

ACT Quick-Diagnostic

Marking Directions: Mark only **one** oval for each question. Fill in response completely. Erase errors cleanly without smudging.

Correct mark: ○ ● ○ ○

Do NOT use these incorrect or bad marks.

Incorrect marks: ○ ○ ○ ○ ○

Overlapping mark: ○ ○ ○ ○ ○

Cross-out mark: ○ ○ ○ ○ ○

Smudged erasure: ○ ○ ○ ○ ○

Mark is too light: ○ ○ ○ ○ ○

Name: _____

Date: _____

TEST 1

| | | | | | |
|--------------------|--------------------|--------------------|-----------|-----------|-----------|
| 1 (A) (B) (C) (D) | 14 (F) (G) (H) (J) | 27 (A) (B) (C) (D) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 2 (F) (G) (H) (J) | 15 (A) (B) (C) (D) | 28 (F) (G) (H) (J) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 3 (A) (B) (C) (D) | 16 (F) (G) (H) (J) | 29 (A) (B) (C) (D) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 4 (F) (G) (H) (J) | 17 (A) (B) (C) (D) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 5 (A) (B) (C) (D) | 18 (F) (G) (H) (J) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 6 (F) (G) (H) (J) | 19 (A) (B) (C) (D) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 7 (A) (B) (C) (D) | 20 (F) (G) (H) (J) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 8 (F) (G) (H) (J) | 21 (A) (B) (C) (D) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 9 (A) (B) (C) (D) | 22 (F) (G) (H) (J) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 10 (F) (G) (H) (J) | 23 (A) (B) (C) (D) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 11 (A) (B) (C) (D) | 24 (F) (G) (H) (J) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 12 (F) (G) (H) (J) | 25 (A) (B) (C) (D) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 13 (A) (B) (C) (D) | 26 (F) (G) (H) (J) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |

TEST 2

| | | | | | |
|------------------------|------------------------|------------------------|---------------|---------------|---------------|
| 1 (A) (B) (C) (D) (E) | 11 (A) (B) (C) (D) (E) | 21 (A) (B) (C) (D) (E) | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ |
| 2 (F) (G) (H) (J) (K) | 12 (F) (G) (H) (J) (K) | 22 (F) (G) (H) (J) (K) | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ |
| 3 (A) (B) (C) (D) (E) | 13 (A) (B) (C) (D) (E) | 23 (A) (B) (C) (D) (E) | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ |
| 4 (F) (G) (H) (J) (K) | 14 (F) (G) (H) (J) (K) | 24 (F) (G) (H) (J) (K) | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ |
| 5 (A) (B) (C) (D) (E) | 15 (A) (B) (C) (D) (E) | 25 (A) (B) (C) (D) (E) | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ |
| 6 (F) (G) (H) (J) (K) | 16 (F) (G) (H) (J) (K) | 26 (F) (G) (H) (J) (K) | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ |
| 7 (A) (B) (C) (D) (E) | 17 (A) (B) (C) (D) (E) | 27 (A) (B) (C) (D) (E) | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ |
| 8 (F) (G) (H) (J) (K) | 18 (F) (G) (H) (J) (K) | 28 (F) (G) (H) (J) (K) | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ |
| 9 (A) (B) (C) (D) (E) | 19 (A) (B) (C) (D) (E) | 29 (A) (B) (C) (D) (E) | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ |
| 10 (F) (G) (H) (J) (K) | 20 (F) (G) (H) (J) (K) | 30 (F) (G) (H) (J) (K) | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ ○ ○ |

TEST 3

| | | | | | |
|-------------------|--------------------|--------------------|-----------|-----------|-----------|
| 1 (A) (B) (C) (D) | 8 (F) (G) (H) (J) | 15 (A) (B) (C) (D) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 2 (F) (G) (H) (J) | 9 (A) (B) (C) (D) | 16 (F) (G) (H) (J) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 3 (A) (B) (C) (D) | 10 (F) (G) (H) (J) | 17 (A) (B) (C) (D) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 4 (F) (G) (H) (J) | 11 (A) (B) (C) (D) | 18 (F) (G) (H) (J) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 5 (A) (B) (C) (D) | 12 (F) (G) (H) (J) | 19 (A) (B) (C) (D) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 6 (F) (G) (H) (J) | 13 (A) (B) (C) (D) | 20 (F) (G) (H) (J) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |
| 7 (A) (B) (C) (D) | 14 (F) (G) (H) (J) | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ | ○ ○ ○ ○ ○ |

TEST 4

| | | | | | |
|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| 1 (A) (B) (C) (D) | 8 (F) (G) (H) (J) | 15 (A) (B) (C) (D) | 22 (F) (G) (H) (J) | 29 (A) (B) (C) (D) | 36 (F) (G) (H) (J) |
| 2 (F) (G) (H) (J) | 9 (A) (B) (C) (D) | 16 (F) (G) (H) (J) | 23 (A) (B) (C) (D) | 30 (F) (G) (H) (J) | 37 (A) (B) (C) (D) |
| 3 (A) (B) (C) (D) | 10 (F) (G) (H) (J) | 17 (A) (B) (C) (D) | 24 (F) (G) (H) (J) | 31 (A) (B) (C) (D) | 38 (F) (G) (H) (J) |
| 4 (F) (G) (H) (J) | 11 (A) (B) (C) (D) | 18 (F) (G) (H) (J) | 25 (A) (B) (C) (D) | 32 (F) (G) (H) (J) | 39 (A) (B) (C) (D) |
| 5 (A) (B) (C) (D) | 12 (F) (G) (H) (J) | 19 (A) (B) (C) (D) | 26 (F) (G) (H) (J) | 33 (A) (B) (C) (D) | 40 (F) (G) (H) (J) |
| 6 (F) (G) (H) (J) | 13 (A) (B) (C) (D) | 20 (F) (G) (H) (J) | 27 (A) (B) (C) (D) | 34 (F) (G) (H) (J) | |
| 7 (A) (B) (C) (D) | 14 (F) (G) (H) (J) | 21 (A) (B) (C) (D) | 28 (F) (G) (H) (J) | 35 (A) (B) (C) (D) | |

**ACT ENGLISH TEST***17 Minutes—29 Questions*

DIRECTIONS: In the **2** 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**Dragonfly**

The nature trail is six feet wide and seven miles long. It slithers through the forest like a snake curving, and bending along the banks of the river.

The county cleared this path and paved it with packed

gravel, so they would have a peaceful place to hike and bike.

I ride this trail nearly every day—not on a bike, but on “Luigi.” That’s the nickname I gave my

motorized wheelchair. 5 Today, Luigi’s battery

1. **A.** NO CHANGE
B. snake, curving and bending
C. snake curving and bending,
D. snake, curving, and bending,
2. Which of the following alternatives to the underlined portion would NOT be acceptable?
F. path, paving
G. path and then paved
H. path before paving
J. path paved
3. **A.** NO CHANGE
B. knowing they
C. that they
D. people
4. **F.** NO CHANGE
G. day; not on a bike
H. day not on a bike
J. day, not on a bike;
5. If the writer were to delete the preceding sentence, the essay would primarily lose:
A. a reason why the narrator is in the forest.
B. a detail important for understanding the essay.
C. a contrast to the lighthearted tone of the essay.
D. nothing at all; this information is irrelevant to the essay.



is fully charged, I know I can go all the way to the end
₆
of the trail and back. But I always carry a cell phone on
me just in case.

Luigi's motor moves slowly as we venture along
₇
the trail. I can hear the gravel quietly crunching beneath

Luigi's rubber wheels. I hear the songs of cardinals in the
₈
trees and the clamor of crickets in the grasses. I hear the
murmur of water slipping over time-smoothed rocks. It is
₉
September, and some of the trees are starting to blush red
and orange at their tips. The wind ruffles my hair and
chills my face as I bounce gently, along in my padded
₁₀
chair.

Bicyclists streak past in a blur of color and a cloud of
₁₁

dust I don't understand their hurry. Luigi can go fast, but I
₁₂
like to ride slowly, to see like a hovering dragonfly. I want
to see everything that has changed, grown, bloomed, or
died since yesterday. Today I notice that a spider has
woven a web between some honeysuckle bushes by the
bridge. I see that the bank of vibrant yellow black-eyed
Susans by the barbed wire fence is starting to dry and fade
away. I spend an hour; looking and listening and learning.
₁₃

6. F. NO CHANGE
G. charged, because of that,
H. charged, this means that
J. charged, so
7. Which choice would most logically and effectively emphasize the positive, friendly attitude the narrator has toward Luigi?
A. NO CHANGE
B. travels safely
C. proceeds carefully
D. purrs softly
8. F. NO CHANGE
G. You can hear
H. One can even hear
J. While hearing
9. A. NO CHANGE
B. Due to the fact that it is
C. It turns into the month of
D. Because it has turned into
10. F. NO CHANGE
G. gentle, along
H. gently along
J. gentle along,
11. Which choice most effectively leads into the new subject of this paragraph?
A. NO CHANGE
B. The sun begins to set
C. Nature always impresses me
D. Days can go by quickly
12. F. NO CHANGE
G. dust, however,
H. dust.
J. dust,
13. A. NO CHANGE
B. hour, looking,
C. hour looking;
D. hour looking



And now my ride is finished for today. I leave the trail and come out into the open, manicured park at the trails end. There, my older brother helps me out of my ¹⁴ chair and into his waiting van. He puts Luigi in the back, and I return to the world of pavement, streetlights, and traffic. But in my mind, I am still gliding through the forest. I am like the water, flowing over ancient stones. Inside, I am still a dragonfly.

14. F. NO CHANGE
 G. trail's
 H. trails'
 J. trails's

Question 15 asks about the preceding passage as a whole.

15. Suppose the writer's goal had been to write an essay illustrating the pleasure that people can take in nature. Would this essay accomplish that goal?
- A. Yes, because it focuses on a variety of wildflowers that the narrator enjoys.
 B. Yes, because it focuses on the narrator's joy at having access to nature.
 C. No, because it describes the world of the city as being more important to the narrator.
 D. No, because it focuses primarily on the functioning of the narrator's motorized wheelchair.

