



Magoosh

ACT Practice Test PDF

What's Included:

Full-length ACT
with Writing Practice Test

Free Text and
Video Explanations
for All Questions

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Hello!

Welcome to an important step in your ACT prep! This full-length ACT Practice Test PDF contains 216 of Magoosh's highest-quality, student-tested practice questions. Taken from our premium online ACT Prep, these questions have been adapted to mimic the official ACT exam that you will encounter on test day...with one key difference.

What's the difference? Well, at the end of this PDF, you will find an answer key and a guide to grading your practice test. That's pretty normal. **But, you will also find a link to text and video explanations that show you how to solve every single question in this practice test.**

In these video explanations, our ACT experts walk you through each question step-by-step. They explain:

- Which concept the question or problem is testing.
- Which strategies you can use to answer the question quickly and correctly.
- Which answer choices are trying to trick you (and how to avoid those traps!)

You sure won't find that in an ACT book!

These video explanations help you take your ACT prep to the next level. Because it's one thing to take a practice test and call it a day—but if you can learn from your mistakes, then you're setting yourself up to do better when it really counts.

Let's Get Started

Taking a timed, full-length practice test is one of the best ways to prepare yourself for the real ACT. Mimicking test-like conditions will help improve your stamina, pacing, and understanding of your personal strengths and weaknesses.

While you may choose to take this test online (and save some trees while you're at it), remember that the official ACT exam is paper-based. We've made this PDF printable so that you can print it out and take it like the official exam if you want—it's totally up to you!

Here's What to Expect on the Following Pages:

- A full-length ACT practice test with the optional Writing test (aka "the essay")
- An answer key
- Information on grading your test
- Links to text and video explanations for every single question

What You'll Need to Take the Test:

- A pencil
- A timer
 - Try the [Study Timer: Test Prep Stopwatch by Magoosh \(iOS app\)](#), which has an ACT Practice Test setting to help you manage your time.
- An answer sheet to record your answers
 - You will find an answer sheet on the last page of this PDF. Print it out so that you can practice bubbling your answers, as you will on test day.
- One page of scratch paper to plan your essay for your Writing test response
 - On test day, you will receive a test booklet with space to plan your essay.
- Four pages of lined paper for the Writing test
 - On test day, you will receive a test booklet with four lined pages on which to write your essay.

Practice Test Tips

- If you'd like to use this practice test as part of your study schedule, you can substitute it for one of the practice tests in our [ACT Study Schedules](#) here:
 - [One Week ACT Study Schedule](#)
 - [One Month ACT Study Schedule](#)
 - [Two Month ACT Study Schedule](#)
 - [Three Month ACT Study Schedule](#)
- Set aside approximately four hours of uninterrupted time to take the practice test.
- Try to take the entire practice test in one sitting.
- Give yourself a brief, ten-minute break after the Mathematics test.
- Give yourself a brief, five-minute break after the Science test.
- Take the test in a quiet place where you won't be distracted.
- Mimic test day conditions by turning off your phone and leaving it in another room.
- Use a countdown timer and remember to reset it for each test.
- Eat a healthy, energizing snack before taking the practice test.
- After the test, check your answers and make note of any questions you missed.
- Watch the explanation video for every question you get wrong, so that you don't repeat the same mistakes on test day!
- Visit act.magoosh.com to sign up for Magoosh ACT Prep and gain access to more practice questions.

Want more tips and tricks?

Read [How to Take an ACT Practice Test](#).

English Test

45 Minutes —75 Questions

INSTRUCTIONS: In the following five passages, you'll find portions that have been underlined and numbered. The questions in the right-hand column will present alternatives for the underlined words and phrases. Some questions will ask you to select the answer choice that best expresses the idea, makes the statement appropriate for standard written English, or makes the wording more consistent with the passage's style and tone. If you think the original wording of the statement is the best option, select "NO CHANGE." In other cases, you'll be asked a question about the underlined text. You will need to choose the best answer to the question.

In addition, you will be asked questions about a portion of the passage or about the entire passage. In these cases, the questions do not refer to an underlined section of the passage. Instead, they are identified by a number in a box. Choose the answer that you consider best and mark that on your answer sheet. ACT recommends reading each passage through one time before answering any questions. Many of the questions will require you to read a few sentences ahead to find the answer. Make sure that you read far enough ahead before answering each question.

PASSAGE I

The Lancashire Witches

About four hundred years ago, in 1612, Northwest England was the scene of England's largest peacetime witch trial¹: the trial of the Lancashire witches. Twenty people, mostly from the Pendle area of Lancashire, were imprisoned² in the castle as witches. In the end, ten were hanged, one died in jail, one was sentenced to the stockades, and eight were acquitted. **[A]** How did this witch trial come about, and what accounts for its static³ fame?

We know so much about the Lancashire Witches because the trial was recorded in unique detail by the clerk of the court Thomas Potts who published⁴ his account soon afterwards. Robert Poole recently published a modern-English edition of their⁵ book, together with an essay piecing together what we know of the events of 1612. **[B]** It reveals how Potts carefully edited the evidence, and also⁶ how the case against the "witches" were constructed⁷ and manipulated to bring about a spectacular show trial.

It all began in mid-March when a peddler from Halifax named John Law had a frightening encounter with a poor young woman, Alizon Device in a field, near⁸ the town of Colne. He refused her request for pins, and there was a brief argument during which he was seized by a fit that left him with "his head drawn awry, his eyes and

1. A. NO CHANGE
B. witch trial and
C. witch trial
D. witch trial;
2. A. NO CHANGE
B. had been imprisoned
C. have been imprisoned
D. were being imprisoned
3. A. NO CHANGE
B. robust
C. enduring
D. vigorous
4. A. NO CHANGE
B. court, Thomas Potts, who published
C. court, Thomas Potts, who published,
D. court Thomas Potts who published,
5. A. NO CHANGE
B. its
C. it's
D. his
6. A. NO CHANGE
B. evidence, but also
C. evidence and additionally
D. evidence and
7. A. NO CHANGE
B. was constructed
C. was being constructed
D. was constructing
8. A. NO CHANGE
B. young woman, Alizon Device, in a field near
C. young woman, Alizon Device in a field near
D. young woman Alizon Device, in a field, near

face deformed, his speech not well to be understood; his thighs and legs stark lame.” We can now recognize this as a stroke, perhaps triggered by the stressful encounter. [C] Alizon Device was sent for and surprised all by confessing to the bewitching of John Law, and then begged for forgiveness. [D] 10

When Alizon Device was unable to cure the peddler the local magistrate, Roger Nowell, was called in. “With weeping tears,” Alizon explained to Nowell that she had been led astray by her grandmother, “old Demdike,” well-known in the district for her knowledge of old prayers, charms, cures, and curses. 12 Nowell quickly interviewed Alizon’s grandmother and mother, as well as Demdike’s supposed rival, “old Chattox.” Their panicky attempts to explain themselves and shift the blame to others eventually only ended up incriminating them, and the four were sent to Lancashire prison in early April to await trial at the summer courts. 13 14 15

Adapted from Poole, R. “The Lancashire Witches, 1612-2012.”
The Public Domain Review.

9. A. NO CHANGE
B. John Law and she then begged
C. John Law and begging
D. John Law and begged
10. The quotation marks used in the preceding paragraph most likely indicate:
A. direct quotes from Alizon Device.
B. direct quotes from John Law.
C. words quoted from a published source.
D. an ironic tone of the author.

11. A. NO CHANGE
B. peddler, the
C. peddler; the
D. peddler: the

12. At this point, the writer wishes to add the following sentence:

“Old Demdike” had lived in the town for decades.

Should the writer make this addition here?

- A. Yes, because it helps the reader understand that old Demdike was an established member of the Lancashire community.
B. Yes, because it explains why Demdike and “old Chattox” were rivals.
C. No, because it interrupts the discussion at this point in the paragraph.
D. No, because it doesn’t explain why old Demdike was accused of practicing witchcraft.

Questions 13 - 15 ask about the preceding passage as a whole.

13. Given that all of the choices are true, which one most effectively concludes the essay?
- A. The trials of the four women were soon followed by the court appearances of sixteen other accused witches, setting the stage for numerous other witch trials of the 17th century.
B. While the women were in prison, they reportedly still practiced witchcraft with the other eight women imprisoned after them.
C. Despite the women’s ill-gotten fate, early 17th-century England was continually plagued with witchcraft well into the 18th century.
D. These four women, however, would set the standard for fair trials for those accused of witchcraft in the rest of the seventeenth century.

14. The writer is considering deleting the word “panicky” in the final sentence of the last paragraph. Should the word be kept or deleted?
- Kept, because it helps indicate why the women’s defense of themselves lacked strength.
 - Kept, because it provides evidence that the women were guilty of their accused crimes.
 - Deleted, because it reiterates information already stated in the previous sentence.
 - Deleted, because the word provides unnecessary descriptive details.
15. The writer is considering adding the following sentence to the essay:
Before modern medicine, however, such an occurrence was often interpreted as magic or witchcraft.
 If the sentence were added, it would most logically be placed at Point:
- A
 - B
 - C
 - D

PASSAGE II

Writing a Personal Essay

[1]

Acclaimed novelist, Toni Morrison, ¹⁶ likens memory to the way the Mississippi River, and other rivers like it, years after being straightened and pushed into levees by the Army Corps of Engineers, still strain ¹⁷ at times to flood its banks and revisit the original, meandering route. “All water has a perfect memory and is forever trying to get back to where it was,” Morrison tells us, “Writers are like that ¹⁸ remember where we were, what valley we ran through, what the banks were like, the light that was there, and the route back to our original place.”

[2]

I have worked with so many writers who worry their in- ¹⁹ consistent memory ¹⁹ is not sharp enough, exact enough, or reliable enough for them to capture childhood moments with any authority, and, of course, science had proven ²⁰ the fallibility of memory time and time again. **[A]** But what can we do, as writers?

[3]

It has been my experience that most of us ²¹ remember more than we think that we do. **[B]** It just takes some time to stop, think, and take our minds back to the original riverbanks.

- NO CHANGE
 - novelist, Toni Morrison
 - novelist Toni Morrison
 - novelist Toni Morrison,
- NO CHANGE
 - strains
 - strained
 - straining
- NO CHANGE
 - are like that. We
 - are like that, we
 - are like that. With us
- NO CHANGE
 - worry that inconsistent memory
 - are worried and think that their memory
 - worry their memory
- NO CHANGE
 - has proven
 - had proved
 - proved
- NO CHANGE
 - It being my experience, most of us
 - In my experience, most of us
 - It was my experience that most of us

Once we have latched onto one of them²²—the color of the tablecloth on Aunt Jean’s holiday table and the old fashioned centerpiece she inherited from her grandmother, perhaps—that tiny, small²³ foothold of memory can often help to unloosen yet another, and then another, small detail. [C] These past moments are in your mind still, Morrison is telling us, waiting for us to uncover the moments²⁴ we have since forgotten²⁴. Bringing it to the front just takes time.

[4]

In the end²⁵, all we promise the reader is that we have done our absolute best to fact-check our memories, and²⁶ that we²⁶ have tried our hardest to be accurate. [D] Smart readers know that no other guarantee is necessary or possible.

[5]

So, go to the river of memory. 27

Find one small detail, and²⁸ start writing for just ten minutes, trying to remember one small detail at a time. See where it takes you today.

Adapted from Moore, D. W. *Crafting the Personal Essay: A Guide for Writing and Publishing Creative Non-Fiction*. Cincinnati, OH: Writer’s Digest Books, 2010.

22. A. NO CHANGE
B. memory
C. of it
D. of those riverbanks
23. A. NO CHANGE
B. perhaps, that tiny small
C. perhaps that tiny, small
D. perhaps—that small
24. Which choice most strongly maintains the imagery used repeatedly in this essay?
A. NO CHANGE
B. and it is up to us, as writers, to learn how to recover what they have to say.
C. just as the past lives in the memory of a river.
D. allowing us to remember childhood events in significant detail.
25. A. NO CHANGE
B. Additionally,
C. However,
D. As a result,
26. A. NO CHANGE
B. memories and that we
C. memories and we
D. memories, and that we, as writers,
27. If the writer were to delete the previous sentence, the paragraph would primarily lose:
A. imagery that is used to connect the reader back to a previous idea.
B. a suggestion that readers should sit by rivers when remembering their past.
C. an unnecessary detail that contradicts information presented earlier in the paragraph.
D. a description that explains how memory and rivers are connected.
28. A. NO CHANGE
B. small moment and,
C. moment and
D. of these rivers and

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

29. The writer wants to add the following sentence to the essay:
- These particulars then enable us to describe our memories with such detail, the reader feels as though he or she were part of the moment itself.**
- If the writer were to add this sentence, it would most logically be placed at Point:
- A. A in Paragraph 2.
B. B in Paragraph 3.
C. C in Paragraph 3.
D. D in Paragraph 4.
30. Suppose the writer's primary purpose had been to describe various difficulties that writers experience while composing a personal essay. Would this essay accomplish that purpose?
- A. Yes, because it describes how writers often remember more than they think when writing from memory.
B. Yes, because it describes how one writer handles her difficulty with writing from memory.
C. No, because it focuses on only one aspect of the personal essay writing process.
D. No, because it does not explain any difficulties that a writer has when writing personal non-fiction.

