 and 2 only
D. Students 3 and 4 only

4. Consider the claim that there are 3 unique bond angles in an AsF_3 molecule. This claim is consistent with the description(s) given by which student(s), if any?

F. Student 2 only
G. Students 1 and 2 only
H. Students 3 and 4 only
J. None of the students

5. Based on the descriptions given by Students 1, 2, and 3, which of these students would be likely to agree that the sum of the 3 bond angles in an AsI_3 molecule is equal to 360° ?

A. Students 1 and 2 only
B. Students 1 and 3 only
C. Students 2 and 3 only
D. Students 1, 2, and 3

6. A molecule of ammonia (NH_3) has only 1 unique bond angle, and that bond angle is 107°. The N atom also has a lone pair that strongly repels the 3 N–H bonds. Based on the descriptions given by Students 2 and 3, is the molecular shape of NH_3 more likely trigonal planar or trigonal pyramidal?

F. Trigonal planar; the bond angle is more consistent with Student 2's description.
G. Trigonal planar; the bond angle is more consistent with Student 3's description.
H. Trigonal pyramidal; the bond angle is more consistent with Student 2's description.
J. Trigonal pyramidal; the bond angle is more consistent with Student 3's description.

7. The data in Table 1 are most consistent with the description given by which student?

A. Student 1
B. Student 2
C. Student 3
D. Student 4

Passage II

Each dog in a particular population has a black, brown, or yellow coat. In this population, coat color is determined by 2 unlinked genes: Gene B and Gene E. Gene B has 2 alleles: *B* and *b*. Gene E also has 2 alleles: *E* and *e*. Table 1 shows the possible genotypes for Gene B and Gene E and the resulting coat color phenotypes.

Table 1

Genotype	Coat color
BBEE	black
BBEe	black
BBee	yellow
BbEE	black
BbEe	black
Bbee	yellow
bbEE	brown
bbEe	brown
bbee	yellow

Two of the dogs with black coats were crossed 3 times (Crosses 1–3). The coat colors of the offspring produced in each cross are shown in Table 2.

Table 2

Cross	Number of offspring with a: black coat	brown coat	yellow coat
1	8	0	0
2	6	1	2
3	2	2	2

8. After Cross 1 but before Cross 2, a student hypothesized that each of the parents in Cross 1 had the genotype *BBEE*. Was this hypothesis consistent with the results of Cross 1 ?
   - **F.** Yes, because all the offspring of Cross 1 had black coats.
   - **G.** Yes, because all the offspring of Cross 1 had yellow coats.
   - **H.** No, because all the offspring of Cross 1 had black coats.
   - **J.** No, because all the offspring of Cross 1 had yellow coats.

9. What was the Gene B and Gene E genotype of the offspring of Cross 2 that had a brown coat?
   - **A.** *bbee*
   - **B.** *BBEE*
   - **C.** *BbEE* or *BbEe*
   - **D.** *bbEE* or *bbEe*

10. Based on Tables 1 and 2, what fraction of the offspring of Cross 3 had 1 or more copies of the *E* allele of Gene E ?
    - **F.** $\frac{1}{4}$
    - **G.** $\frac{1}{3}$
    - **H.** $\frac{2}{3}$
    - **J.** $\frac{15}{16}$

11. Consider the offspring of each of the 3 crosses. Based on Tables 1 and 2, some of the offspring of which of the crosses, if any, could have had only recessive alleles of Gene B and Gene E ?

A. Cross 1 only
B. Crosses 2 and 3 only
C. Crosses 1, 2, and 3
D. None of the crosses

12. Suppose 2 of the offspring from Cross 3 with yellow coats are crossed. What percent of the resulting offspring will have yellow coats?

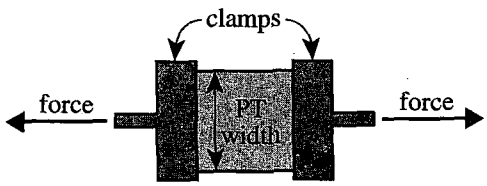
F. 0%
G. 25%
H. 50%
J. 100%

13. Approximately what percent of the normal gametes produced by a dog with the genotype *BbEE* will contain the *B* allele?