PASSAGE II

Beneath the Streets of New York

At 2 p.m., on October 27, 1904; thousands of ¹⁶ New York City residents poured into the streets of Manhattan. Their cheers competed with the blare of ferryboat horns and the whistle of power plants. The city was celebrating an incredible engineering feat; the ¹⁷ completion of the first section of the New York City

Subway. 18

16. F. NO CHANGE
 G. 2 p.m. on October 27, 1904, thousands
 H. 2 p.m., on October 27, 1904; thousands,
 J. 2 p.m. on October 27, 1904, thousands,
17. A. NO CHANGE
 B. feat, over
 C. feat:
 D. feat
18. The writer is concerned about the level of detail in the preceding sentence and is considering deleting the phrase "the first section of" from it. If the writer were to make this deletion, the paragraph would primarily lose information that:
- F. reveals how expansive the New York City Subway would become.
 G. clarifies that only part of the subway system had been completed by October 27, 1904.
 H. makes clear that by October 27, 1904, construction of the second section of the subway was already underway.
 J. provides evidence that New York City residents at this celebration believed the entire subway system was complete.



The original subway line was 9.1 miles long and had twenty-eight stations. [A] The first train took twenty-six minutes to complete the route, which ran from City Hall to West 145th Street in under a half an hour. Tens of thousands of New Yorkers could now avoid traffic jams

by traveling underneath the streets. [B]

As early as 1865, there had been proposals for a New York subway, but that took decades to resolve the many political, financial, and technical challenges. The engineer, William Barclay Parsons accepted responsibility for overseeing this project.

Parsons decided that most of the subway tunnel would be constructed using an innovation engineering method known as “cut and cover.” [C] First, workers used picks and shovels to remove roads and dig a deep trench. After installing wooden braces to hold back the earth, workers built a concrete floor. Tunnel walls were

created: with layers of brick, ceramic blocks, tar-soaked felt for waterproofing, and concrete. The roof was made from arch-shaped wooden molds also covered with concrete. Next, track beds were filled with crushed stone, and rails were secured to wooden ties. Finally, the roof was covered with tar-soaked felt, and the roads were rebuilt.

19. A. NO CHANGE
 B. in the completion of its route.
 C. in twenty-six minutes.
 D. DELETE the underlined portion and end the sentence with a period.
20. Which choice would most effectively conclude the sentence by indicating clearly how the subway system could address the problem described in the first part of the sentence?
 F. NO CHANGE
 G. traveling more effectively.
 H. trying something new.
 J. using a system.
21. A. NO CHANGE
 B. it
 C. those
 D. DELETE the underlined portion.
22. F. NO CHANGE
 G. engineer—William Barclay Parsons
 H. engineer William Barclay Parsons,
 J. engineer William Barclay Parsons
23. A. NO CHANGE
 B. innovate engineer
 C. innovative engineering
 D. innovate engineering
24. F. NO CHANGE
 G. into the ground deeply under where the roads had previously been removed by them.
 H. a trench far down below since it was necessary to shovel deep into the earth in this method known as “cut and cover.”
 J. DELETE the underlined portion and end the sentence with a period.
25. A. NO CHANGE
 B. created, with
 C. created with
 D. created with:



Brightly lit stations welcomed the public, many
of them were skeptical of traveling underground. [D] It
²⁶

didn't take long for New Yorkers to adapt, however. The
day after the subway opened, one newspaper reported that
²⁷
the riders were emerging from underground "having
finished what will be to them the daily routine of the
rest of their lives." 28

26. **F.** NO CHANGE
G. of whom
H. of who
J. DELETE the underlined portion.
27. **A.** NO CHANGE
B. therefore.
C. for instance.
D. that is.
28. The writer wishes to add a sentence that describes the magnitude and expansiveness of the New York City Subway system today. Given that all the following statements are true, which one, if added here, would most clearly and effectively accomplish the writer's goal?
- F.** Even today, for many New Yorkers that newspaper's account is right!
- G.** Today, riding a portion of the New York City Subway's 656 miles of mainline track is a daily routine for more than 4 million people.
- H.** Today, the New York City Transit Authority continuously maintains two separate fleets of subway cars.
- J.** Now, a typical New York City Subway waiting platform ranges from 400 to 700 feet.

Question 29 asks about the preceding passage as a whole.

29. Upon reviewing the essay and finding that some information has been left out, the writer composes the following sentence incorporating that information:
- This technique, also known as "open excavation," became the standard for subway tunneling for nearly sixty years.
- If the writer were to add this sentence to the essay, the sentence would most logically be placed at Point:
- A.** A.
B. B.
C. C.
D. D.



ACT MATHEMATICS TEST

30 Minutes—30 Questions

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

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

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

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

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

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

1. The weekly fee for staying at the Pleasant Lake Campground is \$20 per vehicle and \$10 per person. Last year, weekly fees were paid for v vehicles and p persons. Which of the following expressions gives the total amount, in dollars, collected for weekly fees last year?
 - A. $20v + 10p$
 - B. $20p + 10v$
 - C. $10(v + p)$
 - D. $30(v + p)$
 - E. $10(v + p) + 20p$
2. If $r = 9$, $b = 5$, and $g = -6$, what does $(r + b - g)(b + g)$ equal?
 - F. -20
 - G. -8
 - H. 8
 - J. 19
 - K. 20
3. A copy machine makes 60 copies per minute. A second copy machine makes 80 copies per minute. The second machine starts making copies 2 minutes after the first machine starts. Both machines stop making copies 8 minutes after the first machine started. Together, the 2 machines made how many copies?
 - A. 480
 - B. 600
 - C. 680
 - D. 720
 - E. 960
4. Marlon is bowling in a tournament and has the highest average after 5 games, with scores of 210, 225, 254, 231, and 280. In order to maintain this exact average, what *must* be Marlon's score for his 6th game?
 - F. 200
 - G. 210
 - H. 231
 - J. 240
 - K. 245
5. Joelle earns her regular pay of \$7.50 per hour for up to 40 hours of work in a week. For each hour over 40 hours of work in a week, Joelle is paid $1\frac{1}{2}$ times her regular pay. How much does Joelle earn for a week in which she works 42 hours?
 - A. \$126.00
 - B. \$315.00
 - C. \$322.50
 - D. \$378.00
 - E. \$472.50
6. Which of the following mathematical expressions is equivalent to the verbal expression "A number, x , squared is 39 more than the product of 10 and x " ?
 - F. $2x = 39 + 10x$
 - G. $2x = 39x + 10x$
 - H. $x^2 = 39 - 10x$
 - J. $x^2 = 39 + x^{10}$
 - K. $x^2 = 39 + 10x$
7. If $9(x - 9) = -11$, then $x = ?$
 - A. $-\frac{92}{9}$
 - B. $-\frac{20}{9}$
 - C. $-\frac{11}{9}$
 - D. $-\frac{2}{9}$
 - E. $\frac{70}{9}$



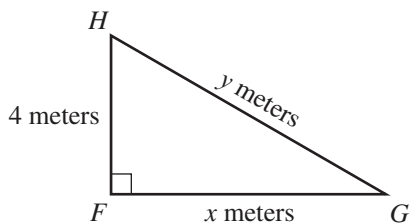
8. The inequality $6(x + 2) > 7(x - 5)$ is equivalent to which of the following inequalities?

A. $x < -23$
 B. $x < 7$
 C. $x < 17$
 D. $x < 37$
 E. $x < 47$

9. The sides of a square are 3 cm long. One vertex of the square is at $(2,0)$ on a square coordinate grid marked in centimeter units. Which of the following points could also be a vertex of the square?

F. $(-4, 0)$
 G. $(0, 1)$
 H. $(1, -1)$
 J. $(4, 1)$
 K. $(5, 0)$

10. For $\triangle FGH$, shown below, which of the following is an expression for y in terms of x ?

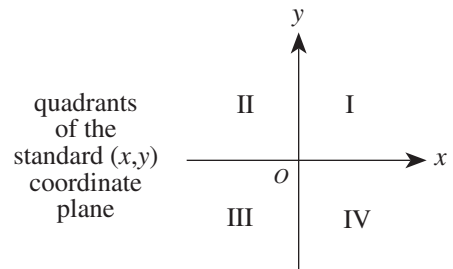


A. $x + 4$
 B. $\sqrt{x^2 + 4}$
 C. $\sqrt{x^2 + 8}$
 D. $\sqrt{x^2 - 16}$
 E. $\sqrt{x^2 + 16}$

11. A bag contains 12 red marbles, 5 yellow marbles, and 15 green marbles. How many additional red marbles must be added to the 32 marbles already in the bag so that the probability of randomly drawing a red marble is $\frac{3}{5}$?

F. 13
 G. 18
 H. 28
 J. 32
 K. 40

12. What are the quadrants of the standard (x,y) coordinate plane below that contain points on the graph of the equation $4x - 2y = 8$?



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

13. The graph of $y = -5x^2 + 9$ passes through $(1,2a)$ in the standard (x,y) coordinate plane. What is the value of a ?

F. 2
 G. 4
 H. 7
 J. -1
 K. -8

14. Jerome, Kevin, and Seth shared a submarine sandwich. Jerome ate $\frac{1}{2}$ of the sandwich, Kevin ate $\frac{1}{3}$ of the sandwich, and Seth ate the rest. What is the ratio of Jerome's share to Kevin's share to Seth's share?

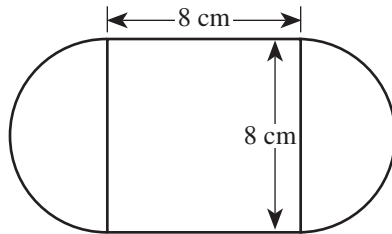
A. 2:3:6
 B. 2:6:3
 C. 3:1:2
 D. 3:2:1
 E. 6:3:2

15. A particular circle in the standard (x,y) coordinate plane has an equation of $(x - 5)^2 + y^2 = 38$. What are the radius of the circle, in coordinate units, and the coordinates of the center of the circle?

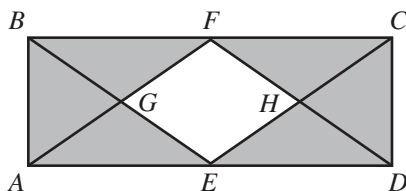
| | radius | center |
|----|-------------|----------|
| F. | $\sqrt{38}$ | $(5,0)$ |
| G. | 19 | $(5,0)$ |
| H. | 38 | $(5,0)$ |
| J. | $\sqrt{38}$ | $(-5,0)$ |
| K. | 19 | $(-5,0)$ |



16. The figure below consists of a square and 2 semicircles, with dimensions as shown. What is the outside perimeter, in centimeters, of the figure?