PASSAGE III

The Origins of Coca-Cola

[1]

Coca-Cola history began in 1886 when the curiosity of an Atlanta pharmacist Dr. John S. Pemberton, led him to create a distinctive-tasting soft drink that could be sold at soda fountains. He created a flavored syrup and took it to his neighborhood pharmacy, where it was mixed with carbonated water and deemed "excellent" by those whom have sampled it. Dr. Pemberton's partner and bookkeeper, Frank M. Robinson, is credited with naming the beverage "Coca-Cola" as well as creating the design of the trademarked, distinctive script that is still used today. The first servings of Coca-Cola were sold for 5 cents per glass. During the first year, sales initially averaged a modest nine servings per day in Atlanta. Today, daily servings of Coca-Cola beverages are estimated at 1.9 billion globally.

[2]

In 1888, Dr. Pemberton sold portions of his business to various parties, just two years after creating what was to become the world's #1-selling sparkling beverage how- ever only a few years before his death. [1] The majority

31. A. NO CHANGE
B. B. pharmacist: Dr. John S. Pemberton
C. C. pharmacist, Dr. John S. Pemberton
D. D. pharmacist, Dr. John S. Pemberton,
32. A. NO CHANGE
B. those whom
C. those who
D. those
33. A. NO CHANGE
B. constructing the original design of
C. designing the logo for
D. designing
34. A. NO CHANGE
B. originally
C. first
D. OMIT the underlined phrase
35. A. NO CHANGE
B. portions of Dr. Pemberton's business were sold to various parties, creating the world's #1-selling sparkling beverage just a few years before his death.
C. the world's #1-selling sparkling beverage was created after portions of Dr. Pemberton's business were sold to various parties just two years later but only a few years before his death.
D. only a few years before his death and just two years after creating what was to become the world's #1-selling sparkling beverage, Dr. Pemberton sold portions of his business to various parties.

of the interest was sold to Atlanta businessman Asa G. Candler. [2] Under Mr. Candler's leadership, distribution of Coca-Cola expanded to soda fountains beyond Atlanta. [3] In 1894, impressed by the growing demand for Coca-Cola and the desire to make the beverage portable, Joseph Biedenharn installed bottling machinery in the rear of his Mississippi soda fountain, becoming the first to put Coca-Cola in bottles. [4] The three entrepreneurs purchased the bottling rights from Asa Candler for just \$1. [5] Benjamin Thomas, Joseph Whitehead, and John Lupton developed what became the Coca-Cola worldwide bottling system. [6] Large-scale bottling was made possible just five years later, when in 1899, three enterprising businessmen in Chattanooga, Tennessee secured exclusive rights to bottle and sell Coca-Cola. [37]

[3]

Among the biggest challenges for early bottlers was the imitations of the beverage by competitors coupled with a lack of packaging consistency among the 1,000 bottling plants at the time. The bottlers agreed that a distinctive beverage needed a standardized, distinctive bottle, and in 1916, the bottler's approved the unique contour bottle. The new Coca-Cola bottle was so distinctive it could be recognized in the dark, and it effectively set the brand apart from competition. Over the years, the Coca-Cola bottle has been an inspiration for the work of artists across the globe — a sampling of which can be viewed at the World of Coca-Cola in Atlanta. The con- toured Coca-Cola bottle was trademarked in 1977.

[4]

The first marketing efforts in Coca-Cola history were executed through coupons promoting free samples of the beverage. Considered an innovative tactic in 1887: couponing was then followed by newspaper advertising and the distribution of promotional items bearing the

36. A. NO CHANGE
B. B. had been purchasing
C. C. have purchased
D. D. were purchasing
37. For the sake of the logic and coherence of Paragraph 2, where should Sentence 6 be placed?
- A. after Sentence 1
B. before Sentence 3
C. before Sentence 4
D. before Sentence 5
38. A. NO CHANGE
B. was
C. were the
D. would of been
39. A. NO CHANGE
B. bottle and in 1916, the bottlers
C. bottle and in 1916, the bottler's
D. bottle, and in 1916, the bottlers
40. A. NO CHANGE
B. However,
C. In contrast,
D. On the other hand,
41. A. NO CHANGE
B. The Coca-Cola bottle was trademarked and contoured in 1977.
C. While the bottle was contoured in 1916, it was not trademarked until 1977.
D. OMIT the underlined sentence.
42. A. NO CHANGE
B. tactic in 1887, couponing
C. tactic in 1887. Couponing
D. tactic in 1887: couponing

Coca-Cola script to participating pharmacies.

[5]

43 Many fondly remember the 1971 Hilltop Singers performing “I’d Like to Buy the World a Coke” or the 1979 “Have a Coke and a Smile” commercial featuring a young fan giving Pittsburgh Steeler “Mean Joe Greene” a refreshing bottle of Coca-Cola. Though these marketing campaigns began in the 1970s, Coca-Cola commercials are still aired today.

This passage was adapted from “Coca-Cola History.” World of Coca-Cola. <http://www.worldofcoca-cola.com/about-us/coca-cola-history/>.

43. Given that all of the choices are true, which of the following statements would provide the best transition from Paragraph 4 to Paragraph 5?
- Fast forward to the 1970s when Coca-Cola’s advertising started to reflect a brand connected with fun, friends, and good times.
 - Fun, friends, and good times became the new brand of Coca-Cola in the 1970s.
 - Pharmacies continued to participate in the distribution of Coca-Cola products well into the 1970s and beyond.
 - The music industry became the first to advertise for Coca-Cola products in both their performances and TV appearances.
44. Given that all the choices are true, which one most effectively concludes Paragraph 5 and the essay by emphasizing the long-term success of the Coca-Cola brand?
- NO CHANGE
 - These campaigns reflect the effectiveness of the original campaign that Dr. Pemberton and Asa Candler began over 100 years ago.
 - The “Mean Joe Green” commercial in particular was the most popular in America.
 - Dr. Pemberton and Asa Candler would be impressed by the progress their work initiated over 100 years ago.

Question 45 asks about the preceding passage as a whole.

45. Suppose the writer’s goal had been to write an essay that explained why soda beverages gained popularity over the last 150 years. Would this essay accomplish that goal?
- Yes, because the essay describes the early challenges that bottlers faced when producing Coca Cola.
 - Yes, because the essay describes how Coca-Cola’s brand was modified in the early 1970’s.
 - No, because the essay only focuses on the development of one soda company, Coca-Cola.
 - No, because the essay does not mention marketing strategies Coca Cola used over that time period.

PASSAGE IV

A Trip Around the World

On the morning of November 14, 1889, John Brisben Walker, the wealthy publisher of, The Cosmopolitan,
⁴⁶
boarded a New Jersey ferry bound for New York City. **[A]**
⁴⁶
Like many other New Yorker's, he was carrying a copy of
⁴⁷

The World, the most widely read and influential newspaper of our time. A front-page story announced that Nellie Bly, The World's star investigative reporter, was about to undertake the most sensational adventure of her career, which was an attempt to go around the world
⁴⁸
⁴⁹ faster than anyone ever had before. **[B]** Sixteen years earlier, in his popular novel, *Around the World in Eighty Days*, Jules Verne had imagined that such a trip could be accomplished in the time stated in the title. 50 Nellie Bly hoped to do the trip in seventy-five days.

Immediately Walker recognized the publicity value of
⁵¹ such a scheme, and at once an idea suggested itself: The Cosmopolitan would sponsor their own competitor in the
⁵² around-the-world race, traveling in the opposite direction. Of course, the magazine's circumnavigator would have to leave immediately, and would have to be, like Bly, a young
⁵³ woman. The public at that time, after all, would never warm to the idea of a man racing against a woman.

46. A. NO CHANGE
 B. publisher of The Cosmopolitan boarded
 C. publisher, of The Cosmopolitan, boarded
 D. publisher of The Cosmopolitan, boarded
47. A. NO CHANGE
 B. Similar as many other New Yorkers,
 C. As many other New Yorker's,
 D. In the same manner as other New Yorkers,
48. A. NO CHANGE
 B. their
 C. its
 D. a
49. A. NO CHANGE
 B. career which was
 C. career: an attempt
 D. career, and
50. If the writer were to delete the preceding sentence, the paragraph would primarily lose:
- A. important context for understanding information presented later in the paragraph.
 B. an unrelated detail describing literature of the late 19th century.
 C. scientific data explaining the minimum length of a trip around the world.
 D. an indication that a trip around the world in less than eighty days could only occur in fiction, not reality.
51. Which of the following alternatives to the underlined portion would NOT be acceptable?
- A. Right away
 B. Instantly
 C. Without delay
 D. As soon as
52. A. NO CHANGE
 B. its own competitor
 C. their competitor
 D. it's own competitor
53. A. NO CHANGE
 B. immediately and would be,
 C. immediately and would have to be,
 D. immediately, and had to be,

[C] That morning, he met with Elizabeth Bisland, the magazine’s literary editor, whom agreed to become

Bly’s competitor. **[D]** In the end, Elizabeth Bisland succeeded in beating Jules Verne’s eighty-day mark, completing the trip in seventy-six days – which would have been the fastest trip ever made around the world but for the fact that Nellie Bly had arrived four days earlier.

Although she ultimately lost the race, Bisland later became friends with Nellie Bly. Prior to her trip, she had

never been out of the country before, and during her competition she discovered a love of travel that would stay with her the rest of her life. That was what the trip had given her, however, as she would reflect later: the vividness of a new world, where one was for the first time, as Tennyson had written, “Lord of the senses five.” “It was well,” she told herself when it was all over, “to have thus once really lived.”

Adapted from Goodman, M. “Elizabeth Bisland’s Race Around the World.” The Public Domain Review.

Questions 59 and 60 ask about the preceding passage as a whole.

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

Walker had a difficult choice ahead of him.

If the writer were to make this addition, it would most logically be placed at Point:

- A. A in Paragraph 1
- B. B in Paragraph 1
- C. C in Paragraph 2
- D. D in Paragraph 2

- 54. A. NO CHANGE
- B. to who
- C. of whom
- D. who

- 55. A. NO CHANGE
- B. Bly’s competitor.
- C. a competitor.
- D. an opponent.

56. Which of the following alternatives to the underlined portion best introduces the topics presented in this paragraph?

- A. NO CHANGE
- B. Bisland was profoundly affected by the experience.
- C. Bisland never forgave Walker for nominating her.
- D. Bly’s competitor, understandably, never went back to America.

- 57. A. NO CHANGE
- B. prior
- C. until then
- D. DELETE the underlined portion

- 58. A. NO CHANGE
- B. though, as
- C. therefore, as
- D. as

60. Suppose the writer had intended to write a historical essay about early races around the world. Would the essay fulfill that goal?

- A. Yes, because it discusses the effect the race had on Bisland when she returned to America.
- B. Yes, because it focuses on how two women competed in a race around the world.
- C. No, because the essay primarily focuses on one race around the world.
- D. No, because the essay discusses how Bly defeated Bisland in the competition.

PASSAGE V

Japanese Comics

Japan has a long and rich history of original graphic arts that include painting, printmaking, calligraphy, and, more recently, serial art such as comic books and animated films. **[A]** The well-established comics' publishing houses and drawing studios in Japan mean that Japanese readers of all ages can choose from a wide variety of high-quality comics that are unique in a variety of ways.

Additionally, Japanese comics are distinctive from most American comics because they read right to left and from the back of the book to the front cover, just like regular Japanese books. **[B]** At first, when Japanese comics were translated into English and other languages that read left to right, the art was flipped and the page order reversed. As a result, American publisher Tokyopop has led a growing movement to keep the original art and order of translated manga, thereby preserving the artists intended presentation of their books.

[C] Osamu Tezuka was among the initial Japanese comics artists who "developed their wartime exposure to Western comics into a form that reflected Japanese techniques and experiences," according to scholar Francisca Goldsmith. While underground comics in the United States found a wider audience after the introduction of graphic novels in the 1980s, sophisticated mature comics for adult readers have flourished in Japan since the 1950s. **[D]** Japanese artists began exporting translated comics such as *Astro Boy* in the 1960s, and such comics became more widely available in English-speaking countries with the growth of manga distributors and publishers in the 1990s.

61. A. NO CHANGE
B. calligraphy, and more recently
C. calligraphy and more recently,
D. calligraphy and more, recently
62. A. NO CHANGE
B. comic's publishing houses
C. comics publishing houses
D. comics publishing house's
63. A. NO CHANGE
B. Similarly,
C. On the other hand,
D. DELETE the underlined phrase.
64. A. NO CHANGE
B. However, American
C. Therefore, American
D. Because American
65. A. NO CHANGE
B. preserving the artists'
C. preserving the artist's
D. preserving, the artist's
66. A. NO CHANGE
B. who, "developed
C. who, "having developed
D. who developed
67. A. NO CHANGE
B. 1980s sophisticated and mature
C. 1980s sophisticated mature
D. 1980s, sophisticated, mature
68. If the underlined portion were deleted, the paragraph would primarily lose:
- A. a specific example of an exported Japanese comic.
B. an indication that translated Japanese comics are no longer produced.
C. essential information that the reader needs to understand the development of graphic novels in Japan.
D. contextual information that is required to understand the remainder of the essay.

69 [9] Similar to American graphic novels, which

range in topics from superheroes to politics. Manga tell
70
many different kinds of stories and have art to match.