A. 0%
B. 25%
C. 50%
D. 100%

Passage III

The *tensile strength* of a paper towel (PT) is the force per unit width required to break the PT when it is clamped and stretched (see diagram).



diagram

Dry strength is the tensile strength of a dry PT, and *wet strength* is the tensile strength of a PT that has been submerged in water. The wet strength can be increased by treating the PT with certain chemicals.

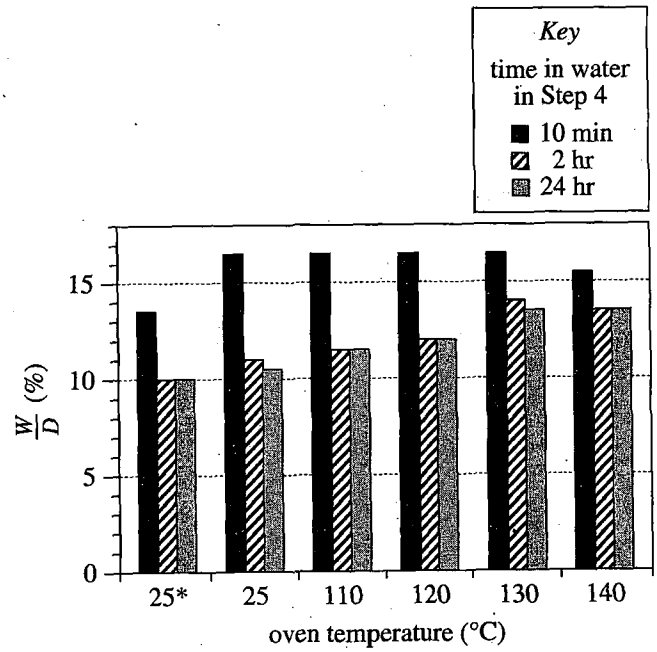
Students conducted 2 experiments to study the wet strengths of identical PTs, each 20 cm × 20 cm, treated with glutaraldehyde (GLA) or with GLA and zinc nitrate.

Experiment 1

First, the dry strengths of 5 PTs were measured, in newtons per meter (N/m), and the average of the measurements, D, was calculated. Then, Steps 1–5 were performed on each of 100 other PTs:

1. A PT was submerged for 30 sec in water (if the PT was to be a control) or in a test solution containing GLA.
2. The PT was dried on a hot plate at 85°C for 4 min.
3. The PT was heated in an oven for 3 min at a certain temperature—25°C for a control PT and 25°C, 110°C, 120°C, 130°C, or 140°C for a treated PT.
4. The PT was submerged in water for 10 min, 2 hr, or 24 hr.
5. The wet strength of the PT was measured in N/m.

The wet strengths of PTs that had been subjected to identical conditions were averaged. Each average wet strength, W, was divided by D and then multiplied by 100. The resulting $\frac{W}{D}$ values are shown in Figure 1.

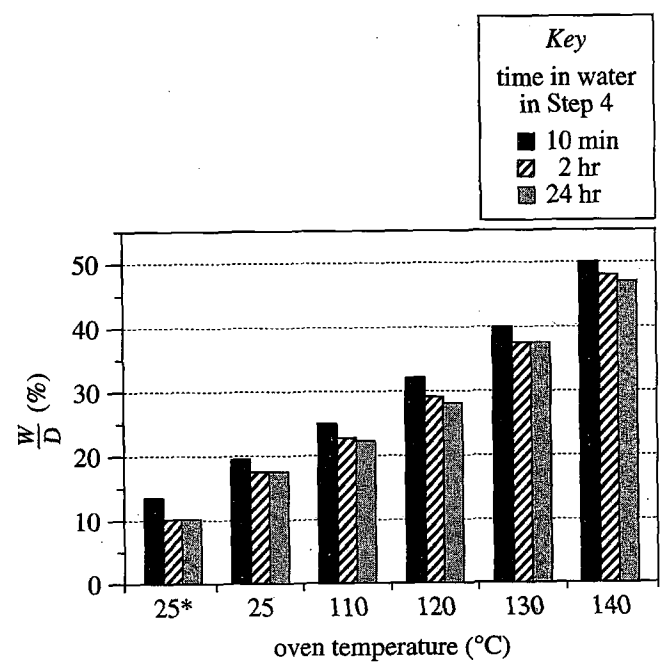


*controls

Figure 1

Experiment 2

Steps 1–5 were repeated with 100 other PTs, except that the test solution contained both GLA and zinc nitrate (see Figure 2).