- A. $8 + 8\pi$
 B. $16 + 8\pi$
 C. $16 + 16\pi$
 D. $32 + 8\pi$
 E. $32 + 16\pi$
17. In the figure below, points E and F are the midpoints of sides \overline{AD} and \overline{BC} of rectangle $ABCD$, point G is the intersection of \overline{AF} and \overline{BE} , and point H is the intersection of \overline{CE} and \overline{DF} . The interior of $ABCD$ except for the interior of $EGFH$ is shaded. What is the ratio of the area of $EGFH$ to the area of the shaded region?



- F. 1:2
 G. 1:3
 H. 1:4
 J. 1:6
 K. Cannot be determined from the given information
18. The coordinates of the endpoints of \overline{CD} , in the standard (x,y) coordinate plane, are $(-4,-2)$ and $(14,2)$. What is the x -coordinate of the midpoint of \overline{CD} ?

- A. 0
 B. 2
 C. 5
 D. 9
 E. 10
19. What is the surface area, in square inches, of an 8-inch cube?
- F. 512
 G. 384
 H. 320
 J. 256
 K. 192

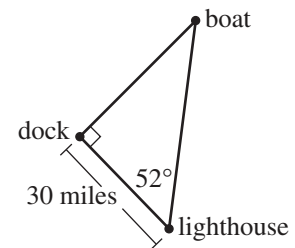
20. The equations below are linear equations of a system where a , b , and c are positive integers.

$$\begin{aligned} ay + bx &= c \\ ay - bx &= c \end{aligned}$$

Which of the following describes the graph of at least 1 such system of equations in the standard (x,y) coordinate plane?

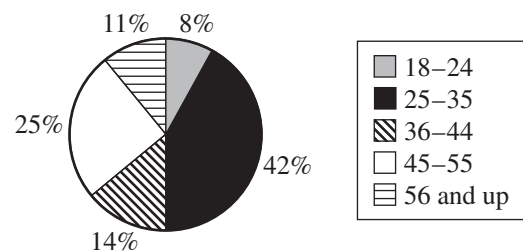
- I. 2 parallel lines
 II. 2 intersecting lines
 III. A single line
- A. I only
 B. II only
 C. III only
 D. I or II only
 E. I, II, or III
21. According to the measurements given in the figure below, which of the following expressions gives the distance, in miles, from the boat to the dock?

- F. $30 \tan 52^\circ$
 G. $30 \cos 52^\circ$
 H. $30 \sin 52^\circ$
 J. $\frac{30}{\cos 52^\circ}$
 K. $\frac{30}{\sin 52^\circ}$



22. The circle graph below shows the distribution of registered voters, by age, for a community. Registered voters are randomly selected from this distribution to be called for jury duty. What are the odds (in the age range: not in the age range) that the first person called for jury duty is in the age range of 25–35 years?

Distribution of Registered Voters by Age

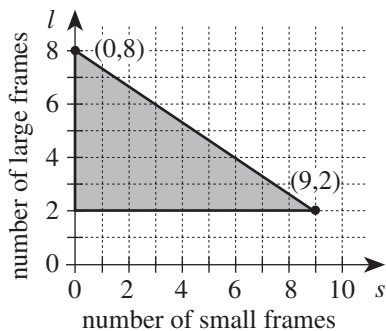


- A. 1:3
 B. 7:8
 C. 7:43
 D. 21:29
 E. 42:25



Use the following information to answer questions 32–33.

Marcia makes and sells handcrafted picture frames in 2 sizes: small and large. It takes her 2 hours to make a small frame and 3 hours to make a large frame. The shaded triangular region shown below is the graph of a system of inequalities representing weekly constraints Marcia has in making the frames. For making and selling s small frames and l large frames, Marcia makes a profit of $30s + 70l$ dollars. Marcia sells all the frames she makes.



23. The weekly constraint represented by the horizontal line segment containing $(9, 2)$ means that each week Marcia makes a minimum of:
- F. 2 large frames.
 - G. 9 large frames.
 - H. 2 small frames.
 - J. 9 small frames.
 - K. 11 small frames.
24. For every hour that Marcia spends making frames in the second week of December each year, she donates \$3 from that week's profit to a local charity. This year, Marcia made 4 large frames and 2 small frames in that week. Which of the following is closest to the percent of that week's profit Marcia donated to the charity?
- A. 6%
 - B. 12%
 - C. 14%
 - D. 16%
 - E. 19%

25. The *determinant* of a matrix $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ equals $ad - cb$.

What must be the value of x for the matrix $\begin{bmatrix} x & 8 \\ x & x \end{bmatrix}$ to

have a determinant of -16 ?

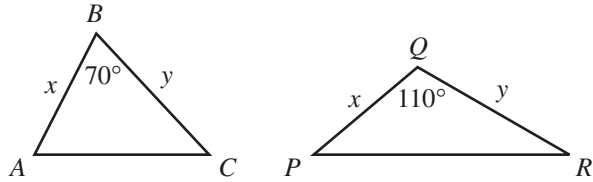
- A. -4
 - B. -2
 - C. $-\frac{8}{5}$
 - D. $\frac{8}{3}$
 - E. 4
26. A formula for finding the value, A dollars, of P dollars invested at $i\%$ interest compounded annually for n years is $A = P(1 + 0.01i)^n$. Which of the following is an expression for P in terms of i , n , and A ?
- F. $A - 0.01i^n$
 - G. $A + 0.01i^n$
 - H. $\left(\frac{A}{1 + 0.01i}\right)^n$
 - J. $\frac{A}{(1 - 0.01i)^n}$
 - K. $\frac{A}{(1 + 0.01i)^n}$

27. If x and y are real numbers such that $x > 1$ and $y < -1$, then which of the following inequalities *must* be true?

- A. $\frac{x}{y} > 1$
- B. $|x|^2 > |y|$
- C. $\frac{x}{3} - 5 > \frac{y}{3} - 5$
- D. $x^2 + 1 > y^2 + 1$
- E. $x^{-2} > y^{-2}$



28. Triangles $\triangle ABC$ and $\triangle PQR$ are shown below. The given side lengths are in centimeters. The area of $\triangle ABC$ is 30 square centimeters. What is the area of $\triangle PQR$, in square centimeters?



- F. 15
G. 19
H. 25
J. 30
K. 33

29. What is the sum of the first 4 terms of the arithmetic sequence in which the 6th term is 8 and the 10th term is 13?

- A. 10.5
B. 14.5
C. 18
D. 21.25
E. 39.5

30. The solution set of which of the following equations is the set of real numbers that are 5 units from -3 ?

- F. $|x + 3| = 5$
G. $|x - 3| = 5$
H. $|x + 5| = 3$
J. $|x - 5| = 3$
K. $|x + 5| = -3$

END OF TEST 2

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

DO NOT RETURN TO THE PREVIOUS TEST.

ACT READING TEST
17 Minutes—20 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

PROSE FICTION: This passage is adapted from the short story “From Aboard the Night Train” by Kimberly M. Blaeser (©1993 by Kimberly M. Blaeser), which appeared in *Earth Song, Sky Spirit: Short Stories of the Contemporary Native American Experience*.

The passage begins with a female narrator traveling to her hometown.

The moon gives some light and I can make out the contours of the land, see the faint reflection in the lakes and ponds we pass. Several times I see or imagine I see glowing eyes staring back at me from a patch of woods beside the track. When we pass through the tiny towns, I try to read their signs, catch their names from their water towers or grain elevators. Occasionally the train stops at . . . Portage . . . Winona . . . Red Wing.

In my sleeping compartment, watching the night countryside, so much world rolls by my window. Like a voyeur I watch the various reunion scenes. I feel these scenes add up to something, some meaning or lesson about all life, and I try to put it into words for myself but find I can’t. I finally give up, roll over, go to sleep, and dream.

But now I am awake, keeping my vigil over the Midwest’s pastoral kingdom. Chicago, even Minneapolis seems a long way away. A few hours later, still in the deep night hours, the train arrives at my stop, Detroit Lakes, Minnesota, the closest I can get to my destination.

Suddenly, as I descend the two steps from the train, the porter hands me into one of the reunion scenes. “Hi, honey, how was the trip? Did you get any sleep?” “A little. Been waiting long?” “Long enough to beat your dad in two games of cribbage . . .” Glancing back at the train windows, I imagine I am looking into eyes hidden behind mirrored sunglasses.

* * *

I think about progress a lot in the next few days and about what passes for progress. Nightly we walk about town, talk marriages and funerals, then sit on the newly installed benches on Main Street. Together we assemble from our memories the town as it was twenty or twenty-five years ago. We remember the little Model

Meat Market and the old Pioneer office. We rebuild the Landmark Hotel, take down the vinyl fronts from the grocery store, change the light posts, the awnings, the names of the current businesses. I put back the old depot, you the corner funeral home. But soon we are distracted and leave things half constructed when we begin to add the people, what’s-his-name, the square dance caller; Ed, the fire chief; and Lydia, the town’s best gossip. On the walk back home, we have begun to list very specific things, which is the closest we get to the intangibles: the rental meat lockers, the four-digit telephone numbers, the free ice cream during dairy month.

Late at night in my old bed, I listen to the night sounds of the house and fall asleep counting the changes that have come to my little hometown: The park is off limits after dark now, the football field is fenced in, one-hour photo has come to town along with a tanning salon and a pizza parlor. The dry goods store is gone, the dairy, long gone. People lock their houses now more than once a year when the carnival comes to town. But all of these changes pale in comparison to what has replaced the bait shop, the used car lot, and Mr. Morton’s small farm, what has sprung up on Highway 59 at the edge of town: Las Vegas-style gambling.

* * *

Taking the train back, I decide to put on pajamas and crawl under the sheets, hoping to trick myself into a good night’s sleep. It seems to work. I have slept soundly for several hours, but then the dreams start. I fall in and out of them. But they are not the usual nightmares. I am in a place where folks know you ten, fifteen, twenty years after you’ve left and still see in your face that of your grandfather or aunt or cousin. I know I am home and I feel safe.