There were funny manga, action-packed manga, fantastic
71
manga, and manga that tell realistic stories about believ-
able characters. Manga style has also influenced.
72
manhwa, Chinese, and Korean comics, and its rhetoric is
73
even

used today in original American graphic novels, which
73
reveals that Japanese graphic novels have taken a strong
73
hold in the Western world.
73

Adapted from "The Importance of Japanese Comics." Graphic Novels.
<http://www.ipl.org/div/graphicnovels/gnsImpJapComs.html>.

69. Which of the following, if inserted at the highlighted point, best introduces the main idea of the last paragraph?
- A. There are manga graphic novels that appeal to adults, young children, and teenagers.
 - B. Manga graphic novels in America, however, do not read from the back cover to the front cover.
 - C. Manhwa, the Korean term for comics, eventually spread into the Americas as well.
 - D. The evolution of comics in America has followed a similar path as in Japan.
70. A. NO CHANGE
B. politics; manga
C. politics, manga
D. politics, and manga
71. A. NO CHANGE
B. is
C. are
D. has been
72. A. NO CHANGE
B. Manga style has also influenced: manhwa, Chinese and Korean comics, and
C. Manga style has also influenced manhwa--Chinese and Korean comics--and
D. Manga style has also influenced manhwa--Chinese and Korean comics and
73. Given that all the choices are true, which one most effectively concludes the essay by connecting to the topics presented in the first paragraph?
- A. NO CHANGE
 - B. covering a wide variety of adventures, both real and fictional.
 - C. indicating the impact of Japanese culture on American society.
 - D. reflecting the far-reaching influence of Japan's skilfull comic artists.

Questions 74 and 75 ask about the preceding passage as a whole.

74. Upon reviewing the essay, the writer wishes to add the following sentence:

The evolution of Japanese comics interestingly began with influences from the western world.

The best place for the sentence would be at Point:

- A. A in Paragraph 1
- B. B in Paragraph 2
- C. C in Paragraph 3
- D. D in Paragraph 3

75. Suppose the writer's primary purpose had been to describe how Japanese manga and American comics influenced one another. Would the essay accomplish that goal?

- A. Yes, because it explains the similarities and differences between American and Japanese comics.
- B. Yes, because it explains how Japanese manga became available in English-speaking countries.
- C. No, because the essay makes no clear connection between Japanese manga and American comics.
- D. No, because the essay focuses more on the styles of individual manga artists.

END OF TEST 1

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

Mathematics Test

60 Minutes — 60 Questions

INSTRUCTIONS: Solve each problem, choose the correct answer, and then note your answer choice on your answer sheet. Be careful not to spend too much time on specific problems. Solve all the problems you can, and then come back to the ones you skipped in the time you have left. You CAN use a calculator on this test. You are permitted to use your calculator on any problem, but some problems are better done without a calculator.

NOTE: Unless otherwise noted, all of the following assumptions are true:

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

1. Which of the following numbers is between $\frac{3}{5}$ and $\frac{5}{7}$?

A. $\frac{1}{2}$
 B. $\frac{3}{7}$
 C. $\frac{8}{9}$
 D. $\frac{19}{35}$
 E. $\frac{47}{70}$

2. $x + 2y = 5$
 $2x + y = 16$
 What does $x + y$ equal?

A. -4
 B. -2
 C. 4
 D. 7
 E. 9

3. To reach her destination, Jeanette must drive 90 miles. If she drives 5 miles every 7 minutes, how long will it take her to reach her destination?

A. 2 hours and 2 minutes
 B. 2 hours and 6 minutes
 C. 2 hours and 10 minutes
 D. 2 hours and 12 minutes
 E. 2 hours and 15 minutes

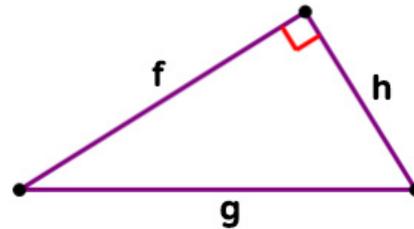
4. Walking at a constant rate of 8 kilometers per hour, Juan can cross a bridge in 6 minutes. What is the length of the bridge in meters? (1 kilometer = 1000 meters)

A. 480
 B. 600
 C. 720
 D. 750
 E. 800

5. After receiving a 25% discount, Sue paid \$180 for a lawnmower. What is the original price of the lawnmower before the discount?

A. \$215
 B. \$220
 C. \$225
 D. \$240
 E. \$245

6. In the figure below



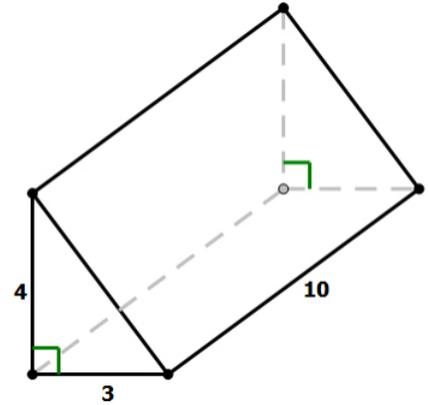
If $f = 6$ and $g = 8$, what does h equal?

A. $2\sqrt{7}$
 B. $3\sqrt{5}$
 C. 4
 D. 10
 E. 14

7. If $J \div 24 = K$, then $J \div 6 =$

F. $4K$
 G. $2K$
 H. K
 I. $\frac{K}{2}$
 J. $\frac{K}{4}$

8. In order to qualify for the year-end tennis tournament, Sam must win at least 60 percent of his matches this year. To date, Sam has won 14 of his 18 matches. Of Sam's 13 matches remaining in the year, what is the least number that he must win in order to qualify for the year-end tournament?
- A. 4
B. 5
C. 6
D. 7
E. 8
9. Five years from now, Tatiana will be two years older than Frederico is now. If Frederico is currently thirteen, how old is Tatiana now?
- A. 8
B. 10
C. 13
D. 15
E. 18
10. In the Antares Corporation, $\frac{3}{7}$ of the managers are female. If there are 42 female managers, how many managers in total are there?
- A. 18
B. 24
C. 60
D. 66
E. 98
11. A company has 40 executives and 120 customer service representatives. If these are the only employees, what percentage of the employees are executives?
- A. 20%
B. 25%
C. 33%
D. 40%
E. 80%
12. If $R = 10b^2$ and $b = 5$, then $R =$
- A. 25
B. 50
C. 100
D. 250
E. 500
13. A prism with dimensions given in centimeters is shown below. If the volume of a prism is the area of a triangular base times the length of a rectangular base, what is the volume of this prism, in cubic cm?
- A. 30
B. 40
C. 50
D. 60
E. 120



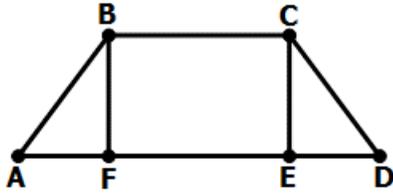
14. On a certain high school athletic team, the ratio of freshmen to sophomores to juniors to seniors is 1:3:4:6. If there are 60 juniors on the team, how many students in total are on the team?
- A. 90
B. 140
C. 150
D. 180
E. 210
15. A group of employees and their spouses are dining out at a fancy restaurant. When the bill for the meal comes, they initially decide to split it equally among the eight employees of the same company. Then, a spouse insists on paying a share, so they split the bill equally among nine people: this reduces the per-person share by \$5. What was the total price of the bill?
- A. \$135
B. \$180
C. \$360
D. \$450
E. \$720

16. In trapezoid ABCD, $BC = EF = 6$, $AF = DE = 3$, and $AB = CD = 5$. If the area of a trapezoid is given by

$$A = \left(\frac{b_1 + b_2}{2} \right) h$$

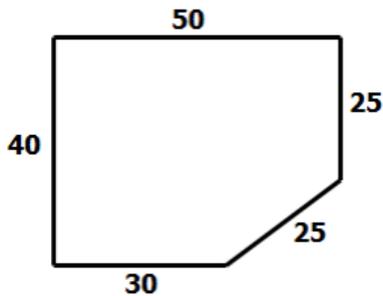
then which of the following is the area of trapezoid ABCD?

- A. 12
B. 24
C. 36
D. 45
E. 54



17. The top of a student's desk is in the shape shown below; all distances are given in inches. What is the area of this desktop in square inches?

- A. 170
B. 1500
C. 1700
D. 1850
E. 2000



18. If 3 apples and 4 bananas cost \$1.37 total, and 5 apples and 7 bananas cost \$2.36 total, what is the total cost of 1 apple and 1 banana?

- A. \$0.38
B. \$0.39
C. \$0.40
D. \$0.41
E. \$0.42

19. In 2004, Cindy had \$4000 in a mutual fund account. In 2005, the amount in the same account was \$5000. If the percent increase from 2004 to 2005 was the same as the percent increase from 2005 to 2006, how much did Cindy have in this account in 2006?

- A. \$5800
B. \$6000
C. \$6250
D. \$7500
E. \$9000

20. Which of the following inequalities is equivalent to $12 - 3x < -18$?

- A. $x > 10$
B. $x < 10$
C. $x > -10$
D. $x < -10$
E. $x > 2$

21. Which of the following equations expresses the relationship between x and y in the table below?

- A. $y = 10x + 1$
B. $y = 2x - 1$
C. $y = -x + 45$
D. $y = -3x + 53$
E. $y = -7x + 81$

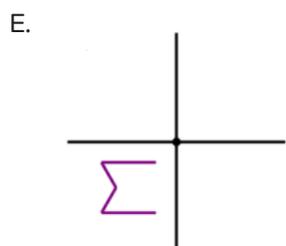
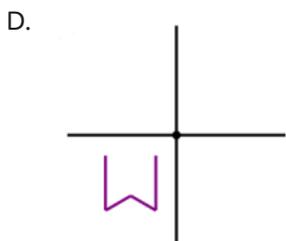
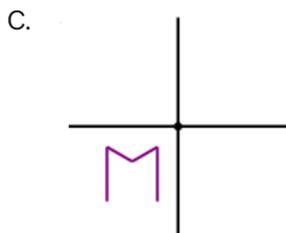
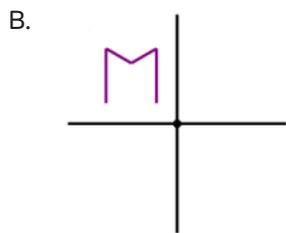
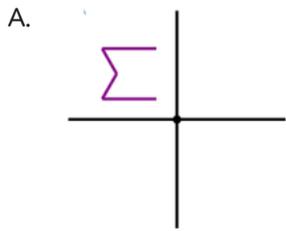
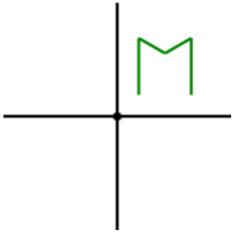
22. The total cost to rent a tour bus for a day is the same for any party over fifteen riders. If the cost is \$720 for a group of sixteen people, how much less would a group of twenty-four riders have to pay per person than a group of sixteen?

- A. \$10.50
B. \$15
C. \$25
D. \$30
E. \$45

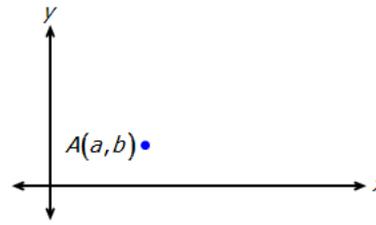
x	y
4	41
7	32
11	20
13	14
16	5

23. If $f(x) = x^2 + 4$ and $f(2k) = 36$, then which of the following is one possible value of k ?
- A. $\sqrt{2}$
 - B. 2
 - C. 4
 - D. $2\sqrt{2}$
 - E. $\sqrt{14}$
24. A municipal water tank is a large cylinder with a radius of 20 feet and a height of 30 feet. Assuming that the tank is filled with water, what is the approximate volume of the water in cubic feet?
- A. 6,000
 - B. 12,000
 - C. 18,000
 - D. 36,000
 - E. 54,000
25. The average of x and t is y . If $s = 2y$, what is the average of s , x , and t in terms of y ?
- A. $3y$
 - B. $2y$
 - C. $\frac{5y}{3}$
 - D. $\frac{4y}{3}$
 - E. y
26. If $f(x) = x^3 - 5$ and $f(k) = 3$ then $k =$
- A. -22
 - B. 2
 - C. 4
 - D. 6
 - E. 22
27. If the average (arithmetic mean) of 24 consecutive odd integers is 48, what is the median of the 24 numbers?
- A. 36
 - B. 47
 - C. 48
 - D. 49
 - E. 72
28. Suppose that 10 US dollars is equivalent to 9 euros. How do you convert from euros to US dollars?
- A. add 1
 - B. multiply by 9
 - C. multiply by 10
 - D. multiply by $\frac{9}{10}$
 - E. multiply by $\frac{10}{9}$
29. The square base of a regular pyramid has a side length of 6 inches. Each of the other 4 faces of the pyramid is a triangle with a base of 6 inches and a height of 8 inches. The pyramid has a total surface area of 132 inches. A second regular pyramid has a square base that is 6 inches by 6 inches, but its total surface area is double that of the first pyramid. What is the height, in inches, of each of the triangular faces of the second pyramid?
- A. 11
 - B. 16
 - C. 19
 - D. 22
 - E. 44
30. $(3 \times 10^{20}) \cdot (8 \times 10^{30}) =$
- A. 2.4×10^{50}
 - B. 2.4×10^{51}
 - C. 2.4×10^{60}
 - D. 2.4×10^{61}
 - E. 2.4×10^{301}

31. The figure shown below in the standard x - y coordinate plane is to be rotated 180° about the origin. One of the following graphs is the result of this rotation. Which one is it?