*controls

Figure 2

Figures 1 and 2 adapted from Gordon Guozhong Xu, Charles Qixiang Yang, and Yulin Deng, "Applications of Bifunctional Aldehydes to Improve Paper Wet Strength." ©2002 by John Wiley & Sons, Inc.

14. In Experiment 2, the greatest average wet strength was observed for the PTs that were submerged in water for 10 min after having been heated in an oven at what temperature?

F. 110°C
G. 120°C
H. 130°C
J. 140°C

15. In Experiment 2, for PTs that were submerged in water for 2 hr, as the oven temperature increased from 110°C through 140°C, the $\frac{W}{D}$ value:

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

16. In Step 1 of Experiment 1, the PTs that would become controls were submerged in what liquid, and in Step 3 of Experiment 1, these control PTs were heated in an oven at what temperature?

	liquid	temperature
F.	water	25°C
G.	water	85°C
H.	GLA solution	25°C
J.	GLA solution	85°C

17. In which of Experiments 1 and 2, if either, did the students measure the wet strengths of PTs that had been submerged in water for a total of 18 hr ?

A. Experiment 1 only
B. Experiment 2 only
C. Both Experiment 1 and Experiment 2
D. Neither Experiment 1 nor Experiment 2

18. Which of the following statements comparing the $\frac{W}{D}$ value of the PTs that were submerged in water for 2 hr with the $\frac{W}{D}$ value of the PTs that were submerged in water for 10 min is supported by the results of Experiment 1 ?

F. For all the oven temperatures, the $\frac{W}{D}$ value at 2 hr was greater than the $\frac{W}{D}$ value at 10 min.
G. For all the oven temperatures, the $\frac{W}{D}$ value at 2 hr was less than the $\frac{W}{D}$ value at 10 min.
H. For all the oven temperatures, the $\frac{W}{D}$ value at 2 hr was the same as the $\frac{W}{D}$ value at 10 min.
J. For some of the oven temperatures, the $\frac{W}{D}$ value at 2 hr was greater than the $\frac{W}{D}$ value at 10 min; at the other oven temperatures, the $\frac{W}{D}$ value at 2 hr was less than the $\frac{W}{D}$ value at 10 min.

19. One of the students predicted that the wet strengths of PTs would NOT increase after treating the PTs with a solution containing both GLA and zinc nitrate. The results of which experiment better refute or support this prediction? The results of:

A. Experiment 1 better refute this prediction.
B. Experiment 1 better support this prediction.
C. Experiment 2 better refute this prediction.
D. Experiment 2 better support this prediction.

20. Based on the results of the experiments, is the dry strength of a paper towel greater than or less than the wet strength of the paper towel?

F. Greater; each average wet strength, W, was greater than 100% of D.
G. Greater; each average wet strength, W, was less than 100% of D.
H. Less; each average wet strength, W, was greater than 100% of D.
J. Less; each average wet strength, W, was less than 100% of D.

Passage IV

The tiger frog, *Rana rugulosa*, is a species of frog that is commercially farmed. A farmer conducted 2 experiments to help determine the optimum diet for the growth of *R. rugulosa*.

Prior to the experiments, 10 diets (Diets 1–10) were prepared. The diets differed in the percent by mass of protein, the number of calories per gram (cal/g), or both (see Table 1).

Table 1

Diet	Percent by mass of protein	Calories per gram (cal/g)
1	30.0	5,300
2	32.5	5,300
3	35.0	5,300
4	37.5	5,300
5	40.0	5,300
6	37.0	4,500
7	37.0	4,700
8	37.0	4,900
9	37.0	5,300
10	37.0	5,700

Experiment 1

Each of 5 identical outdoor 1 m^3 tanks was prepared as follows: First, the tank was filled with water to a depth of 20 cm. Next, 30 adult *R. rugulosa*, each with a mass of 3.3 g, were placed into the tank. Then the tank was covered with a fine wire mesh.