I have an early breakfast with a would-be journalist and some ski vacationers who want to talk about election prospects. I merely feign attention. I nod or laugh on cue, while I try to read upside-down a story in the would-be journalist’s newspaper that has caught my eye. It is about the Russian space station and the cosmonaut who had been up in orbit during the takeover attempt and ultimate dissolution of the Soviet Union. After sixteen long months, they are bringing the capsule back. While the train carries me back to my current home and away from my former, I keep thinking about

that poor cosmonaut coming back to find his whole world changed, to find himself a man without a country—at least without the country he left behind.

85 I watch the ten o'clock national news broadcast. I see him emerge from the capsule. I see him try to stand and have his knees buckle. I know they said it was because he hadn't been able to exercise for such a long time, but I wonder if his weak-kneed feeling might not
90 have more to do with what he saw out the window of the space station and with how the world was happening around without him.

1. The point of view from which the passage is told is best described as that of:
 - A. a young adult riding a train through the small towns of the Upper Midwest.
 - B. a young adult preparing to move away from her hometown.
 - C. an adult missing the new home she has established.
 - D. an adult reflecting on the past and pondering the present.
2. The passage contains recurring references to all of the following EXCEPT:
 - F. dreams.
 - G. reunion scenes.
 - H. photographs.
 - J. train trips.
3. The first three paragraphs (lines 1–21) establish all of the following about the narrator EXCEPT that she is:
 - A. passing through a number of towns.
 - B. originally from Chicago.
 - C. traveling by train.
 - D. observant of the landscape.
4. It can reasonably be inferred from the passage that the narrator thinks her hometown has:
 - F. improved significantly over the years.
 - G. made little genuine progress.
 - H. remained about the same as it was years ago.
 - J. a chance of being rebuilt as it used to be.
5. Based on the narrator's account, all of the following were part of the past, rather than the present, in her hometown EXCEPT:
 - A. four-digit phone numbers.
 - B. the fenced-in football field.
 - C. free ice cream during dairy month.
 - D. the depot.
6. According to the narrator, which of the following businesses is relatively new to her hometown?
 - F. The tanning salon
 - G. The bait shop
 - H. The dry goods store
 - J. The used-car lot
7. When the narrator refers to the cosmonaut as "a man without a country" (lines 83–84), she is most likely directly referring to the:
 - A. cosmonaut's feeling that he is now a citizen of space, not the former Soviet Union.
 - B. cosmonaut's unrealized expectation that he will be treated like a hero.
 - C. political transformation that occurred while the cosmonaut was in space.
 - D. sixteen months that the cosmonaut spent in orbit around Earth.
8. Details in the passage most strongly suggest that the people meeting the narrator at the train station include:
 - F. her father.
 - G. her sister.
 - H. a neighbor.
 - J. a journalist.
9. The narrator indicates that the most significant change to her hometown has been the addition of:
 - A. square dancing.
 - B. vinyl storefronts.
 - C. benches on Main Street.
 - D. Las Vegas-style gambling.
10. According to the passage, news reports attributed the cosmonaut's knees buckling to:
 - F. his gratitude at being back on Earth.
 - G. political changes in the world.
 - H. a lack of exercise.
 - J. his dismay at what he had seen from the space station.

Passage II

SOCIAL SCIENCE: This passage is adapted from the article “Green Music in the Rain Forest” by Suzanne Charlé, which appeared in the Fall 2002 *Ford Foundation Report*.

OELA is an acronym based on Portuguese words rather than the English words used in this article. A *luthier* is a maker of stringed musical instruments.

The Amazonian Workshop School for Fabrication of Stringed Instruments (OELA) is a small part of a larger effort to create a sustainable harvest of the great Amazon forest and to give employment to the region’s
5 burgeoning population.

“Few people know that the Amazon is one of the most rapidly urbanizing regions of the world,” observes José Gabriel López, a Ford Foundation program officer in Brazil. The city of Manaus, for example, has grown
10 in the past decade from 850,000 to 1.5 million. “This rural-urban migration and the resultant urban shantytowns stand as living symbols of failed or nonexistent rural development policies,” López says. “In many
15 places, small-scale rural producers have been abandoned—devoid of health and education services, credit, technical assistance and opportunity. What Rubens Gomes, founder of the workshop school, and his colleagues have created in Manaus is hope.”

Gomes knows how to build hope. The school, he
20 notes proudly, is the first to make stringed instruments in the Amazon. And it is the first in all of the Americas to construct instruments exclusively of lumber harvested in an environmentally and socially sustainable manner certified by the Forest Stewardship Council.

“Officially, there are 30 million cubic meters of wood cut in the Amazon annually,” Gomes says. “Twenty million of this is wasted—sawdust, scraps, unwanted wood left to rot. And those are the official
25 numbers. The motive of this school is to transform what is lost into things of value. Many people could do this—but there are no schools teaching carpentry in the Amazon.”

OELA is meant to help fill the void. To graduate, each student must make a stringed instrument. All the
35 guitars are made from certified wood. Gomes explains that traditionally, Brazilian rosewood and ebony were used in the construction of guitars. But because of intense harvesting, these trees are close to extinction. “I’ve been working for years, trying to find Amazon
40 woods that are unknown on the market, that are in plentiful supply and that can be used in instrument making,” Gomes says. He experimented with dozens before he found types that have the right strength and sound. (Like other master luthiers, he can tell by touching the wood whether it will reverberate well.) Once he
45 identified the woods as possible substitutes, he sent them to a laboratory to be tested for the right grain and density. Today, *Brosimum rubescens* is substituted for rosewood, *Aniba canellila* for ebony, and *Protium*
50 species for Brazilian mahogany and cedar. These and

some 25 other undervalued tropical hardwoods have found their way into the luthiers’ workshop, taking the pressure off the better-known woods.

For the past year, master luthier Raúl Lage from
55 the Fernando Ortiz Instrument-Making School of the Cuban Music Institute has been working with the students. There are hurdles, he cautions, a number of them technical. The high humidity in Manaus means that the wood will crack in drier climates unless properly
60 treated. Glue frequently doesn’t hold. These problems are slowly being resolved.

There is also a major obstacle outside the workshop: The resistance of buyers to new woods. Thus far, most of the instruments have been sold to environmentalists, some of whom “adopt” a student by paying his
65 or her tuition; the student’s “project guitar” is then given to the donor as a gift.

There is also the possibility of contract work from outside the Amazon. Gomes’s hopes were raised
70 recently when the president of a well-known guitar company based in Nashville, Tennessee, ordered 15 guitars to be auctioned off for the Rainforest Alliance.

Lage cautions that it will be a long time before any
75 of the students can command a master luthier’s fee. “There is a saying,” Lage says. “Anyone can make one good guitar; it takes a master to make one every time.”

José Lucio do Nascimento Rabelo, director of the technical school, says, “By learning this skill, students
80 come to look at the forest in a new way; there are ways other than logging for plywood and firewood to earn a living, to better the life of the people.” One of the woods being used as a replacement for the precious rosewood, he notes, is typically used to make charcoal.

Such an appreciation for the forest, says Rabelo,
85 could have a huge effect on the survival of the rain forest; some 80 percent of the students come from other parts of the state of Amazonas, and virtually all of them return to their home towns. “Some,” he adds, “go on to
90 become politicians who will have a direct influence on the future of the forest.”

11. Which of the following assumptions would be most critical for a reader to accept in order to agree fully with the author’s claims in the passage?
- A. Shantytowns in the Amazon need to be relocated if the forest is to be saved.
 - B. Learning to make consistently good guitars requires access to the best materials available.
 - C. Small-scale rural producers in the Amazon can help preserve the forest by being innovative.
 - D. Consumers outside of the Amazon can do little to help prevent deforestation.

12. In the context of the passage, the statement “All the guitars are made from certified wood” (lines 34–35) most nearly suggests that Gomes’s workshop:
- F. uses environmentally sustainable woods in its guitars.
 - G. isn’t doing enough to stop unnecessary deforestation in the Amazon.
 - H. has little chance of pleasing both musicians and environmentalists.
 - J. uses only traditional woods in making its guitars.
13. It can most reasonably be inferred from the passage that regarding OELA, the author feels:
- A. skeptical of the workshop’s aims.
 - B. dismayed by the workshop’s low productivity.
 - C. supportive of the workshop’s goals.
 - D. confident that the workshop could be duplicated in other places.
14. The main purpose of the second paragraph (lines 6–18) is to:
- F. draw attention to the Amazon’s tremendous population growth.
 - G. explain the necessity for ventures such as Gomes’s.
 - H. explain the presence of the Ford Foundation in the Amazon.
 - J. justify raising taxes to increase social services in the Amazon.
15. The main function of the fifth paragraph (lines 33–53) is to:
- A. demonstrate the woodworking skills required to be a master luthier.
 - B. explore the limitations of science as compared to intuition.
 - C. outline the scientific reasons why one type of wood cannot be replaced by another.
 - D. show that experiments led to the discovery of good substitutes for rare woods.
16. The passage notes all of the following as problems that the fledgling Amazon guitar industry has experienced EXCEPT that:
- F. glue on the guitars sometimes doesn’t hold.
 - G. the wood used may crack in drier climates.
 - H. woods usable for guitars have become extinct.
 - J. buyers resist guitars made with nontraditional woods.
17. The passage indicates that, as a group, the OELA students may impact the survival of the rain forests because most of them:
- A. care deeply enough about music to spend their lives making musical instruments.
 - B. will return to their homes and spread their environmental knowledge.
 - C. are willing to endure personal hardships in order to use their new skills.
 - D. will have political careers after they return home.
18. In the passage, Gomes indicates that of the wood cut in the Amazon rain forest each year, approximately how much wood is wasted?
- F. One-fourth
 - G. One-third
 - H. One-half
 - J. Two-thirds
19. The passage states that all of the following are woods traditionally used for making stringed instruments EXCEPT:
- A. Aniba canellila.
 - B. rosewood.
 - C. Brazilian mahogany.
 - D. ebony.
20. According to the passage, when an OELA student is “adopted,” he or she receives:
- F. tuition.
 - G. room and board.
 - H. food and clothing.
 - J. a musical instrument.