32. Point A in the xy -coordinate system is shown below. Given two other points $B(4a, b)$ and $C(2a, 5b)$, what is the area of triangle ABC in terms of a and b ?



- A. $\frac{7ab}{2}$
 B. $\frac{9ab}{2}$
 C. $\frac{15ab}{2}$
 D. $4ab$
 E. $6ab$

33. Students in an 11th grade history class are randomly divided into three teams of five students for a history trivia contest. Each student takes a trivia test with 100 total points, and their scores are posted below. The team with the highest average score (rounded to the nearest whole number) wins the contest.

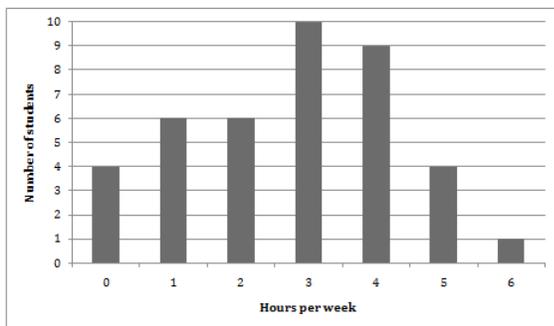
	Team 1	Team 2	Team 3
	74	64	77
	80	76	91
	93	81	92
	94	85	90
	74	89	85
Average Score	83	79	87

Which of the following is closest to the percent of individual trivia test scores that are at or above 80 points?

- A. 10%
 B. 33%
 C. 60%
 D. 67%
 E. 80%

34. The average (arithmetic mean) of two numbers is $4x$. If one of the numbers is y , then the value of the other number is
- $x - 4y$
 - $4x + 4y$
 - $8x - 4y$
 - $4y - 8x$
 - $8x - y$

35. A survey of a high school track team asked the 40 members how many hours per week (rounded to the nearest hour) they spend running outside of team practices. The 40 responses are summarized in the histogram below.



To the nearest hundredth of an hour, what is the average number of hours spent running for the 40 respondents?

- 2.75
 - 2.90
 - 3.25
 - 3.40
 - 6.00
36. Suppose water was being pumped into a cistern, and the height of the water was rising at a constant rate. The height of the water was 23 cm at 9:00 am and 72 cm at 4:00 pm. What was the height of the water at noon (12:00 pm)?
- 26 cm
 - 37 cm
 - 44 cm
 - 53 cm
 - 63 cm

37. In the standard (x,y) coordinate plane, what is the slope of a line that is perpendicular to $4x - 6y = 14$?
- -4
 - $-\frac{3}{2}$
 - $-\frac{2}{3}$
 - $\frac{3}{2}$
 - 4

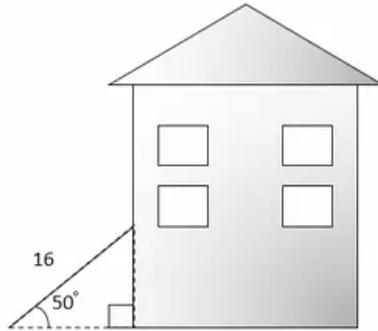
38. In the xy -coordinate system, line k passes through points $(-5m, 0)$ and $(0, 2m)$. Which of the following is a possible equation of line k ?

- $y = -\frac{5}{2}x + 2m$
- $y = \frac{2}{5}x - 5m$
- $y = \frac{5}{2}x + 2m$
- $y = \frac{2}{5}x + 2m$
- $y = -\frac{2}{5}x - 5m$

39. The microcurrent through the electrode in a delicate circuit is usually held constant at 3.6×10^{-8} amps. Because of a defect in another part of the circuit, the current was 1000 times smaller. What was the current, in amps, caused by this defect?
- 3.6×10^{-8000}
 - 3.6×10^{-24}
 - 3.6×10^{-11}
 - 3.6×10^{-5}
 - $3.6 \times 10^{-8/3}$

40. A straight 16-foot-tall ladder is leaning against an apartment building at an angle of 50° , as shown in the figure below. Which of the following expressions gives the distance, in feet, from the base of the ladder to the building?

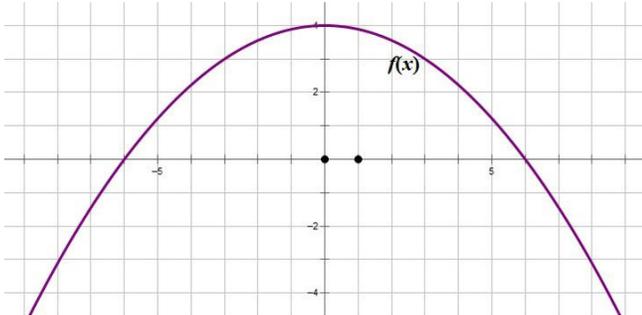
- A. $16 \cos 50^\circ$
 B. $16 \sin 50^\circ$
 C. $16 \tan 50^\circ$
 D. $\frac{16}{\sin 50^\circ}$
 E. $\frac{16}{\cos 50^\circ}$



41. In the standard (x,y) coordinate plane, when $a \neq 0$ and $b \neq 0$, the graph of $f(x) = \frac{2x+b}{x+a}$ has a vertical asymptote at:

- A. $y = -a$
 B. $y = a$
 C. $x = -1$
 D. $x = -a/2$
 E. $x = -a$

42. If $g(x) = -1/2 f(x)$, for all values of x , which of the following is a true statement describing the graph of g in comparison with the graph of f , shown below?

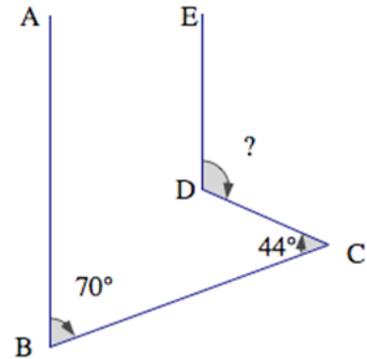


- A. It is narrower and opens downward.
 B. It is narrower and opens upward.
 C. It is the same width but opens upward.
 D. It is wider and opens downward.
 E. It is wider and opens upward.

43. Which of the following angles has the same terminal side as $1,105^\circ$?

- A. 15°
 B. 25°
 C. 45°
 D. 105°
 E. 335°

44. In the two-dimensional figure below, AB is parallel to ED , the measure of DCB is 44° , and the measure of ABC is 70° . What is the measure of EDC ?



- A. 100°
 B. 114°
 C. 118°
 D. 124°
 E. 136°

45. In the complex number system, what does i^{45} equal?

- A. -1
 B. 0
 C. 2
 D. i
 E. $-i$

46. A bag contains x blue chips and y red chips. If the probability of selecting a red chip at random is $3/7$, then $x/y =$

- F. $7/11$
 G. $3/4$
 H. $7/4$
 I. $4/3$
 J. $11/7$

47. If $f(x) = 12 - \frac{x^2}{2}$ and $f(2k) = 2k$, what is one possible value for k ?

- A. 2
- B. 3
- C. 4
- D. 6
- E. 8

48. The equation $y = x^2$ is graphed in the standard (x,y) coordinate plane. In which of the following equations is the graph of the parabola shifted 4 units to the left and 2 units up?

- A. $y = (x - 4)^2 + 2$
- B. $y = (x - 4)^2 - 2$
- C. $y = (x - 2)^2 + 4$
- D. $y = (x + 4)^2 + 2$
- E. $y = (x + 4)^2 - 2$

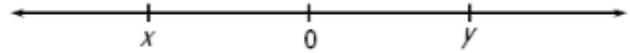
49. If $x^4 = y^{16}$, then $y = ?$

- A. $\sqrt[4]{x}$
- B. \sqrt{x}
- C. x^2
- D. x^4
- E. x^{12}

50. A square in the standard (x,y) coordinate plane has vertices at $(1,0)$, $(0,2)$, $(2,3)$, and $(3,1)$. Where do the diagonals of the square intersect?

- A. $(2, \frac{3}{2})$
- B. $(1, \frac{3}{2})$
- C. $(\frac{5}{3}, \frac{5}{3})$
- D. $(\frac{4}{3}, \frac{4}{3})$
- E. $(\frac{3}{2}, \frac{3}{2})$

51. Note: Figure not drawn to scale.



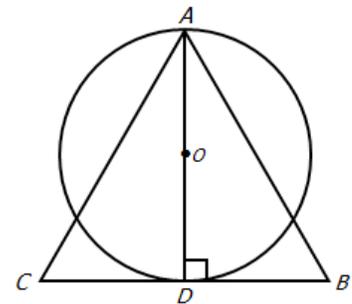
If x and y are numbers on the number line above, which of the following statements must be true?

- I. $|x + y| < y$
- II. $x + y < 0$
- III. $xy < 0$

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

52. If the circle with center O has area 9π , what is the area of equilateral triangle ABC ?

- A. $9\sqrt{3}$
- B. 18
- C. $12\sqrt{3}$
- D. 24
- E. $16\sqrt{3}$



53. In the equation $\log_4 256 - \log_3 9 = \log_2 x$, what does x equal?

- A. 0
- B. 1
- C. 2
- D. 4
- E. 6

54. Bryce is building a ramp up to a platform in a skate park. The ramp is 11.5 feet long, and the end of the ramp that meets the platform is 3 feet above the level ground. Which of the following gives the angle of inclination of the ramp?



- A. $\sin^{-1}\left(\frac{3}{11.5}\right)$
 B. $\cos^{-1}\left(\frac{3}{11.5}\right)$
 C. $\tan^{-1}\left(\frac{3}{11.5}\right)$
 D. $\sin^{-1}\left(\frac{11.5}{3}\right)$
 E. $\cos^{-1}\left(\frac{11.5}{3}\right)$
55. The n th term (t_n) of a certain sequence is defined as $t_n = t_{n-1} + 4$.
 If $t_1 = -7$ then $t_{71} =$
- A. 273
 B. 277
 C. 281
 D. 283
 E. 287
56. A circle has an area of x . If the diameter is increased by 50%, what is the area of the resulting circle in terms of x ?
- A. $1.25x$
 B. $1.5x$
 C. $2x$
 D. $2.25x$
 E. $3x$

57. If $2^{2n} + 2^{2n} + 2^{2n} + 2^{2n} = 4^{24}$, then $n =$
- A. 3
 B. 6
 C. 12
 D. 23
 E. 24

58. For quadrant 1 angles α and β ,

$$\sin(\alpha) = \frac{3}{5} \quad \text{and} \quad \cos(\beta) = \frac{12}{13}$$

Given that $\cos(\alpha + \beta) = \cos(\alpha)\cos(\beta) - \sin(\alpha)\sin(\beta)$

which of the following equals $\cos(\alpha + \beta)$?

- A. $\frac{33}{65}$
 B. $\frac{48}{65}$
 C. $\frac{56}{65}$
 D. $\frac{63}{65}$
 E. $\frac{99}{65}$
59. The expression $\log_3(63) + \log_3(5) - \log_3(35)$ equals which of the following?
- A. 2
 B. 3
 C. 6
 D. $\log_3(33)$
 E. $\log_3(56)$
60. Which of the following complex numbers equals $(2 - i\sqrt{3})(\sqrt{2} + i)$?
- A. $(2\sqrt{2} + \sqrt{3}) + i(2 - \sqrt{6})$
 B. $(2\sqrt{3} - \sqrt{2}) + i(2 + \sqrt{6})$
 C. $(2\sqrt{2} + \sqrt{6}) + i(2 - \sqrt{3})$
 D. $(2 + \sqrt{2}) + i(2\sqrt{2} - \sqrt{6})$
 E. $(2 - \sqrt{3}) + i(2\sqrt{2} + \sqrt{3})$

END OF TEST 2

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

Reading Test

35 Minutes — 40 Questions

INSTRUCTIONS: The four passages in this test are accompanied by several questions. Read the passage, and then select the best answer to each question.

Note this answer on your answer sheet. You may go back to the passages as often as you need.

PASSAGE I

LITERARY NARRATIVE: This passage is adapted from the short story “The Way of the Bow” by Paulo Coelho (2008).

1 “Tetsuya.”

The boy looked at the stranger, startled.

5 “No one in this city has ever seen Tetsuya holding a bow,” he replied. “Everyone here knows him as a carpenter.”

10 “Maybe he gave up, maybe he lost his courage,” insisted the stranger. “But he cannot be considered to be the best archer in the country if he has abandoned his art. That’s why I’ve been traveling all these days, in order to challenge him and put an end to a reputation he no longer deserves.”

15 The boy saw there was no point in arguing; it was best to take the man to the carpenter’s shop so that he could see with his own eyes that he was mistaken. Tetsuya was in the workshop at the back of his house. He turned to see who had come in, but his smile froze when his eyes fell on the long bag that the stranger was carrying.

20 “It’s exactly what you think it is,” said the new arrival. “I did not come here to humiliate or to provoke the man who has become a legend. I would simply like to prove that, after all my years of practice, I have managed to reach perfection.”