Each tank of frogs was assigned a different diet: Diet 1, Diet 2, Diet 3, Diet 4, or Diet 5. Each frog was fed 1,000 mg of its assigned diet, twice per day, for the next 12 weeks. At the end of 12 weeks, the average final mass of the frogs was determined for each diet (see Table 2).

Table 2

Diet	Average final mass (g)
1	54.0
2	69.3
3	80.1
4	86.2
5	90.4

Experiment 2

Five more of the outdoor 1 m^3 tanks were prepared as in Experiment 1, except that each of the *R. rugulosa* had an initial mass of 7.9 g instead of 3.3 g. Each tank of frogs was assigned a different diet: Diet 6, Diet 7, Diet 8, Diet 9, or Diet 10. Each frog was fed 2,000 mg of its assigned diet, once per day, for the next 12 weeks. At the end of 12 weeks, the average final mass of the frogs was determined for each diet (see Table 3).

Table 3

Diet	Average final mass (g)
6	126.9
7	135.1
8	143.0
9	132.0
10	129.5

Tables adapted from P. Somsueb and M. Boonyaratpalin, "Optimum Protein and Energy Levels for the Thai Native Frog, *Rana rugulosa* Weigmann." ©2001 by Blackwell Science Ltd.

21. The values that were averaged to obtain the data in Tables 2 and 3 were most likely read from which of the following instruments?

A. Graduated cylinder
B. Electronic balance
C. Metric ruler
D. Calorimeter

22. In Experiment 1, as the percent by mass of protein increased, the average final mass of the frogs:

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

23. The fine wire mesh was most likely intended to function in which of the ways described below?

I. To prevent predators of frogs from entering each tank
II. To place the frogs into each tank
III. To keep the frogs from leaving each tank

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

24. In Experiment 2, as the number of calories per gram increased, the average final mass of the frogs:

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

25. Which of the statements about the frogs involved in the experiments given below, if either, is(are) consistent with the information in the passage?

I. All the frogs belonged to the same genus.
II. All the frogs belonged to the same species.

A. I only
B. II only
C. Both I and II
D. Neither I nor II

26. Experiment 2 differed from Experiment 1 in which of the following ways?

F. The initial mass of each frog was greater in Experiment 1 than in Experiment 2.
G. The initial mass of each frog was greater in Experiment 2 than in Experiment 1.
H. The quantity of food that each frog was fed per day was greater in Experiment 1 than in Experiment 2.
J. The quantity of food that each frog was fed per day was greater in Experiment 2 than in Experiment 1.

27. To determine whether the number of calories per gram in the diet of *R. rugulosa* affects the growth of *R. rugulosa*, would the farmer more likely have compared the results of Diets 1–5 or the results of Diets 6–10 ?

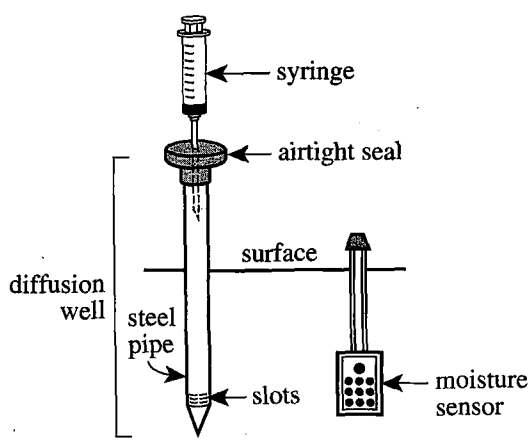
A. Diets 1–5, because those diets varied in the percent by mass of protein but not in the number of calories per gram.
B. Diets 1–5, because those diets varied in the number of calories per gram but not in the percent by mass of protein.
C. Diets 6–10, because those diets varied in the percent by mass of protein but not in the number of calories per gram.
D. Diets 6–10, because those diets varied in the number of calories per gram but not in the percent by mass of protein.