ACT 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

Finch beak depth (see Figure 1) is an *inheritable* trait (it can be passed from parents to offspring).



Figure 1

Researchers studied the beak depth of 2 species of finches, *Geospiza fortis* and *Geospiza fuliginosa*. Both species live on Island A. *G. fortis* alone lives on Island B, and *G. fuliginosa* alone lives on Island C. For both species, the primary food is seeds. Birds with shallower beaks can efficiently crush and eat only small seeds. Birds with deeper beaks can crush and eat both large and small seeds, but they prefer small seeds.

Study 1

Researchers captured 100 *G. fortis* finches and 100 *G. fuliginosa* finches on Island A. They tagged each bird, measured its beak depth, and released it. Then they calculated the percent of birds having each of the beak depths that had been measured. The researchers followed the same procedures with 100 *G. fortis* finches from Island B and 100 *G. fuliginosa* finches from Island C. The results of this study are shown in Figure 2.

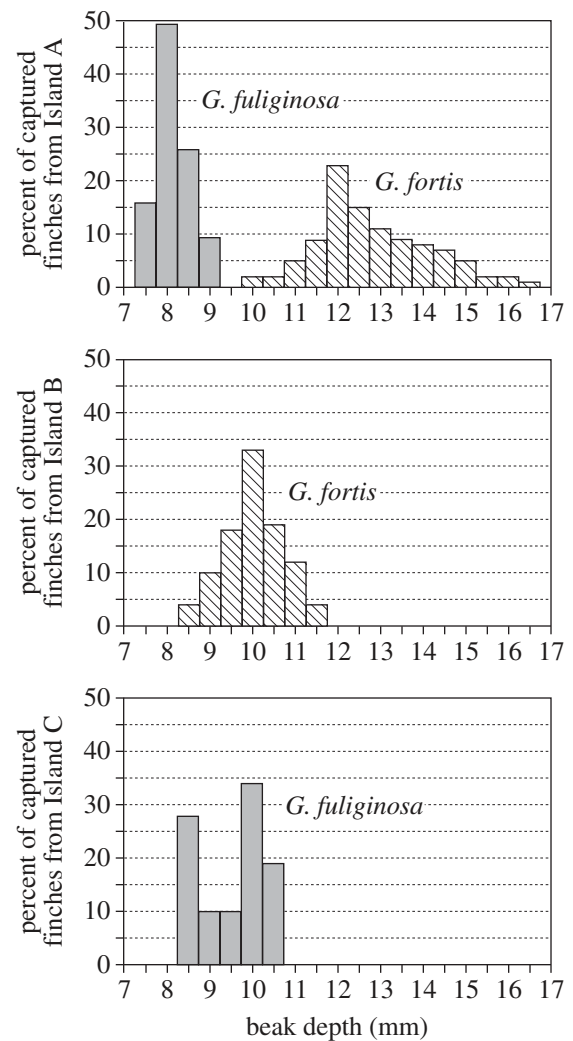


Figure 2

Study 2

After completing Study 1, the researchers returned to Island B each of the next 10 years, from 1976 to 1985. During each visit, the researchers captured at least 50 *G. fortis* finches and measured their beak depths. Then



they calculated the average *G. fortis* beak depth for each of the 10 years. The researchers noted that, during the 10-year period, 3 years were exceptionally dry, and 1 year was very wet (see Figure 3). Small seeds are abundant during wet years. During dry years, all seeds are less abundant, and the average size of the available seeds is larger.

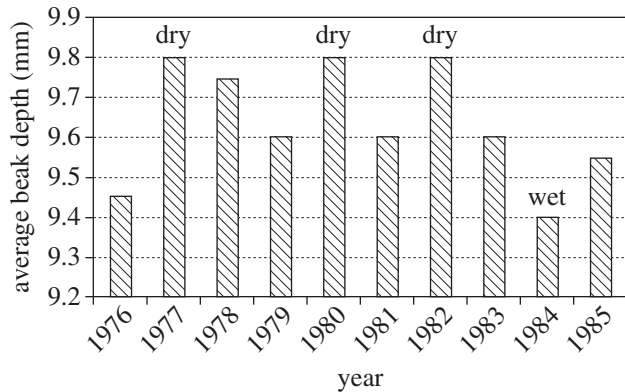


Figure 3

Figures adapted from Neil A. Campbell, Jane B. Reece, and Lawrence G. Mitchell, *Biology*, 5th ed. ©1999 by Benjamin/Cummings.

- Based on the results of Study 1, the highest percent of finches on Island B and Island C had a beak depth of:

| | Island B | Island C |
|----|----------|----------|
| A. | 8 mm | 8 mm |
| B. | 9 mm | 12 mm |
| C. | 10 mm | 8 mm |
| D. | 10 mm | 10 mm |
- During which of the following years were small seeds likely most abundant on Island B ?
 - 1977
 - 1980
 - 1982
 - 1984
- Study 1 differed from Study 2 in which of the following ways?
 - G. fortis* finches were captured during Study 1 but not during Study 2.
 - G. fuliginosa* finches were captured during Study 1 but not during Study 2.
 - The beak depth of captured birds was measured during Study 1 but not during Study 2.
 - The beak depth of captured birds was measured during Study 2 but not during Study 1.
- It is most likely that the researchers tagged the birds that they captured during Study 1 to:
 - determine how beak depth was affected by rainfall on Island A.
 - determine the average age of each finch population.
 - ensure that the beak depth of each finch was measured multiple times during Study 1.
 - ensure that the beak depth of each finch was measured only once during Study 1.
- Based on the results of Study 2, would a finch with a beak depth of 9.4 mm or a finch with a beak depth of 9.9 mm more likely have had a greater chance of survival during 1977 ?
 - A finch with a beak depth of 9.4 mm, because, on average, the size of available seeds is larger during dry years.
 - A finch with a beak depth of 9.4 mm, because, on average, the size of available seeds is smaller during dry years.
 - A finch with a beak depth of 9.9 mm, because, on average, the size of available seeds is larger during dry years.
 - A finch with a beak depth of 9.9 mm, because, on average, the size of available seeds is smaller during dry years.
- A researcher hypothesized that there would be more variation in the beak depths measured for the *G. fortis* finches when they were forced to compete with another finch species for seeds. Do the results of Study 1 support this hypothesis?
 - Yes; the range of beak depths measured for *G. fortis* finches was greater on Island A than on Island B.
 - Yes; the range of beak depths measured for *G. fortis* finches was greater on Island B than on Island A.
 - No; the range of beak depths measured for *G. fortis* finches was greater on Island A than on Island B.
 - No; the range of beak depths measured for *G. fortis* finches was greater on Island B than on Island A.

**Passage II**

Substances in the atmosphere, such as Cu^{2+} , Zn^{2+} , Cl^- , and SO_4^{2-} ions, are carried down to Earth's surface by precipitation. This process is known as *wet deposition*. Cu^{2+} and Zn^{2+} ions are put into the atmosphere by high-temperature combustion processes. The presence of Cl^- and SO_4^{2-} ions in the atmosphere can be attributed to road-salt dust and electrical power generation, respectively.

Study 1

A rain gauge, placed on the roof of a 1-story building, at a specific urban site was used to collect precipitation over a 12-month period. At the same time each evening, the amount of precipitation in the rain gauge was recorded, after which the collected precipitation was emptied from the gauge and stored. (Assume no measurable evaporation occurred during any day.) Figure 1 shows the measured monthly precipitation in centimeters.

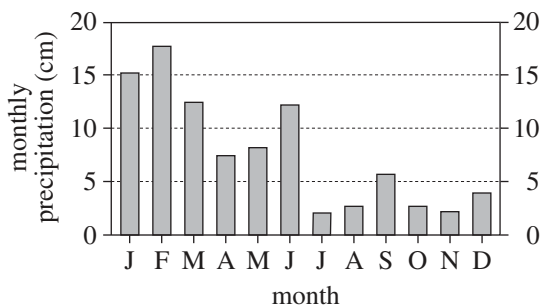


Figure 1

At the end of each month, all the samples collected during that month were mixed, and some of this combined sample was analyzed for the concentrations of Cu^{2+} and Zn^{2+} ions. Using these data, the monthly wet deposition of each substance, in micrograms (μg) per meter², was calculated (see Figure 2).

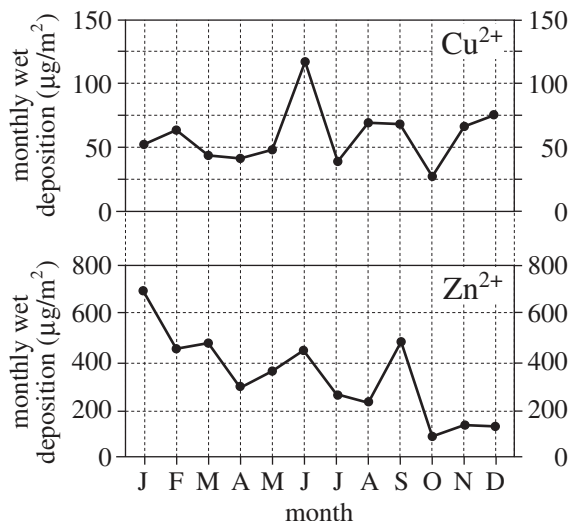


Figure 2

Study 2

Another portion of the combined sample for each month was analyzed for the concentrations of Cl^- and SO_4^{2-} ions. Using these data, the monthly wet deposition of each substance, in milliequivalents (meq) per m², was calculated (see Figure 3).

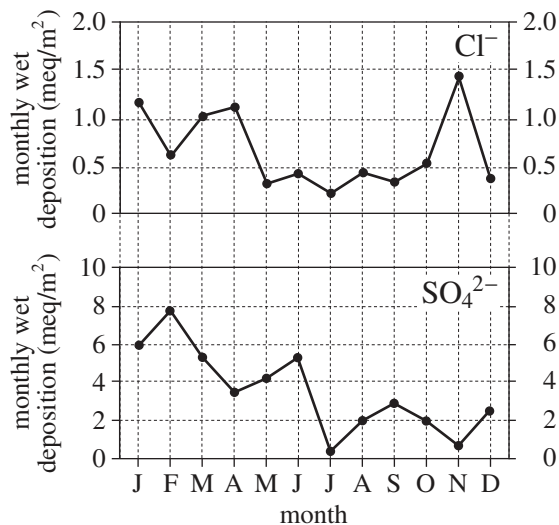


Figure 3

Study 3

The *annual* wet deposition of Cu^{2+} and of Zn^{2+} for the 12-month period, in $\mu\text{g}/\text{m}^2$, was calculated for the urban site (the source of the Cu^{2+} and Zn^{2+}) and also for Rural Sites 1 and 2, located 50 km and 100 km east, respectively, of the urban site (see Figure 4).