25 Tetsuya made as if to resume his work: he was just putting the legs on a table.

30 “A man who served as an example for a whole generation cannot just disappear as you did,” the stranger went on. “I followed your teachings, I tried to respect the way of the bow, and I deserve to have you watch me shoot.”

The stranger drew from his bag a longbow made from varnished bamboo. He bowed to Tetsuya, went out into the garden and bowed again towards a par-

35 ticular place. Then he took out an arrow, stood with his legs firmly planted on the ground, so as to have a solid base for shooting, and with one hand brought the bow in front of his face, while with the other he positioned the arrow.

40 The boy watched with a mixture of glee and amazement. Tetsuya had now stopped working and was observing the stranger with some curiosity.

45 With the arrow fixed to the bow-string, the stranger raised the bow so that it was level with the middle of his chest. He lifted it above his head and, as he slowly lowered his hands again, began to draw the string back. By the time the arrow was level with his face, the bow was fully drawn. For a moment that seemed to last an eternity, archer and bow remained utterly still. The boy was looking at the place where the arrow was pointing, but could see nothing.

Suddenly, the hand on the string opened, the hand was pushed backwards, the bow in the other hand described a graceful arc.

“Go and fetch it,” said Tetsuya.

55 The boy returned with the arrow: it had pierced a cherry, which he found on the ground, forty meters away.

60 Tetsuya bowed to the archer, went to a corner of his workshop and picked up what looked like a slender piece of wood, delicately curved, wrapped in a long strip of leather. He slowly unwound the leather and revealed a bow similar to the stranger’s, except that it appeared to have seen far more use.

“I have no arrows, so I’ll need to use one of yours.”

65 The stranger nodded and offered him one of his arrows.

Then, without a word, Tetsuya set off towards the mountains. The stranger and the boy went with him. They walked for an hour, until they reached a large

70 crevice between two rocks through which flowed a rushing river, which could only be crossed by means of a fraying rope bridge almost on the point of collapse.

Quite calmly, Tetsuya walked to the middle of the 75 bridge; he bowed to something on the other side, loaded the bow just as the stranger had done, lifted it up, brought it back level with his chest and fired.

The boy and the stranger saw that a ripe peach, about twenty meters away, had been pierced by the 80 arrow.

“You pierced a cherry, I pierced a peach,” said Tetsuya, returning to the safety of the bank. “The cherry is smaller. You hit your target from a distance of forty meters, mine was half that. You should, therefore, be 85 able to repeat what I have just done.”

Terrified, the stranger made his way to the middle of the dilapidated bridge, transfixed by the sheer drop below his feet. He performed the same ritual gestures and shot at the peach tree, but the arrow sailed past.

90 When he returned to the bank, he was deathly pale.

“You have skill, dignity, and posture,” said Tetsuya. “You have mastered the bow, but you have not mastered your mind. You know how to shoot when all the 95 circumstances are favorable, but the archer cannot always choose the battlefield, so start your training again and be prepared for unfavorable situations. Continue in the way of the bow, for it is a whole life's journey, but remember that a good, accurate shot is very different from one made with peace in your soul.”

100

The stranger made another deep bow, replaced his bow and his arrows in the long bag he carried over his shoulder, and left.

1. What changes in the stranger's message between when he speaks to the boy and when he speaks to Tetsuya himself?
 - A. To the boy, he claims he wants to challenge Tetsuya, but to Tetsuya, he insists he only wants to demonstrate his own mastery.
 - B. To the boy, he ridicules Tetsuya's skill, but to Tetsuya, he expresses his awe of it.
 - C. To the boy, he says Tetsuya is considered the best archer in the country, but to Tetsuya, he claims Tetsuya is no longer a legend.
 - D. To the boy, he says that Tetsuya has abandoned his art, but to Tetsuya, he reveals he knows Tetsuya is still practicing.
2. The passage implies that the boy mainly views the stranger's demonstration of his archery skills as:
 - A. a humiliating insult to Tetsuya.
 - B. an inconvenience to the day's carpentry work.
 - C. a startling and confusing display.
 - D. a fun and exciting game.
3. It can reasonably be inferred that Tetsuya has no arrows, because:
 - A. he hasn't used his bow in a long time.
 - B. he used them all up in recent practice.
 - C. he has had no time to make them in his carpentry shop.
 - D. he is too poor to afford them.
4. The repeated descriptions of the rituals of shooting the bow (bowing to the other archer, bowing toward the target) are most likely intended to emphasize:
 - A. the boy's exasperation with the repetitiveness of the archery competition.
 - B. Tetsuya's and the stranger's connection with their heritage.
 - C. the sacredness of the ritual and the respect with which the archers treat the art.
 - D. the irony of Tetsuya's and the stranger's feigned respect in the heat of competition.
5. It can be assumed that Tetsuya takes the stranger to bridge for his archery demonstration because:
 - A. it is Tetsuya's favorite archery spot.
 - B. it is a place where Tetsuya is assured to win the competition.
 - C. it is far enough away to exhaust the stranger before he has a chance to shoot again.
 - D. it is an ideal place to demonstrate the importance of learning to shoot in unfavorable circumstances.

6. It can reasonably be inferred that the stranger is “deathly pale” when he returns to the bank:
- because he was terrified by the fraying bridge and the long drop below.
 - because he failed to hit a target he has always made in the past.
 - because he is fearful of Tetsuya’s punishment.
 - because of the cold and dampness near the mountain river.
7. According to the passage, Tetsuya and the stranger are similar to each other in all of the following ways EXCEPT:
- they are both skilled archers.
 - they both have a respect for the bow.
 - they both have an understanding of the connection between archery and the mind.
 - they complete similar rituals before shooting their arrows.
8. As it is used in line 76, the word *loaded* most nearly means:
- weighed down
 - armed
 - supplied abundantly
 - took on
9. Tetsuya’s comments to the stranger in lines 91 - 99 are most intended to demonstrate:
- Tetsuya’s wisdom in understanding that the way of the bow is a lifelong process.
 - Tetsuya’s arrogance in assuming that he knows more about archery than the stranger.
 - Tetsuya’s desire to return to archery.
 - Tetsuya’s reasoning for why he gave up archery.
10. It can reasonably be concluded that the stranger, upon leaving, reacts to Tetsuya’s lesson with:
- anger
 - guilt
 - humility
 - triumph

PASSAGE II

SOCIAL SCIENCE

Passage A

Edmund Burke, the British writer of political theory, believed government had been improved by every preceding generation up to his own. He saw the successive effort of early Greek democracies and Byzantine emperors and the rules set forth by the Magna Carta coalescing into a consummately effective — though far from perfect — society. In his eyes, the British Parliamentary system of his day represented the realization of all of the efforts theretofore drawn together by the work of Enlightenment philosophers in the 18th century. It was the fullest expression of liberty balanced with order yet known to man. A deep sense of gratitude to his forbears reigned in every word from his lips and from his pen.

Due to this national pride and patriotism, Burke’s dismissal of the French Revolution brings little surprise to the student of history. Yet, his positive attitude toward the American Revolutionaries, so uncommon in his time and station, was no less a natural expression of his political stance.

Years before the fateful July fourth, Burke addressed the British House of Commons regarding the trouble stirring far across the Atlantic. The British had treated the American Englishmen unjustly, he argued. Taxation without representation violated the principles foundational to Parliament. Taking a long and careful view of history, Burke believed that the colonists had both tactical and ideological advantages; they wielded the two-edged sword of power and virtue. As long as the English people exploited their overseas brethren, they could not hope to suppress the colonists with violence.

Burke’s call to action went unheeded, and the American Revolution began. Still appealing to his perennial belief in the superiority of the Parliamentary system of government, he pled with the House, “As long as you have the wisdom to keep the sovereign authority of this country as the sanctuary of liberty, the sacred temple consecrated to our common faith, wherever the chosen race and sons of England worship freedom, they will turn their faces towards you. The more they multiply, the more friends you will have; the more ardently they love liberty, the more

perfect will be their obedience. Slavery they can have
 45 anywhere. It is a weed that grows in every soil. They
 may have it from Spain, they may have it from Prussia.
 But, until you become lost to all feeling of your true
 interest and your natural dignity, freedom they can
 have from none but you." Despite his wise words, the
 50 English still sought to enslave the colonies, thereby
 losing America.

Passage B

A refugee torn from the prisons of the French
 Revolution, political philosopher Thomas Paine ended
 his life without the slightest loss of confidence in the
 55 beauty and value of revolution. As he had stood with
 America throughout his boyhood and early manhood,
 Paine stood with France even as it sought to kill him.
 For Paine, the world had been a brutal, unjust place
 until the Enlightenment in the 1700s. In the light of
 60 liberty and intellectual freedom, the dusty thrones
 and inbred monarchy that filled Europe's ruling class
 seemed a matter for history books rather than news-
 papers.

Paine championed these views and praised the
 65 necessity of the American Revolution in his famous
 pamphlet, *Common Sense*. Read in bars and parlors
 throughout the colonies, the straightforward, some-
 times vulgar language of Paine's writings provided the
 battle cry of an Enlightened people against the old,
 70 cold ways of King George III. It argued that ordinary
 people had not only the ability and the right to con-
 tribute to the structure of their leadership, but even
 the duty.

What was true in America was doubly true in
 75 France. A little over a decade after arguing the
 American people into shuffling off the shackles of
 the English monarchy, Paine joined what he saw as a
 parallel effort in France. When the peasants deposed
 the king and tore apart the structure of their govern-
 80 ment, Paine lauded the end of tyranny. The political
 philosopher joined the effort in France with almost
 complete accord, although he did try to argue against
 the execution of King Louis XVI, who had been an ally
 to the Americans in their own fight for independence.
 85 Even after that execution, Paine went on to write
 headstrong defenses of the French Revolution until
 the tides turned. In the unstable atmosphere of the
 French political landscape, Paine soon found himself
 on the wrong side of the ruling powers. Imprisoned

90 and sentenced to death, Paine relied on allies from
 America and England to help him escape.

Despite this accident of history, Paine refused to
 speak against the French Revolution. To his death, he
 continued to claim that individual safety and stability
 ought to be sacrificed on the altar of liberty.

11. The author's attitude toward Edmund Burke in Pas-
 sage A can best be described as:
 - A. interest and wariness.
 - B. skepticism and apprehension.
 - C. amusement and sentimentality.
 - D. reverence and fascination.
12. Lines 1 - 14 make it clear that Edmund Burke be-
 lieved that early Greek democracies, Byzantine
 emperors, and the Magna Carta were:
 - A. the result of Enlightenment philosophy.
 - B. influential in the formation of the British Parlia-
 mentary system.
 - C. founded on outdated political science.
 - D. the fulfillment of all preceding governmental
 models.
13. In lines 36 - 49, the author quotes Burke's speech to
 Parliament primarily to emphasize the fact that:
 - A. Burke still believed Parliament was an inherently
 good institution.
 - B. Parliament had ignored Burke's previous appeals.
 - C. the American colonies would find another na-
 tion to govern them if Parliament pulled away its
 support.
 - D. Parliament was too entangled in the slave trade
 to maintain relations with America.
14. Passage A states that Edmund Burke's first effort to
 change British treatment of the American colonies
 was:
 - A. ineffective.
 - B. too emotional.
 - C. belated.
 - D. incoherent.

15. Passage B states that Thomas Paine made some effort to defend:
- King George III.
 - King Louis XVI.
 - Greek democracy.
 - the English throne.
16. One of the main purposes of lines 91 - 94 is to show that:
- Paine experienced a change of heart after his persecution in France.
 - the French Revolution preserved safety and stability.
 - liberty can only be achieved when individual safety is upheld.
 - Paine did not allow negative personal experiences to change his convictions.
17. As it is used in lines 79 - 83, the word *accord* most nearly means:
- proportion.
 - acknowledgement.
 - agreement.
 - length of rope.
18. The author of Passage B most strongly implies that Thomas Paine was:
- uneducated.
 - stubborn.
 - timid.
 - compliant.
19. Both Passage A and Passage B highlight the importance of which of the following in shaping attitudes towards the American and French Revolutions?
- Byzantine emperors.
 - the Enlightenment.
 - the British Parliament.
 - King Louis XVI.
20. Based on the description of Edmund Burke in Passage A and Thomas Paine in Passage B, which of the following statements best summarizes the differences between these men?
- Burke had faith in existing government structures, while Paine believed that all good government systems had already died out.
 - Burke expected the American Revolution to fail, while Paine was confident that it would succeed.
 - Burke understood his government to be without fault, while Paine was skeptical about the idea of a perfect government.
 - Burke believed that good governments give equal attention to liberty and order, while Paine believed that liberty was most important.

PASSAGE III

This passage was adapted from the essay "Costume, Cinema, and Materiality" by Therese Andersson. *Culture Unbound* 3 (2011): 101-112.

- The opening scene of the film *Marie Antoinette* (Sofia Coppola, 2006) is set in Austria: a static image of a young Marie Antoinette sleeping in a dark room. The establishing shot that follows shows Schönbrunn Palace in the early, grey morning light, before reverting to a close-up of Marie Antoinette waking up. Completely unaware of what the future has in store for her, Marie Antoinette allows the attendants to dress her just as on any other day. While she waits for them to lace the corset and finish her hair, she appears unconcerned and plays with her little pug. Dressed in a soft, velvety and lavender blue two-pieced dress, she then meets with her mother, before being sent off to France.