Passage V

In soil, CO_2 is produced through 2 processes—respiration in plant roots and bacterial decomposition of organic matter. A study was done in an oak forest to examine the CO_2 content of soil gas as well as the water content of the soil. The study was done during an 8-week period that began just as the growing season ended.

Study

On October 12, 5 evenly spaced locations in the forest were marked along a 120 m long straight line, starting at one end. At each location, 5 sets of 2 instruments each—a *diffusion well* and a *moisture sensor*—were positioned so that soil gas could be collected and soil water content could be measured at each of 5 soil depths: 10 cm, 30 cm, 60 cm, 100 cm, and 140 cm. The slots near one end of the steel pipe of the diffusion well allowed only soil gas to enter the pipe. The soil gas could be sampled by inserting the needle of a syringe through the airtight seal on the aboveground end of the pipe. See Figure 1.



Note: Drawing is not to scale.

Figure 1

At noon on each of 4 dates—October 26, November 9, November 23, and December 7—a 0.5 mL sample of soil gas was collected from each diffusion well and the water content of the soil was read from each moisture sensor. Each soil gas sample was analyzed to determine its CO_2 content. Figure 2 shows the averaged results for CO_2 content of the soil gas, expressed in percent by volume, and Figure 3 shows the averaged results for water content of the soil, expressed in percent by mass.