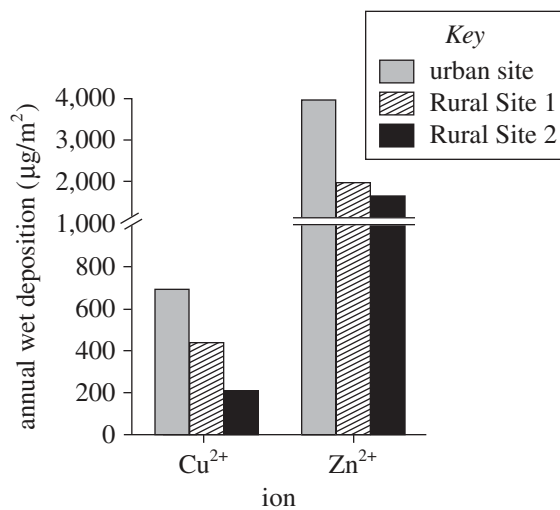
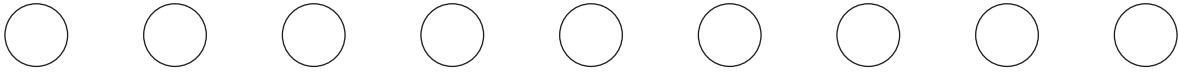


Figure 4

Figures adapted from Kathryn Conko et al., "Atmospheric Wet Deposition of Trace Elements to a Suburban Environment, Reston, Virginia, USA." ©2004 by Elsevier, Ltd.



7. According to Figure 1, over the 12-month period, the monthly precipitation at the urban site was maximum in February and minimum in July. According to Figures 2 and 3, the wet deposition of which ion was also maximum in February and minimum in July?
- A. Cu^{2+}
 - B. Zn^{2+}
 - C. Cl^-
 - D. SO_4^{2-}
8. Based on the results of Study 1, the average monthly wet deposition for Cu^{2+} over the 12-month period was:
- F. less than $50 \mu\text{g}/\text{m}^2$.
 - G. between $50 \mu\text{g}/\text{m}^2$ and $75 \mu\text{g}/\text{m}^2$.
 - H. between $75 \mu\text{g}/\text{m}^2$ and $100 \mu\text{g}/\text{m}^2$.
 - J. greater than $100 \mu\text{g}/\text{m}^2$.
9. Is the statement “The values for Cl^- wet deposition were greater during the winter and early spring when road salt is typically applied” supported by the results of Study 2 ?
- A. Yes, because Cl^- wet deposition values were, on average, greater from November to April than they were from May to October.
 - B. Yes, because Cl^- wet deposition values were, on average, less from November to April than they were from May to October.
 - C. No, because Cl^- wet deposition values were, on average, greater from November to April than they were from May to October.
 - D. No, because Cl^- wet deposition values were, on average, less from November to April than they were from May to October.
10. Suppose there had been no precipitation during 1 entire month of the 12-month period. Based on the information provided, during that month there would have been:
- F. significant wet deposition of all 4 substances.
 - G. significant wet deposition of Cu^{2+} and Zn^{2+} , but no wet deposition of Cl^- and SO_4^{2-} .
 - H. no wet deposition of any of the 4 substances.
 - J. no wet deposition of Cu^{2+} and Zn^{2+} , but significant wet deposition of Cl^- and SO_4^{2-} .
11. According to Study 3, as distance from the urban site increased, the annual wet deposition:
- A. increased for both Cu^{2+} and Zn^{2+} .
 - B. increased for Cu^{2+} but decreased for Zn^{2+} .
 - C. decreased for both Cu^{2+} and Zn^{2+} .
 - D. remained the same for both Cu^{2+} and Zn^{2+} .
12. Which of the following variables was kept constant in Study 2 ?
- F. Site
 - G. Monthly rainfall
 - H. Wet deposition of Zn^{2+}
 - J. Wet deposition of Cl^-



Passage III

Cloud cover is the percent of Earth’s surface covered by clouds. Cloud cover may increase because of an increase in the *cosmic ray flux* (number of high-energy particles from space reaching Earth per m² per hour). Table 1 shows how Earth’s cover of *low clouds* (0 km to 3.2 km altitude) varies with the cosmic ray flux. Figures 1–3 show the *relative cosmic ray flux*, RCRF (the percent below the flux measured on October 1, 1965), and the monthly average cover of *high clouds* (6.0 km to 16.0 km altitude), *middle clouds* (3.2 km to 6.0 km altitude), and low clouds, respectively, from January 1980 to January 1995.

| Cosmic ray flux (particles/m ² /hr) | Cover of low clouds (%) |
|--|-------------------------|
| 340,000 | 27.8 |
| 360,000 | 28.1 |
| 380,000 | 28.4 |
| 400,000 | 28.7 |
| 420,000 | 29.0 |

Table 1 adapted from E. Palle Bagó and C. J. Butler, “The Influence of Cosmic Rays on Terrestrial Clouds and Global Warming.” ©2000 by Institute of Physics Publications, Ltd.

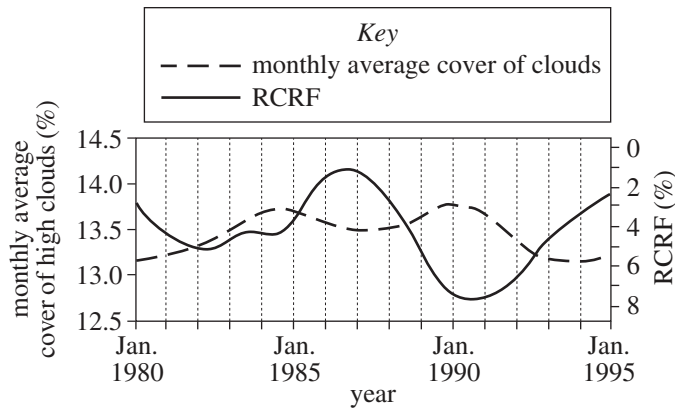


Figure 1

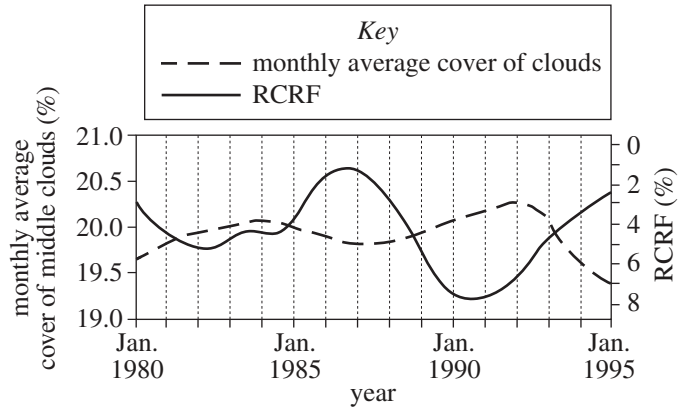


Figure 2

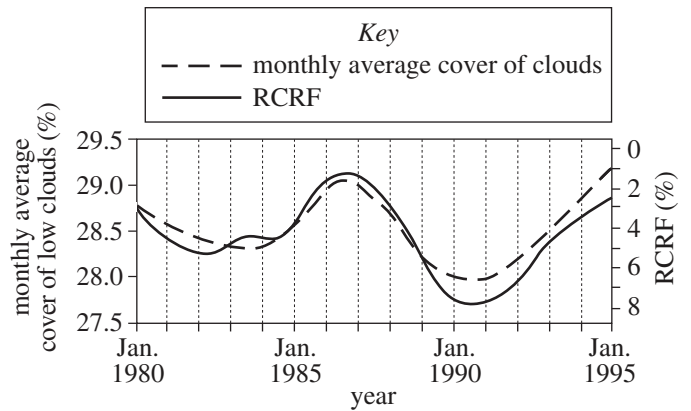
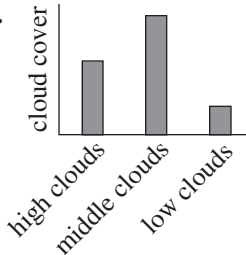
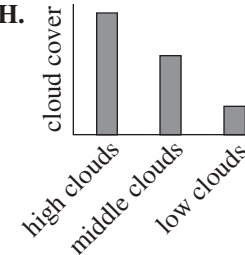
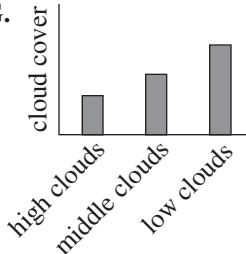
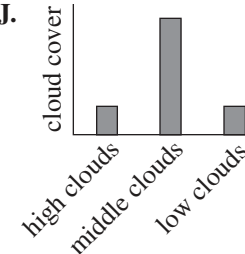


Figure 3

Figures adapted from Nigel Marsh and Henrik Svensmark, “Low Cloud Properties Influenced by Cosmic Rays.” ©2000 by The American Physical Society.