- The theme of dressing and redressing, which is accentuated in the opening scene, is pursued throughout the film *Marie Antoinette*, establishing costume as a significant feature for reading the movie. Costumes help in the construction of cinematic identities. Their colors and configurations intervene with the actors' movements, allowing further characterization on a more associative level. A character's story is visualized through clothing. At first glance the attire of a filmic character connotes time period,

25 social status, and whether or not the cinematic world refers to fantasy or reality. A closer examination reveals more subtle details: a character's state of mind, motivations, and how the character wishes to be perceived.

30 Costume design involves conceptualizing and creating garments that capture and define the personalities of fictional characters and are therefore intended to embody the psychological, social and emotional condition of the character at a particular moment in the screenplay. For instance, one of the scenes in the "I Want Candy" montage in the film shows Marie Antoinette trying on new high-heeled shoes, and next to her on the floor lays a pair of well-worn, light blue Converse boots. The anachronistic feature is a cross-reference to today's fashion and youth culture, reminding the audience that this is a film about teenagers and not really an 18th century period piece.

45 Additionally, in *Marie Antoinette*, color is used in a nuanced way, not only to describe the characters, but also in order to facilitate a specific look for the whole movie. On a conceptual level, the colors are used to tell a story. In this case, a story with an unhappy ending. In this early stage of Marie Antoinette's time at Versailles, the colors worn and applied are light and icy, more sorbet-like. In the middle of the film—depicting her party years—her gowns become most desert-like in their choice of color and even in cut, with bright yellow, pink and blue combinations creating a macaroon effect with the ornamentation of petticoats and skirts. Her dresses are modified in configuration as well and become bolder, with more daring garnish. In the final sequences of Marie Antoinette's life at Versailles, the colors grow a bit darker, faded, and become stricter. The fabric seems to change as well, and the dresses look heavier and more formal. The whole *mise-en-scène* subsequently becomes darkened and the film ends with a frame of her wrecked apartment overlaid with the sound of the guillotine as it slices the air (implying Marie Antoinette's beheading).

65 The color palette of the costumes might be translated to a depiction of Marie Antoinette's inner journey. The range of colors are comparable to those of the seasons, beginning with the light, spring-like pastels for her youth; bright summer colors representing her party years; and the darker, autumn-like shades for the last period at Versailles. As such,

75 the costumes have metaphoric meaning; they are symbols of a stage in life and a state of mind. The costumes for Marie Antoinette are thus understood as being designed in order to communicate the inner experiences of the characters.

80 Ultimately, costume design in *Marie Antoinette* allows us to quickly grasp what the characters are all about. The actual changes in French fashion that began in the 1780s are in the film used as a way to visualize Marie Antoinette's state of mind. The costumes conspire with the other cinematic features, generating a symbolic network for telling a story through dress.

21. The main point of the passage is that:
- Marie Antoinette uses the symbolism of costumes more than many other films like it.
 - Costume design in *Marie Antoinette* allows audiences to more easily understand the psychological state of the main character.
 - Marie Antoinette's use of anachronous costuming helps audiences today better relate to the movie's time period.
 - Costume design in *Marie Antoinette* allows the audience to more easily distinguish between the personalities of the different characters.
22. According to the passage, which of the following statements is true about the film's costumes during the "party years" of Marie Antoinette, as compared to her previous dresses?
- They are lighter in color.
 - They are more mature.
 - They are more daring.
 - They are autumn-like in shade.
23. It can be inferred that the passage's reference to "light blue Converse boots" is primarily intended to:
- reveal a flaw in the cohesiveness of the film's costume design.
 - support how costume choices can be used to reveal inner psychological conditions.
 - indicate how the film depicts various time periods through costumes.
 - provide an example of the overall light color scheme of costuming in the film.

24. As it is used in lines 14 - 17, the word *pursued* most nearly means:
- chased
 - followed
 - explored
 - accomplished
25. The passage claims that costumes help convey all of the following about characters EXCEPT:
- social status.
 - how realistic their world is.
 - historical time period.
 - family relationships.
26. The passage characterizes a young Marie Antoinette in Austria as:
- naive
 - bold
 - subdued
 - irresponsible
27. In the context of the passage as a whole, it can be assumed that the author chooses to mention the specific detail of Marie Antoinette's "soft, velvety and lavender blue two-pieced dress" in lines 11 - 13 in order to:
- emphasize the formality of the occasion of Marie Antoinette traveling to France.
 - imply that this costume choice reflects Marie Antoinette's current state in life.
 - foreshadow Marie Antoinette's icy, light-colored dresses mentioned in Paragraph 4.
 - indicate the differences Marie Antoinette will encounter in climate between Austria and France.
28. The phrase "In this case, a story with an unhappy ending" in lines 45 - 46 is most directly foreshadowing which part of the passage?
- "her wrecked apartment"
 - "the final sequence of Marie Antoinette's life at Versailles"
 - "before being sent off to France"
 - "Marie Antoinette's beheading"
29. It can reasonably be assumed that the author intended lines 67 - 71 to build on the information provided in lines 48 - 64 on the colors of Marie Antoinette's dresses by:
- introducing an opposing argument to the information provided in Paragraph 4.
 - repeating a key point from Paragraph 4.
 - introducing a symbolic reading of the details provided in Paragraph 4.
 - explaining how her dresses continue to change beyond the information provided in Paragraph 4.
30. As it is used in lines 82 - 85, *conspire with* most nearly means:
- scheme with.
 - combine with.
 - agree with.
 - connive with.

PASSAGE IV

After the discovery of Neptune in 1846, eager astronomers combed the Solar System for signs of another planet that might lie beyond this gas giant. They had good reason to believe one might exist: Neptune's discovery had directly resulted from French mathematician Urbain Le Verrier's hypothesis that perturbations in the orbit of Uranus were caused by the gravitational pull of a yet-undiscovered planet. Le Verrier predicted the position of this new planet and sent his calculations to German astronomer Johann Gottfried Galle. With these coordinates, Galle discovered Neptune the very next day—exactly where Le Verrier had predicted. But there remained some discrepancies in the gas giants' orbits even with the discovery of the blue planet, so the hunt for yet another distant planet in the solar system forged onward.

Percival Lowell, an early twentieth century astronomer, exhibited a particular obsession with this search for a ninth planet. Lowell christened this hypothetical new planet "Planet X," and, in his 1915 Memoir on a Trans-Neptunian Planet, concluded that Planet X must have a mass roughly seven times that

of Earth—about half that of Neptune—and a mean
 25 distance from the Sun of 43 AU.* When Lowell died
 suddenly in 1916, his observatory, led by the efforts
 of his widow, persisted in the search for the elusive
 Planet X.

Fourteen years later, an ambitious budding
 30 astronomer from a Kansas farming family made the
 first major discovery in the search for Planet X. In
 1929, twenty-three-year-old Clyde Tombaugh arrived
 at the Lowell Observatory and was given the task of
 systematically imaging the night sky. Tombaugh cap-
 35 tured sections of the sky in pairs of images taken two
 weeks apart. He then placed the paired images into
 a machine called a blink comparator, a microscope
 that superimposes two photographic plates, “blink-
 ing” rapidly between them and creating a time-lapse
 40 illusion of the movement of any planetary body. In
 February 1930, after searching for almost a year and
 examining nearly two million stars, Tombaugh discov-
 ered a moving object on photographic plates taken
 in the previous month. The object lay just six degrees
 45 from one of the two locations for Planet X that Lowell
 had suggested, and it seemed as though, at long last,
 Lowell had been vindicated.

This supposed new planet was named Pluto, in
 part to honor Percival Lowell, as his initials make up
 50 the first two letters of the word. However, it did not
 take long before astronomers began debating Pluto’s
 status as a planet. Observations showed that Pluto
 was six times dimmer than Lowell had predicted. It
 also had a far more elliptical orbit than any other plan-
 55 et in the solar system. In 1978, Pluto was found to
 be too small for its gravity to affect the gas giants, a
 discovery that resulted in a search for a tenth planet,
 which was eventually abandoned in the early 1990s
 when the Voyager 2 spacecraft found that irregular-
 60 ities in Uranus’s orbit were actually due to a slight
 overestimation of Neptune’s mass.

In 1992, the discovery of numerous small, icy
 objects similar in size and orbit to Pluto led to a more
 vocal debate over whether it should remain a planet
 65 or whether Pluto and its asteroid neighbors should be
 given their own separate classification. In 2006, the
 International Astronomical Union ultimately reclassi-
 fied Pluto and its friends as “dwarf planets,” leaving
 the Solar System, once again, with only eight planets.
 70 It is not likely that Pluto will ever be called an official
 planet again, either. Mike Brown, who discovered Eris,

a dwarf planet larger than Pluto, in 2005, speculates
 that there are likely thousands of other “rocks” like
 Pluto orbiting in the Kuiper belt outside of Neptune.

75 Today, the astronomical community is largely
 in agreement that Planet X as it was originally con-
 ceived does not exist, but Planet X as a concept has
 been revived by a number of astronomers to explain
 other anomalies observed in the outer Solar System.
 80 In popular culture, Planet X has become a stand-in
 term for any undiscovered planet in the Solar System,
 regardless of whether or not it fits into Lowell’s origi-
 nal theory. Thus, real or not, Planet X remains a fixture
 in the astronomical universe.

*An AU (astronomical unit) is roughly the distance from the
 Earth to the Sun.

31. The main purpose of the passage is to:
- describe how the gas giant Neptune and the dwarf planet Pluto were discovered and how they were classified.
 - explain how Pluto’s discovery resulted from the search for Planet X and how new findings about Pluto affected understandings of Planet X.
 - analyze the opposing arguments in the debate over Pluto’s status as a planet.
 - interpret the meaning of Planet X from the perspective of twentieth-century astronomers, modern-day astronomers, and popular culture references.
32. As it is used in lines 1 - 3, the word *combed* most nearly means:
- brushed.
 - searched.
 - smoothed.
 - rolled over.
33. The “blue planet” referred to in lines 13 - 17 is intended to be:
- Pluto.
 - Neptune.
 - Uranus.
 - Earth.

34. The passage devotes the LEAST attention to which of the following topics?
- A. Clyde Tombaugh's work at the Lowell Observatory
 - B. the size and orbit of Pluto
 - C. the process of Neptune's discovery
 - D. Lowell's book, *Memoir on a Trans-Neptunian Planet*
35. Which of the following developments does the passage indicate occurred first chronologically?
- A. Clyde Tombaugh's discovery of Pluto
 - B. Le Verrier's and Galle's discovery of Neptune
 - C. The discovery of Uranus
 - D. Percival Lowell's establishment of his Lowell Observatory
36. The author most likely chooses to describe Tombaugh as coming "from a Kansas farming family" in order to:
- A. imply that we might be surprised someone of Tombaugh's background discovered Pluto.
 - B. emphasize the significance of Pluto's discovery by a Kansas-based observatory.
 - C. foreshadow the eventual demotion of Pluto from a planet to a dwarf planet.
 - D. indicate Tombaugh's close relationship with Lowell's family.
37. Within the passage, descriptions of findings concerning the size, brightness, and orbit of Pluto in lines 52 - 56 serve mainly to:
- A. support the idea that Lowell was correct in his assumptions about Planet X.
 - B. discredit the original observations of Clyde Tombaugh when he discovered Pluto.
 - C. provide evidence that casts doubt on Pluto's status as a planet.
 - D. indicate the need for Voyager 2's mission to explore the outer Solar System.
38. It can be inferred that Mike Brown's discovery of Eris was particularly damaging to Pluto's status as a planet because Eris was found to be:
- A. larger than Pluto.
 - B. denser than Pluto.
 - C. close enough to Neptune to have an effect on Neptune's orbit.
 - D. a dwarf planet, unlike Pluto.
39. It can be inferred that the "friends" of Pluto referred to in line 68 are:
- A. supporters of Pluto's status as a planet.
 - B. other orbiting objects that are similar to Pluto.
 - C. the other eight planets in the Solar System.
 - D. astronomers and researchers at the Lowell Observatory.
40. The passage indicates that the most important difference between Planet X as it was conceived of by Lowell and Planet X as it is conceived of today is that:
- A. Planet X according to Lowell was Pluto and Planet X as it is used today is Eris.
 - B. Planet X according to Lowell had a significant effect on Neptune's orbit and Planet X as it is used today does not.
 - C. Planet X according to Lowell was a hypothetical entity and Planet X as it is used today refers to a concrete planetary body.
 - D. Planet X according to Lowell had a specific location and specific characteristics and Planet X as it is used today is a substitute term for any undiscovered planet in the outer Solar System.

Science Test

35 Minutes — 40 Questions

INSTRUCTIONS: Each of the seven passages in this test is accompanied by several questions. Read the passage, and then choose the best answer to each question.

Note your answer on your answer sheet. You may return to the passages as often as you need.
You may NOT use a calculator on this test.

PASSAGE I

Malaria is an infectious disease that kills more than 600,000 people every year. Several species of the genus *Plasmodium* cause malaria, with two of the most common being *Plasmodium falciparum* and *Plasmodium vivax*. Though both species cause a very similar illness, *P. falciparum* malaria is more likely to result in fatalities than *P. vivax* malaria, while *P. vivax* malaria is more likely to recur -- to return after a period of time during which the patient is healthy and has no parasites present in the blood.