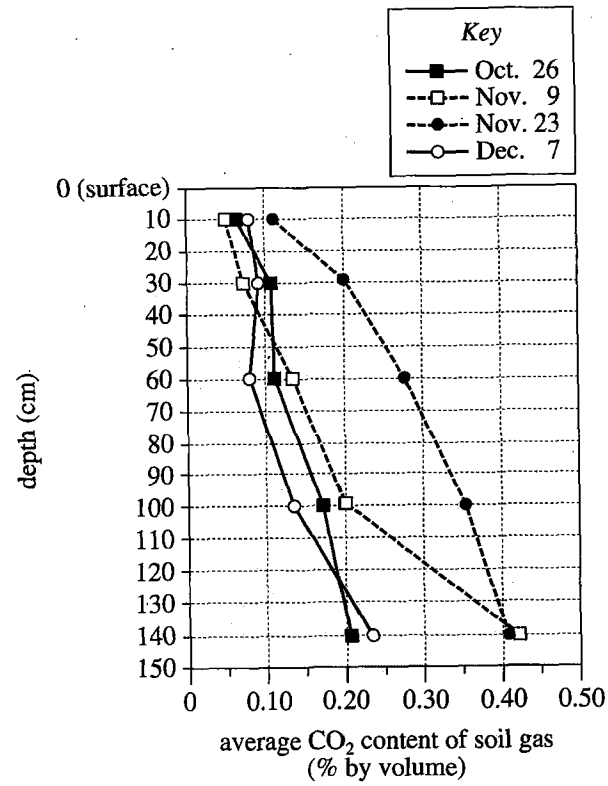


Figure 2

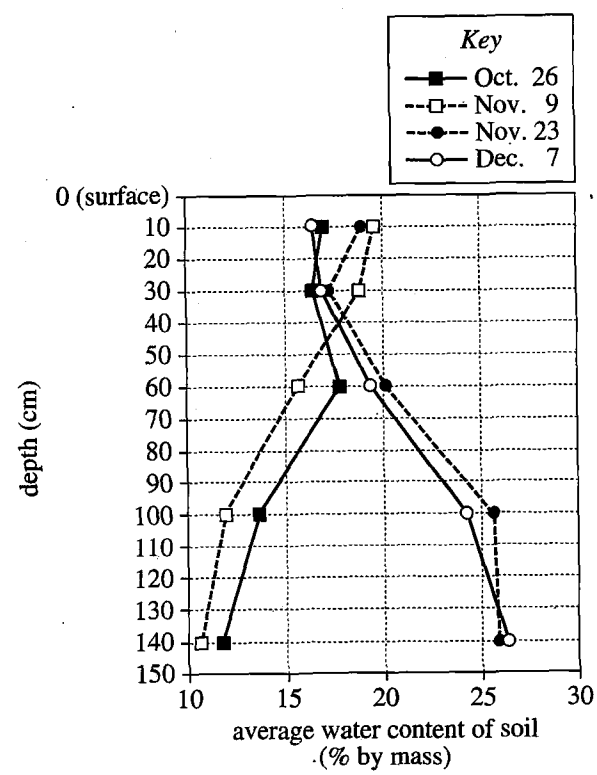


Figure 3

Figures adapted from James M. Dyer and George A. Brook, "Spatial and Temporal Variations in Temperate Forest Soil Carbon Dioxide during the Non-Growing Season." ©1991 by John Wiley & Sons, Ltd.

28. According to Figure 3, at what depth were the average water content values for the 4 dates closest in value?

F. 30 cm
G. 60 cm
H. 100 cm
J. 140 cm

29. The slots at the bottom of a diffusion well's pipe were designed to allow the passage of:

A. soil gas but not soil or water.
B. soil and water but not soil gas.
C. water but not soil or soil gas.
D. soil gas as well as soil and water.

30. What percent of the CO_2 in each soil gas sample was due to bacterial decomposition of organic matter and not due to respiration in plant roots?

F. 10%
G. 25%
H. 50%
J. Cannot be determined from the given information

31. In the study, one step in the determination of CO_2 content was to divide a volume of CO_2 by another volume. That other volume was the volume of a:

A. sample of soil.
B. sample of soil gas.
C. sample of water.
D. steel pipe of a diffusion well.

32. Which of the following statements describing how the average water content generally varied over the 140 cm of soil depth is consistent with Figure 3 ?

F. On each of the 4 dates, the average water content generally increased with depth.
G. On each of the 4 dates, the average water content generally decreased with depth.
H. On October 26 and November 9, the average water content generally increased with depth, whereas on November 23 and December 7, the average water content generally decreased with depth.
J. On October 26 and November 9, the average water content generally decreased with depth, whereas on November 23 and December 7, the average water content generally increased with depth.

33. Suppose that at each of the 5 locations a diffusion well had been positioned at a depth of 145 cm. Based on Figure 2, on November 23, the average CO_2 content of the soil gas at that depth would most likely have been determined to be:

A. less than 0.30% by volume.
B. between 0.30% by volume and 0.35% by volume.
C. between 0.35% by volume and 0.40% by volume.
D. greater than 0.40% by volume.

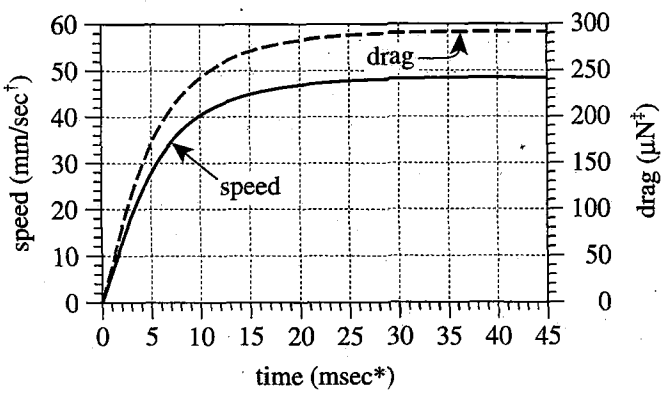
34. Suppose that a 10 g sample of soil had been collected on November 23 at a depth of 60 cm. Based on Figure 3, what mass of water would most likely have been present in the sample?

F. 1 g
G. 2 g
H. 5 g
J. 10 g

Passage VI

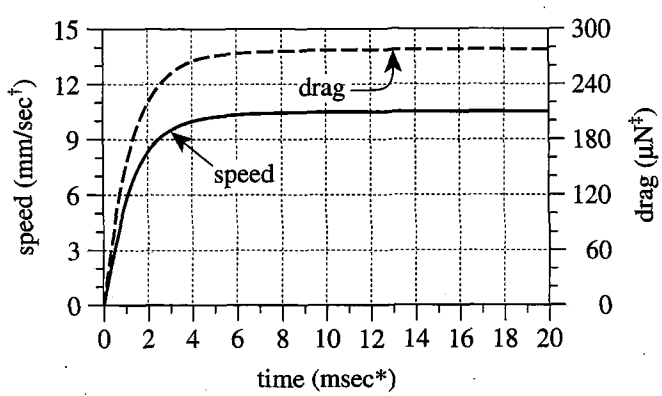
An object falling through a liquid has 3 forces acting on it: gravity, a buoyant force, and *drag* (a force that opposes motion). If the net upward force on the object is equal in magnitude to the net downward force on the object, then the object will fall at *terminal speed.*