13. The percent of Earth's surface covered by high clouds in January 1987 was closest to which of the following?
- 13.0%
 - 13.5%
 - 14.0%
 - 14.5%
14. Based on Table 1, a cosmic ray flux of 440,000 particles/m²/hr would correspond to a cover of low clouds that is closest to which of the following?
- 28.7%
 - 29.0%
 - 29.3%
 - 29.6%
15. Is the statement "The monthly average cover of low clouds is more directly correlated with cosmic ray flux than is the monthly average cover of high clouds" consistent with Figures 1 and 3 ?
- Yes, because the plot for the monthly average cover of low clouds more closely parallels the plot for RCRF.
 - Yes, because the plot for the monthly average cover of high clouds more closely parallels the plot for RCRF.
 - No, because the plot for the monthly average cover of low clouds more closely parallels the plot for RCRF.
 - No, because the plot for the monthly average cover of high clouds more closely parallels the plot for RCRF.
16. Which of the following figures best represents the monthly average cover of high, middle, and low clouds in January 1992 ?
- F.** 
- H.** 
- G.** 
- J.** 
17. High clouds are composed primarily of ice crystals, whereas low clouds are composed primarily of water droplets. This difference is most likely because the average air temperature at altitudes from:
- 0 km to 3.2 km is at or below 0°C, whereas the average air temperature at altitudes from 3.2 km to 6.0 km is above 0°C.
 - 0 km to 3.2 km is at or below 0°C, whereas the average air temperature at altitudes from 6.0 km to 16.0 km is above 0°C.
 - 0 km to 3.2 km is above 0°C, whereas the average air temperature at altitudes from 3.2 km to 6.0 km is at or below 0°C.
 - 0 km to 3.2 km is above 0°C, whereas the average air temperature at altitudes from 6.0 km to 16.0 km is at or below 0°C.

**Passage IV**

Acid-base titration is a technique in which precise volumes of a *titrant* (an acid or base solution) are added incrementally to a known volume of a *sample solution* (a base or acid solution, respectively). This process can be monitored by adding an *acid-base indicator* (a substance that changes color over a certain pH range) to the sample solution or by measuring the sample solution's *conductivity*. Conductivity (measured in kilosiemens per centimeter, kS/cm) is a measure of a substance's ability to conduct electricity.

Two titration experiments were done at 25°C using a 0.10 M sodium hydroxide (NaOH) solution and either a 0.0010 M hydrochloric acid (HCl) solution or a 0.0010 M acetic acid solution (where M is moles of acid or base per liter of solution). All solutions were aqueous. An acid-base indicator solution of *nitrazine yellow* was also used. Nitrazine yellow is yellow if the pH is less than 6.0 or blue if the pH is greater than 7.0.

Experiment 1

A drop of nitrazine yellow solution was added to a flask containing 100.0 mL of the HCl solution. A probe that measures conductivity was placed in the solution. The NaOH solution was slowly added to the HCl solution in small increments. After each addition, the HCl solution was stirred and then the solution's color and conductivity were recorded (see Figure 1).

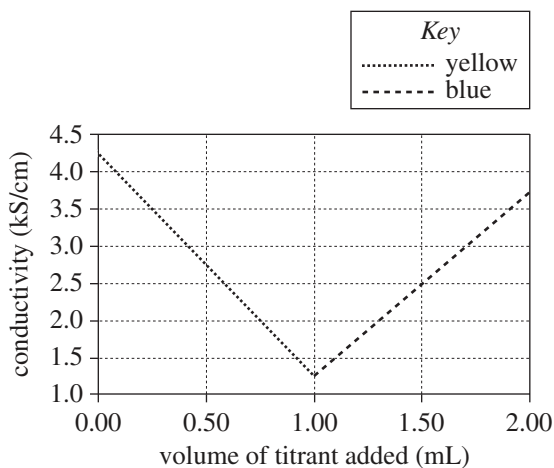


Figure 1

Experiment 2

Experiment 1 was repeated, except that the acetic acid solution was used instead of the HCl solution (see Figure 2).

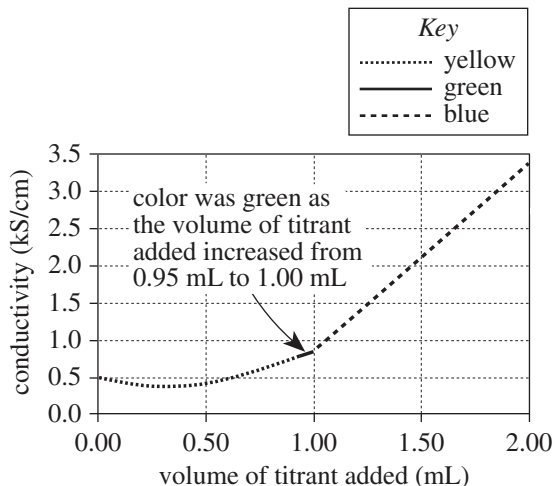


Figure 2

Figures adapted from J. West Loveland, "Conductance and Oscillography," in Gary D. Christian and James E. O'Reilly, eds., *Instrumental Analysis*, 2nd ed. ©1986 by Allyn and Bacon, Inc.

18. In Experiment 1, the sample solution was yellow at which of the following values for the volume of titrant added?

- F. 0.80 mL
- G. 1.20 mL
- H. 1.60 mL
- J. 2.00 mL

19. In Experiment 2, the sample solution was neutral at which of the following values for the volume of titrant added?

- A. 0.50 mL
- B. 1.00 mL
- C. 1.50 mL
- D. 2.00 mL



20. In Experiment 1, if 2.30 mL of titrant had been added to the sample solution, the conductivity would most likely have been:
- F. less than 0.80 kS/cm.
 - G. between 0.80 kS/cm and 2.30 kS/cm.
 - H. between 2.30 kS/cm and 3.80 kS/cm.
 - J. greater than 3.80 kS/cm.
21. In Experiment 2, which solution was the titrant and which solution was the sample solution?
- | <u>titrant</u> | <u>sample solution</u> |
|----------------|------------------------|
| A. acetic acid | NaOH |
| B. HCl | NaOH |
| C. NaOH | acetic acid |
| D. NaOH | HCl |
22. In Experiments 1 and 2, the probe that was placed in the sample solution most likely did which of the following?
- F. Cooled the solution to its freezing point
 - G. Heated the solution to its boiling point
 - H. Detected the concentration of nitrazine yellow in the solution
 - J. Passed an electrical current through a portion of the solution
23. A chemist claimed that in Experiment 2, the pH of the sample solution was greater at a value of 0.2 mL of titrant added than at a value of 1.8 mL of titrant added. Do the results of Experiment 2 support this claim?
- A. No; at a value of 0.2 mL of titrant added, the sample solution was yellow, and at a value of 1.8 mL of titrant added, the sample solution was blue.
 - B. No; at a value of 0.2 mL of titrant added, the sample solution was blue, and at a value of 1.8 mL of titrant added, the sample solution was yellow.
 - C. Yes; at a value of 0.2 mL of titrant added, the sample solution was yellow, and at a value of 1.8 mL of titrant added, the sample solution was blue.
 - D. Yes; at a value of 0.2 mL of titrant added, the sample solution was blue, and at a value of 1.8 mL of titrant added, the sample solution was yellow.

**Passage V**

An astronomy class is given the following facts about stellar evolution.

1. A star's evolution can be divided into 3 stages: *pre-main sequence* (pre-MS), *main sequence* (MS), and *post-main sequence* (post-MS).
2. Gravity causes part of a cloud of gas and dust to collapse and heat up, creating a pre-MS star. The star's hot dust and gas emit its energy.
3. A pre-MS star becomes an MS star when the star produces the majority of its energy by fusing hydrogen nuclei (protons) at its center to make helium nuclei.
4. An MS star becomes a post-MS star when the star expands in volume and produces the majority of its energy by fusing hydrogen to make helium in a shell surrounding its center.
5. The more massive a star, the more rapidly the star passes through each of the 3 stages of its evolution.

Two students discuss the evolution of the *Algol system*—Algol A, a 3.6-solar-mass MS star; Algol B, a 0.8-solar-mass post-MS star; and Algol C, a 1.7-solar-mass MS star. (One solar mass = the Sun's mass.) The 3 stars orbit a mutual center of mass, with Algol A and Algol B much closer to each other and to the center of mass than to Algol C.

Student 1

The 3 stars of the Algol system formed at the same time from the same cloud of gas and dust. Algol B, originally the most massive of the 3 stars, became a post-MS star and expanded in volume while Algol A remained an MS star. Because the matter in the outer parts of Algol B was more strongly attracted to Algol A than to the matter in the inner parts of Algol B, this matter flowed from Algol B to Algol A, and, over time, Algol A became more massive than Algol B.

Student 2

Algol B was not part of the original Algol system (Algol A and Algol C). Algol B and the original Algol system formed in different clouds of gas and dust at different times and moved in 2 different but intersecting orbits around the center of the galaxy. During a particular orbit, Algol B encountered the original Algol system at the intersection of the 2 orbits and became part of the Algol system.

Algol B became a post-MS star while Algol A and Algol C remained MS stars. Algol B never lost mass to Algol A. Algol B was always less massive than Algol A.

24. Based on Student 2's discussion, Algol B is part of the present Algol system because of which of the following forces exerted on Algol B by the original Algol system?
 - F. Electric force
 - G. Magnetic force
 - H. Gravitational force
 - J. Nuclear force
25. Based on Student 1's discussion and Fact 4, while matter flowed between Algol A and Algol B, Algol B produced the majority of its energy by fusing:
 - A. hydrogen nuclei to make helium nuclei at its center.
 - B. hydrogen nuclei to make helium nuclei in a shell surrounding its center.
 - C. helium nuclei to make hydrogen nuclei at its center.
 - D. helium nuclei to make hydrogen nuclei in a shell surrounding its center.
26. Suppose that chemical composition is uniform among stars formed from the same cloud of gas and dust, but that chemical composition varies among stars formed from different clouds of gas and dust. Student 2 would most likely agree with which of the following statements comparing the chemical compositions of the stars in the present-day Algol system at the time they formed?
 - F. Algol A and Algol B had the most similar compositions.
 - G. Algol A and Algol C had the most similar compositions.
 - H. Algol B and Algol C had the most similar compositions.
 - J. Algol A, Algol B, and Algol C had the same composition.
27. If the mass of the Sun is 2.0×10^{30} kg, what is the mass of Algol C?
 - A. 1.6×10^{30} kg
 - B. 2.0×10^{30} kg
 - C. 3.4×10^{30} kg
 - D. 7.2×10^{30} kg
28. Which of the following statements best explains why the reaction described in Fact 3 requires a high temperature and pressure?
 - F. All protons are positively charged, and like charges attract each other.
 - G. All protons are positively charged, and like charges repel each other.
 - H. All electrons are negatively charged, and like charges attract each other.
 - J. All electrons are negatively charged, and like charges repel each other.

4**4**

- 29.** Based on Fact 5 and Student 1’s discussion, which of the 3 stars in the Algol system, if any, was most likely the first to become an MS star?
- A.** Algol A
 - B.** Algol B
 - C.** Algol C
 - D.** The 3 stars became MS stars at the same time.