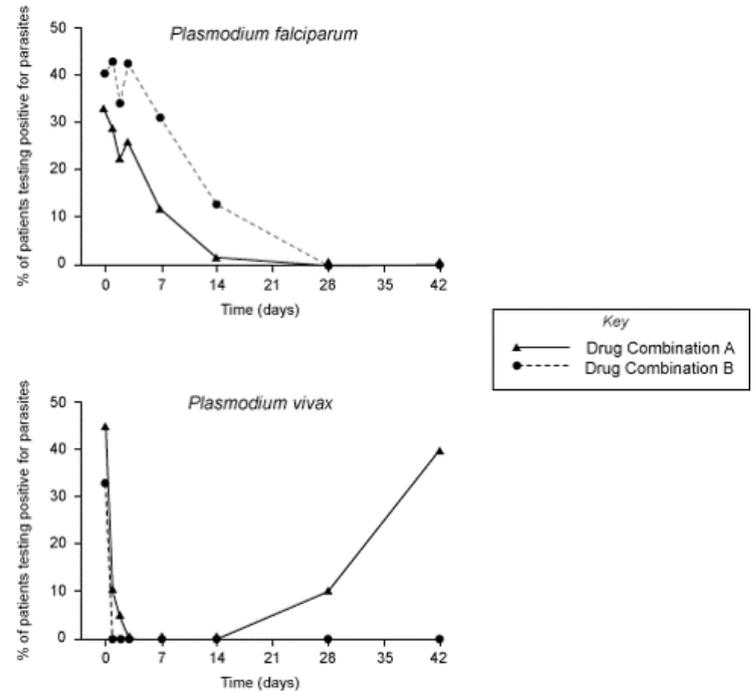
The two species of malaria parasites respond differently to antimalarial medications, but in many areas where malaria is common, testing to determine what type of malaria a patient has is not widely available. Therefore, malaria treatments are often tested against both species of the parasite, and first-line malaria treatments in these regions ideally should be effective against both parasites.

Experiment 1

For many years, public health professionals in Papua New Guinea have recommended a treatment regimen, Drug Combination A, as a first-line malaria treatment. Recently a new treatment regimen, Drug Combination B, has been proposed as a potential replacement for Combination A, and a study was conducted to compare their effectiveness.

Children entering a local health clinic with malaria symptoms were tested to determine which *Plasmodium* species they carried. The patients were then randomly assigned Drug Combination A or Drug Combination B, and their blood was tested periodically for the presence of parasites.

Figure 1



Experiment 2

On rare occasions, patients have severe allergic reactions to a compound that is found in both Drug Combination A and Drug Combination B. In these cases, a second-line treatment must be used. A second study was conducted to determine which of several drug combinations would be the best second-line drug to recommend for use in Papua New Guinea. Table 1 shows the treatment response to the second-line drug combinations.

Table 1

Response Measure	<i>P. falciparum</i>			<i>P. vivax</i>		
	Drug C	Drug D	Drug E	Drug C	Drug D	Drug E
% patients free of parasites						
Day 1	0	25	90	62	87	55
Day 2	30	49	95	85	90	58
Day 7	75	51	100	99	97	76
Day 14	100	51	100	100	100	99
Day 42	100	52	100	20	100	89

- According to Figure 1, the percentage of *P. falciparum* patients with parasites remaining in their blood on day 14 was approximately:
 - 1% for patients treated with Drug Combination A, 12% for patients treated with Drug Combination B.
 - 12% for patients treated with Drug Combination A, 1% for patients treated with Drug Combination B.
 - 7% for patients treated with Drug Combination A, 14% for patients treated with Drug Combination B.
 - 0% for both drug combinations.
- Based on the data from Experiment 1, on which day of treatment could a patient expect to be free of parasites regardless of which species they were infected with or which drug combination they were given?
 - Day 7
 - Day 14
 - Day 28
 - There is no day that meets this criteria.
- Recurrences of *P. vivax* malaria are known to be caused by hypnozoites, a form of the malaria parasite that can go dormant in the patient's liver for up to two weeks, that remain alive following the initial treatment. Based on the data in Figure 1, which of the following conclusions is most likely to be true?
 - Drug Combination A eliminates hypnozoites in all patients, but Drug Combination B eliminates hypnozoites only in some patients.
 - Drug Combination B eliminates all hypnozoites, but Drug Combination A eliminates hypnozoites only in some patients.
 - Drug Combination B eliminates all hypnozoites in all patients, but Drug Combination A does not eliminate any hypnozoites.
 - Neither treatment kills hypnozoites.
- If 1000 patients in the *P. falciparum* group were treated with Drug Combination B in Experiment 1, approximately how many of those patients remained infected on Day 7?
 - 100
 - 300
 - 700
 - 900
- Suppose a patient is brought to the clinic with a life-threatening case of *P. falciparum* malaria. As the patient's condition is deteriorating quickly, it is essential that they be given the treatment that eliminates parasites from their blood within 7 days. Based on the data from Experiments 1 and 2, which treatment should they be given?
 - Drug Combination A
 - Drug Combination D
 - Drug Combination E
 - Drug Combination B
- Drug treatments that are eliminated from a patient's body very quickly are likely to result in recurrence of *P. vivax* in the patient. Based on the information in the passage, which of the following drugs is likely NOT removed from the body quickly?
 - Drug Combination A
 - Drug Combination C
 - Drug Combination D
 - Drug Combination E

PASSAGE II

Gregor Mendel discovered the basic principle of independent assortment in genetics through selective cross-breeding of common pea plants (*Pisum sativum*).

Table 1 lists the possible alleles of 4 of the genes Mendel discovered and the possible genotypes for each.

Gene	Alleles	Genotypes	
		Homozygous	Heterozygous
A	<i>A, a</i>	<i>AA, aa</i>	<i>Aa</i>
B	<i>B, b</i>	<i>BB, bb</i>	<i>Bb</i>
C	<i>C, c</i>	<i>CC, cc</i>	<i>Cc</i>
D	<i>D, d</i>	<i>DD, dd</i>	<i>Dd</i>

Table 2 lists *Pisum sativum* genotypes and the phenotype associated with each genotype.

Genotype	Phenotype			
	flower color	seed color	pod color	pod shape
<i>AABBCCDD</i>	purple	yellow	green	smooth
<i>AABBCCDd</i>	purple	yellow	green	smooth
<i>AABBCCdd</i>	purple	yellow	green	constricted
<i>AABBCcDD</i>	purple	yellow	green	smooth
<i>AABBccDD</i>	purple	yellow	yellow	smooth
<i>AABbccdd</i>	purple	yellow	yellow	constricted
<i>AabbccDD</i>	purple	green	yellow	smooth
<i>AabbCCdd</i>	purple	green	green	constricted
<i>aabbccdd</i>	white	green	yellow	constricted
<i>aaBBccDD</i>	white	yellow	yellow	smooth
<i>aaBBCCDD</i>	white	yellow	green	smooth
<i>AaBbCcDd</i>	purple	yellow	green	smooth

Table 3 lists 6 *Pisum sativum* crosses, the genotypes of each parent, and the percentage of offspring that displayed each phenotype for the traits listed in Table 2. Multiple matings of each genotype pairing were performed.

Cross	Parent Genotype		Offspring phenotype			
	Parent 1	Parent 2	flower color	seed color	pod color	pod shape
1	<i>AABBCCDD</i>	<i>aabbccdd</i>	100% purple	100% yellow	100% green	100% smooth
2	<i>aaBBCcDd</i>	<i>aabbCcDd</i>	100% white	100% yellow	75% green 25% yellow	75% smooth 25% constricted
3	<i>Aabbccdd</i>	<i>aaBbCcDd</i>	50% purple 50% white	50% yellow 50% green	50% green 50% yellow	50% smooth 50% constricted
4	<i>AabbCcdd</i>	<i>AabbCcdd</i>	75% purple 25% white	100% green	75% green 25% yellow	100% constricted
5	<i>AaBbccDD</i>	<i>AaBbccDD</i>	75% purple 25% white	75% yellow 25% green	100% yellow	100% smooth
6	<i>aabbccdd</i>	<i>aabbccdd</i>	100% white	100% green	100% yellow	100% constricted

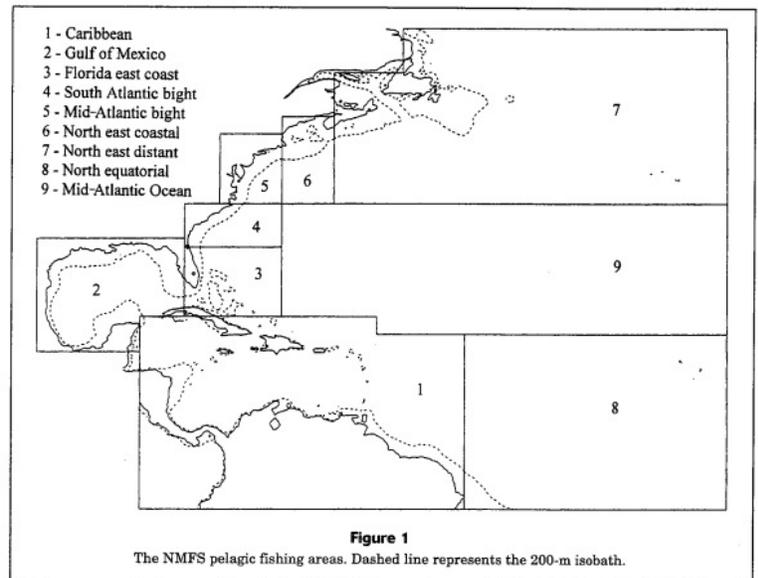
7. Based on the information provided, a *P. sativum* plant that is heterozygous for each of the 4 genes will have which of the following phenotypes?
- White flowers, green seeds, yellow pods, smooth pods
 - White flowers, green seeds, yellow pods, constricted pods
 - Purple flowers, yellow seeds, green pods, smooth pods
 - Purple flowers, yellow seeds, green pods, constricted pods
8. Based on the information provided in Table 3, $\frac{3}{4}$ of the offspring in which of the following crosses produced phenotypes expressing purple flowers and green pods?
- AABBCCDD* × *aabbccdd*
 - aaBBCcDd* × *aabbCcDd*
 - AabbCcdd* × *AabbCcdd*
 - AaBbccDD* × *AaBbccDD*

9. Based on the information in Table 3, if Cross 5 produced 100 offspring, approximately how many would be expected to have white flowers?
- 25
 - 50
 - 75
 - 100
10. Based on the information provided, all of the offspring of Cross 6 produced constricted pods because each received:
- allele *a* from Parent 1 and allele *a* from Parent 2
 - allele *B* from Parent 1 and allele *b* from Parent 2
 - allele *c* from Parent 1 and allele *C* from Parent 2
 - allele *d* from Parent 1 and allele *d* from Parent 2
11. According to the information in Table 3, which of the following pairs of parental genotypes would produce offspring in which 50% presented yellow pea pods and 50% presented green pea pods?

- Parent 1: *CC* Parent 2: *CC*

PASSAGE III

Sea turtles are often incidentally captured in commercial fishing operations in the Atlantic Ocean. The National Marine Fisheries Service (NMFS) records and reports incidents of sea turtle capture. The figures below show the seasonal distribution and relative abundance of leatherback (*Dermochelys coriacea*) and loggerhead (*Caretta caretta*) sea turtles caught by the U.S. Atlantic longline fleet from 1992 through 1995. Figure 1 shows a map of fishing areas in the Atlantic Ocean. Table 1 shows leatherback (Lb) and loggerhead (Lh) turtle captures by month in some areas shown in Figure 1. Table 2 shows captures by area. Table 3 shows CPUE (catch-per-unit-effort) values for the number of turtles caught per 1000 hooks fished, as well as whether longline fishing vessels were using chemical light sticks to attract fish at the time of capture.



	Area 1		Area 2		Area 3		Area 6		Area 7	
	Lb	Lh	Lb	Lh	Lb	Lh	Lb	Lh	Lb	Lh
Jan	16	12	4	6	4	2	0	0	0	0
Feb	17	7	12	1	2	3	0	0	0	0
Mar	13	24	8	4	6	2	0	0	0	0
Apr	4	4	7	3	2	1	2	1	0	0
May	5	1	1	4	1	1	5	3	0	0
Jun	1	1	3	9	2	1	35	49	40	39
Jul	2	0	10	5	0	0	48	62	170	233
Aug	3	0	10	7	1	0	48	14	152	212
Sep	0	1	0	1	1	1	30	4	167	310
Oct	1	1	2	5	1	1	12	6	56	123
Nov	3	1	3	2	0	0	0	4	8	19
Dec	4	4	3	1	3	3	0	0	0	0
Total	69	56	73	48	23	13	180	143	593	936

Area	1992		1993		1994		1995	
	Lb	Lh	Lb	Lh	Lb	Lh	Lb	Lh
1	19	12	17	6	8	11	25	27
2	20	9	25	8	12	6	16	25
3	3	2	6	4	11	3	3	4
4	10	2	3	6	7	5	10	7
5	147	30	68	13	29	32	18	33
6	81	26	54	51	19	19	26	47
7	84	59	67	33	105	278	337	566
8	0	0	0	1	3	0	16	3
9	5	0	5	5	4	2	1	2
Total	369	140	245	127	198	356	452	714

Area	Lights	Lb Captures	Lh Captures	Lb CPUE	Lh CPUE
1	Y	66	54	0.0637	0.0521
1	N	3	2	0.0295	0.0197
2	Y	38	37	0.0147	0.0143
2	N	35	11	0.0112	0.0035
3	Y	23	13	0.0166	0.0094
3	N	0	0	0.0000	0.0000
7	Y	591	932	0.2832	0.4466
7	N	2	4	0.0362	0.0724
9	Y	15	9	0.0302	0.0181
9	N	0	0	0.0000	0.0000

Tables and figures adapted from Witzell, Wayne N., "Distribution and Relative Abundance of Sea Turtles Caught Incidentally." *Fishery Bulletin* 97(1). https://www.sefsc.noaa.gov/turtles/PR_Witzell_1999_FBull.pdf. ©1999 by the Southeast Fisheries Science Center.