A steel ball was dropped from rest into a column of motor oil and into a column of glycerin. Figures 1 and 2 show how the speed of the ball and the drag on the ball varied with time as the ball fell through the oil and through the glycerin, respectively. Figure 3 shows how the depth of the ball varied with time for each case.



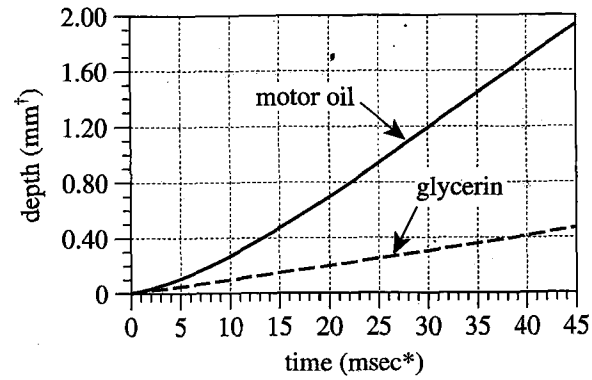
*milliseconds
†millimeters per second
‡micronewtons

Figure 1



*milliseconds
†millimeters per second
‡micronewtons

Figure 2



*milliseconds
†millimeters

Figure 3

35. Based on Figure 3, the depth of the steel ball in the motor oil at time = 50 msec would most likely have been closest to which of the following?

A. 0.50 mm
B. 0.60 mm
C. 1.90 mm
D. 2.10 mm

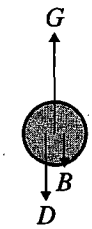
36. Which of the following diagrams best represents the 3 forces that acted on the steel ball—gravity (*G*), the buoyant force (*B*), and drag (*D*)—as it moved through either liquid?

(Note: Assume that down is toward the bottom of the page.)

F.

H.

G.

J.


37. The steel ball required *less* time to reach terminal speed in which liquid?

A. Motor oil; the ball took less than 10 msec in motor oil but more than 25 msec in glycerin to reach terminal speed.
B. Motor oil; the ball took more than 25 msec in motor oil but less than 10 msec in glycerin to reach terminal speed.
C. Glycerin; the ball took less than 10 msec in glycerin but more than 25 msec in motor oil to reach terminal speed.
D. Glycerin; the ball took more than 25 msec in glycerin but less than 10 msec in motor oil to reach terminal speed.

38. According to Figures 1 and 2, the steel ball's terminal speed was greater in which liquid?

F. Motor oil; the terminal speed was about 48 mm/sec in motor oil and about 10.5 mm/sec in glycerin.
G. Motor oil; the terminal speed was about 240 mm/sec in motor oil and about 210 mm/sec in glycerin.
H. Glycerin; the terminal speed was about 48 mm/sec in glycerin and about 10.5 mm/sec in motor oil.
J. Glycerin; the terminal speed was about 240 mm/sec in glycerin and about 210 mm/sec in motor oil.

39. Based on Figures 1, 2, and 3, is it reasonable to conclude that the drag on the steel ball was directly proportional to the depth of the ball?

A. Yes; both the depth and the drag increased only.
B. Yes; both the depth and the drag increased and then gradually approached a constant value.
C. No; the depth increased only, whereas the drag increased and then approached a constant value.
D. No; the depth increased and then approached a constant value, whereas the drag increased only.

40. Based on Figures 1 and 3, at a depth of 0.50 mm in the motor oil, what was the approximate drag exerted on the steel ball?

F. 230 μN
G. 250 μN
H. 270 μN
J. 290 μN

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.