- 30.** Based on Fact 5, would Student 2 agree that by the time Algol A stops being an MS star, Algol A will have spent as much time being an MS star as Algol B spent being an MS star?
- F.** Yes, because according to Student 2, Algol A has always been more massive than Algol B.
 - G.** Yes, because according to Student 2, Algol A has always been less massive than Algol B.
 - H.** No, because according to Student 2, Algol A has always been more massive than Algol B.
 - J.** No, because according to Student 2, Algol A has always been less massive than Algol B.

**Passage VI**

Three experiments were done using CO₂, krypton (Kr), or O₂. For each gas:

1. A 3 L steel vessel was fitted with a cap that contained a gas inlet valve and a pressure and temperature sensor.
2. Air was pumped out of the vessel until the pressure measured 0.00 torr.
3. The vessel was placed on a balance, and the balance was reset to 0.000 g.
4. Some of the gas was added to the vessel.
5. When the gas in the vessel reached room temperature (22°C), mass and pressure were recorded.
6. Steps 4 and 5 were repeated several times.

The experiments were then repeated, except that a 6 L vessel was used (see Figures 1 and 2).

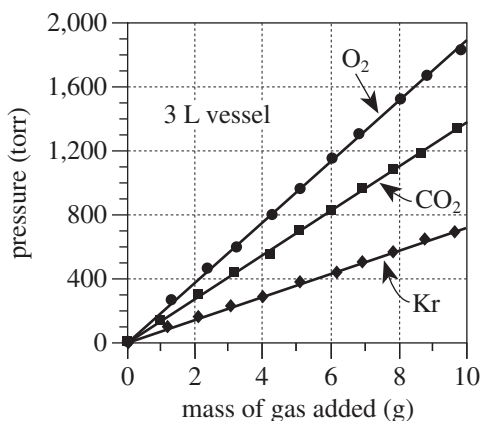


Figure 1

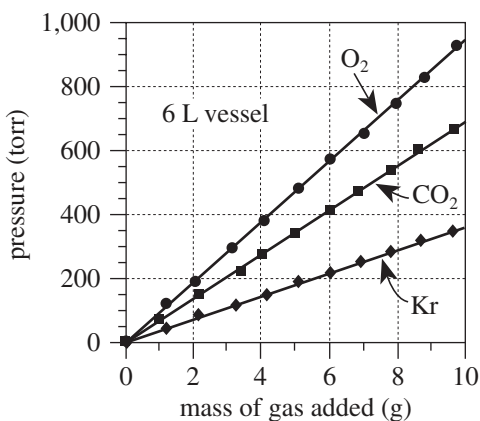


Figure 2

31. Based on Figure 2, if 13 g of Kr had been added to the 6 L vessel, the pressure would have been:
 - A. less than 200 torr.
 - B. between 200 torr and 400 torr.
 - C. between 400 torr and 600 torr.
 - D. greater than 600 torr.
32. Suppose the experiments had been repeated, except with a 5 L vessel. Based on Figures 1 and 2, the pressure exerted by 7 g of CO₂ would most likely have been:
 - F. less than 500 torr.
 - G. between 500 torr and 1,000 torr.
 - H. between 1,000 torr and 1,500 torr.
 - J. greater than 1,500 torr.
33. Based on Figures 1 and 2, for a given mass of O₂ at 22°C, how does the pressure exerted by the O₂ in a 6 L vessel compare to the pressure exerted by the O₂ in a 3 L vessel? In the 6 L vessel, the O₂ pressure will be:
 - A. $\frac{1}{2}$ as great as in the 3 L vessel.
 - B. the same as in the 3 L vessel.
 - C. 2 times as great as in the 3 L vessel.
 - D. 4 times as great as in the 3 L vessel.
34. Which of the following best explains why equal masses of O₂ and CO₂ at the same temperature and in the same-size vessel had different pressures? The pressure exerted by the O₂ was:
 - F. less, because there were fewer O₂ molecules per gram than there were CO₂ molecules per gram.
 - G. less, because there were more O₂ molecules per gram than there were CO₂ molecules per gram.
 - H. greater, because there were fewer O₂ molecules per gram than there were CO₂ molecules per gram.
 - J. greater, because there were more O₂ molecules per gram than there were CO₂ molecules per gram.
35. Suppose the experiment involving O₂ and the 6 L vessel had been repeated, except at a room temperature of 14°C. For a given mass of O₂, compared to the pressure measured in the original experiment, the pressure measured at 14°C would have been:
 - A. less, because pressure is directly proportional to temperature.
 - B. less, because pressure is inversely proportional to temperature.
 - C. greater, because pressure is directly proportional to temperature.
 - D. greater, because pressure is inversely proportional to temperature.



Passage VII

The *human threshold of hearing* is the minimum intensity at each sound frequency required for a sound to be heard by humans. The *human threshold of pain* is the maximum intensity at each sound frequency that humans can tolerate without pain.

The figure below displays, for sounds in water and in air, the human thresholds of hearing and of pain. The figure also shows S , the percent increase in air density and water density that accompanies the compression of air and water by sound waves of given intensities. Sound intensities are given in decibels (db) and frequencies are given in hertz [(Hz); 1 Hz = 1 cycle/sec].

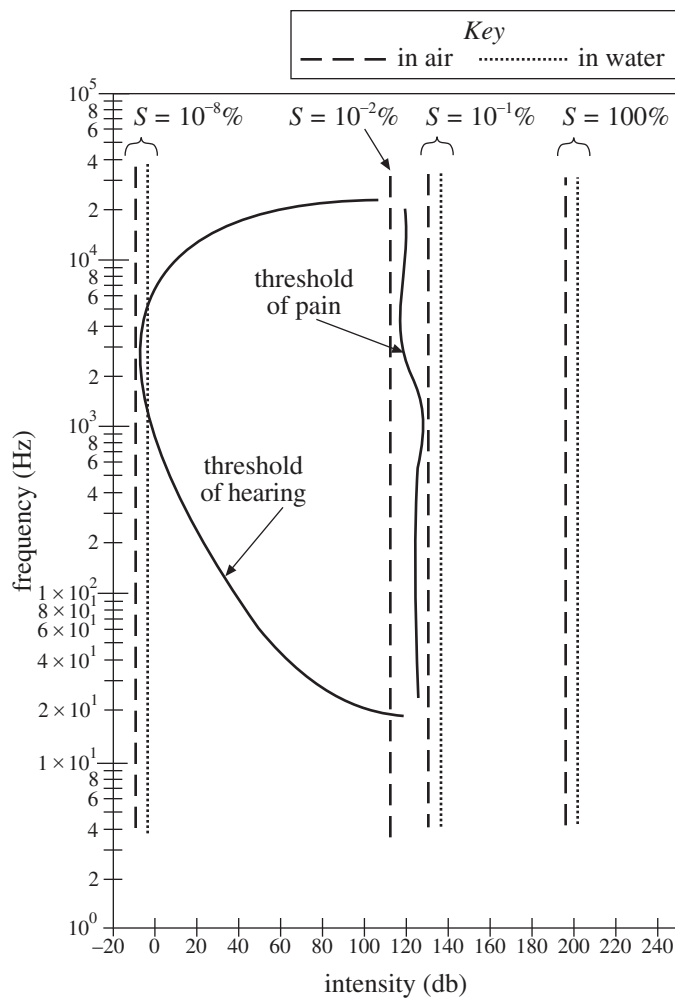
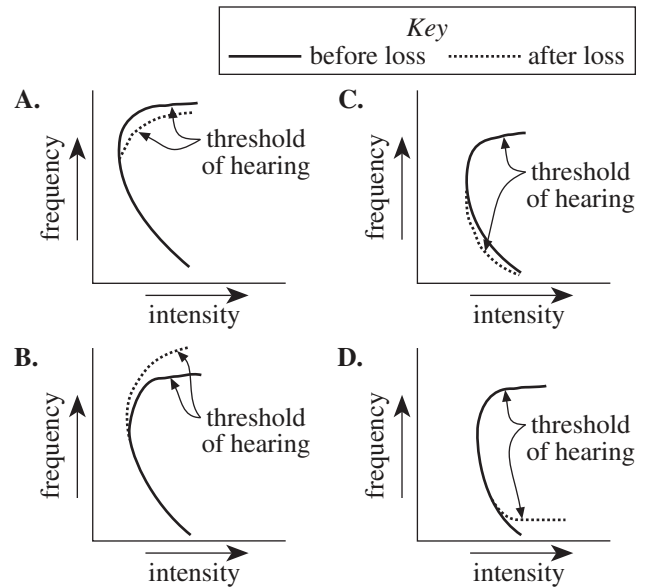


Figure adapted from Rita G. Lerner and George L. Trigg, eds., *Encyclopedia of Physics*, 2nd ed. ©1991 by VCH Publishers, Inc.

36. According to the figure, which of the following is closest to the lowest frequency that can be heard by a human being?
- F. 8 Hz
 - G. 20 Hz
 - H. 1,000 Hz
 - J. 20,000 Hz

37. As humans age, it is common for selective hearing loss to occur at high sound frequencies. Which of the following figures best illustrates this loss?



38. Based on the figure, a sound of a given frequency will have the highest intensity for which of the following sets of conditions?

| | Sound is passing through: | S |
|----|---------------------------|-------------|
| F. | water | 100% |
| G. | water | $10^{-8}\%$ |
| H. | air | 100% |
| J. | air | $10^{-8}\%$ |

39. A student hypothesized that sounds of any intensity at a frequency of 10^5 Hz would be painful for humans to hear. Do the data in the figure support this hypothesis?
- A. Yes, because the threshold of pain is relatively constant with changes in frequency.
 - B. Yes, because as frequency increases above 10^5 Hz, the threshold of pain increases.
 - C. No, because humans cannot hear sounds at 10^5 Hz.
 - D. No, because the threshold of pain is relatively constant with changes in frequency.
40. Based on the figure, does S depend on the frequency of a sound wave of a given intensity?
- F. Yes, because as frequency increases, S increases.
 - G. Yes, because as frequency increases, S remains constant.
 - H. No, because as frequency increases, S increases.
 - J. No, because as frequency increases, S remains constant.

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.