- 12.** According to the information provided in Figure 1 and Table 1, which of the following areas accounted for the greatest number of loggerhead sea turtles incidentally caught during the period studied?
- Caribbean
 - North east coastal
 - North east distant
 - Florida east coast
- 13.** According to Table 2, during which year was the number of loggerhead turtles caught greater than the number of leatherback turtles in Area 6?
- 1992
 - 1993
 - 1994
 - 1995
- 14.** According to Table 1, during which of the following months was the greatest number of sea turtles captured during the period studied?
- March
 - July
 - November
 - December
- 15.** Vessels fishing for swordfish generally work at night using chemical lightsticks to attract baitfish while vessels fishing for tuna generally fish during the day without lightsticks. Does the data presented in Table 3 for Areas 1-9 support the conclusion that fishing for swordfish is more harmful to endangered sea turtle populations than fishing for tuna?
- Yes, because Lb and Lh CPUE values were higher when lightsticks were used.
 - Yes, because Lb and Lh CPUE values were lower when lightsticks were used.
 - No, because Lb and Lh CPUE values were higher when lightsticks were used.
 - No, because Lb and Lh CPUE values were lower when lightsticks were used.

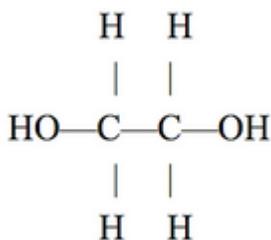
16. Sea turtles migrate to different oceanic regions over the course of the year, and higher sea turtle capture numbers indicate a higher population of sea turtles in a given region. Which of the following observations about sea turtle migration is supported by Table 1? Some sea turtle populations:

- A. reside in Area 2 during January, February, and March and migrate to Area 3 during June, July, August, and September.
- B. reside in Area 7 during June, July, August, and September and migrate to Area 1 during January, February, and March.
- C. reside in Area 3 during June, July, August, and September and migrate to Area 6 during January, February, and March.
- D. reside in Area 1 during June, July, August, and September and migrate to Area 7 during January, February, and March.

PASSAGE IV

Ethylene glycol, a popular industrial chemical used in the manufacture of polyester fibers and in industrial applications like antifreeze, has the structure shown below:

Figures 1-3 each show how a property of solutions of ethylene glycol in H₂O varies as the concentration of ethylene glycol increases at 1 atmosphere (atm) of pressure. Concentration is given as the percent ethylene glycol by mass in H₂O. Figure 1 shows how the freezing point varies with % ethylene glycol. Figure 2 shows how the boiling point varies with % ethylene glycol. The surface tension is the property of the surface of a liquid that allows it to resist an external force due to the cohesive forces between molecules in the liquid. Figure 3 shows how surface tension varies with % ethylene glycol at 25°C.



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Figure 1

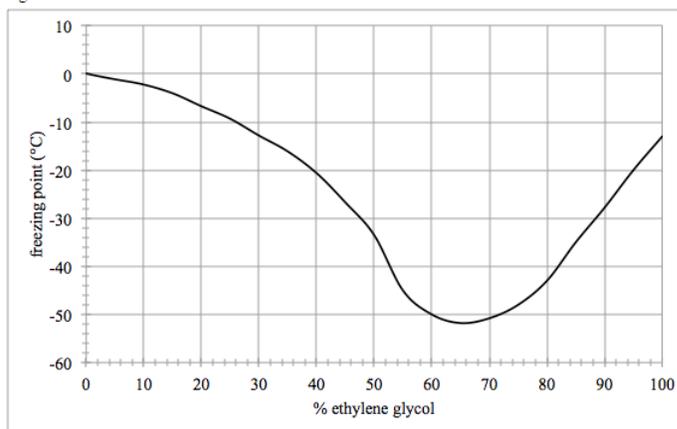


Figure 2

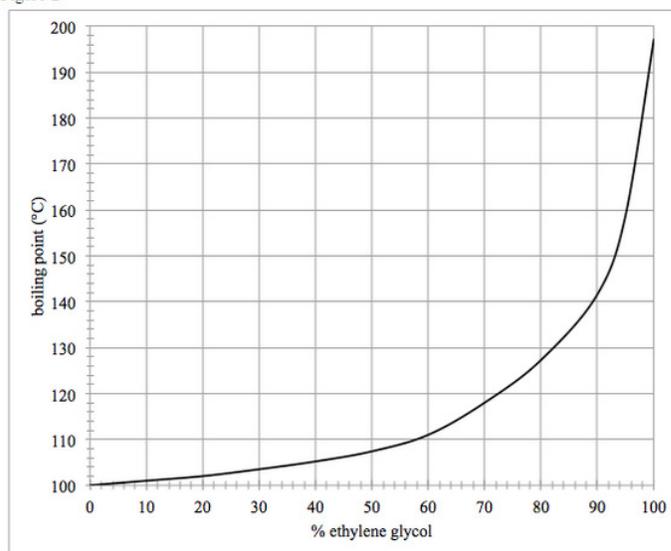
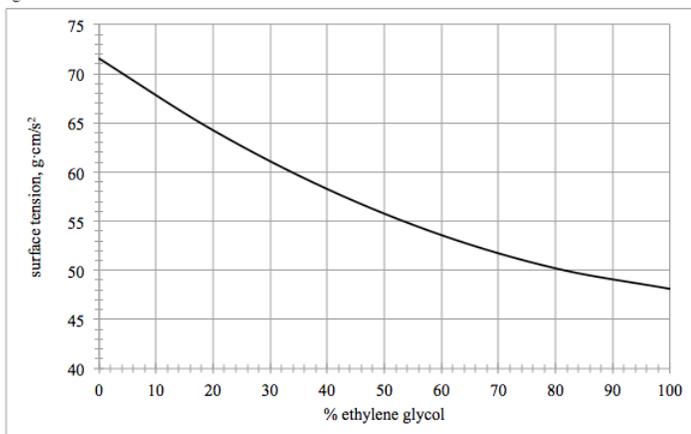


Figure 3



Tables and figures adapted from MEGlobal, "Ethylene Glycol Product Guide."
http://www.meglobal.biz/media/product_guides/MEGlobal_MEG.pdf. ©2008 by MEGlobal.

17. According to Figure 1, at 1 atm, which of the following solutions has a freezing point furthest from the freezing point of pure H₂O ?
- 15% ethylene glycol
 - 40% ethylene glycol
 - 65% ethylene glycol
 - 90% ethylene glycol
18. At 25°C and 1 atm, as % ethylene glycol increases from 0% to 100%, the cohesive forces between molecules in aqueous ethylene glycol solutions:
- increase only.
 - decrease only.
 - increase, then decrease.
 - decrease, then increase.
19. According to Figure 1, at 1 atm, the melting point of pure 100% ethylene glycol is closest to which of the following?
- 0°C
 - 13°C
 - 33°C
 - 52°C
20. According to Figures 2 and 3, at 1 atm, an aqueous solution of ethylene glycol that has a boiling point of 130°C will have a surface tension closest to which of the following at 25°C?
- 50 g·cm/s²
 - 53 g·cm/s²
 - 60 g·cm/s²
 - 63 g·cm/s²

21. Based on Figure 1, at 1 atm, how many gallons of pure H₂O would need to be added to 4 gallons of pure ethylene glycol to produce an antifreeze solution with a freezing point of -20°C ?

- 1 gallon
- 2 gallons
- 5 gallons
- 6 gallons

PASSAGE V

Electricity can be defined as the movement of electrons. Three of the most important concepts to understand in order to manipulate electricity to perform work are voltage, current, and resistance.

Voltage (measured in volts (V)) describes the amount of potential energy between two points on a circuit and is created by a difference in charge between those two points.

Current (measured in Amperes (A)) is the rate at which electrons flow through a circuit. A rate of one ampere is equivalent to 1 coulomb (a standard unit of charge) per second.

Resistance (measured in ohms (Ω)) is a measurement of how much a material resists the passage of current through the material. Materials with high resistance are referred to as insulators, while materials with low resistance are referred to as conductors.

Students in a physics course conducted several experiments to investigate the relationship between these three electrical properties.

Experiment 1

Students were provided with a variety of batteries, resistors (electrical components that resist the flow of current), and an ammeter (a device to measure current flow), along with wire and connectors. The students constructed circuits based on the circuit diagram below and measured the current in each circuit. Table 1 shows their results.

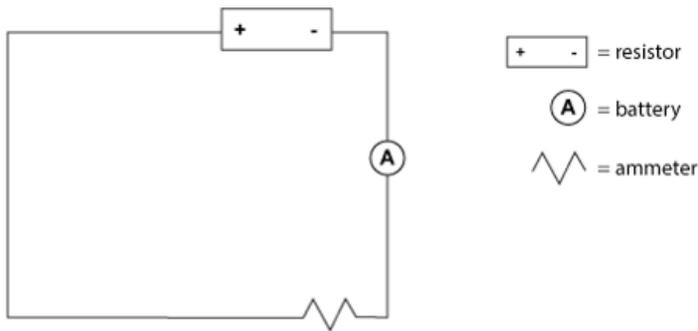


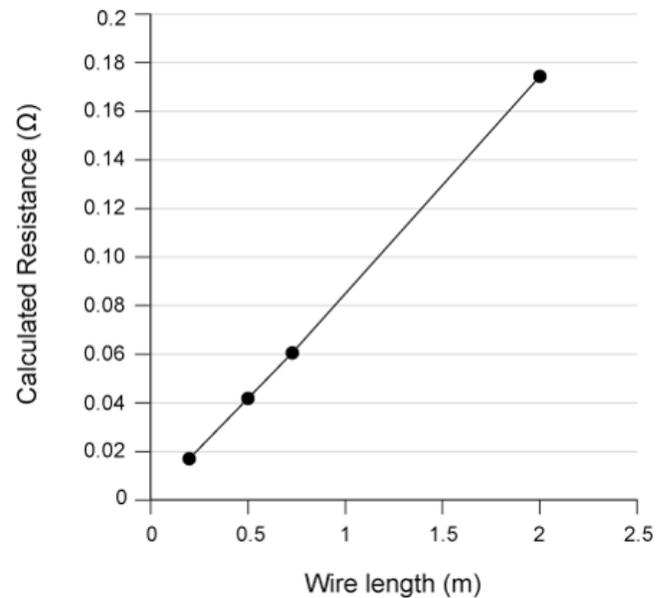
Table 1

Trial #	Battery Voltage (V)	Resistance (Ω)	Current (A)
1	6	3	2.000
2	9	3	3.000
3	12	3	4.000
4	6	6	1.000
5	9	6	1.500
6	12	6	2.000
7	6	9	0.667
8	9	9	1.000
9	12	9	1.333

Experiment 2

To further study the property of resistance, students replaced the resistor in their circuit with coils of nickel wire of various lengths. Students used a variable power supply to adjust voltage until the current was equal to 1 A. They then used the relationship between voltage, current, and resistance determined in Experiment 1 to calculate the resistance of the wire coil. Their results are graphed in Figure 2.

Figure 2
Resistance of Nickel Coils



Experiment 3

Students repeated the procedure from Experiment 2 using 1-meter wire coils of a variety of other metals. Their results are given in Table 2.

Table 2

Material	Calculated Resistance (Ω)
Copper	0.0214
Tungsten	0.0672
Aluminum	0.0338

22. Based on the data in Experiment 1, which of the following best describes the relationship between current, voltage, and resistance? Current:
- increases with an increase in voltage (V) and increases with an increase in resistance (Ω).
 - increases with an increase in voltage (V) and decreases with an increase in resistance (Ω).
 - decreases with an increase in voltage (V) and increase with an increase in resistance (Ω).
 - decreases with an increase in voltage (V) and decreases with an increase in resistance (Ω).
23. In an additional experiment, the students set up a circuit similar to the one in Experiment 1, except that they used a 2V battery and a 5 Ω resistor, and discovered that the current measured in this circuit is 0.400 A. What current should the students expect to measure in this same circuit if they doubled both the voltage and the resistance?
- 0.100 A
 - 0.400 A
 - 0.800 A
 - 1.600 A
24. Silver is a slightly better conductor than copper. Considering the data from Experiment 3, which of the following could be the resistance of a 1-m silver coil?
- 0.0202
 - 0.0281
 - 0.0414
 - 0.0702
25. What would you expect to happen to the current in the circuit if the 2-m nickel coil from Experiment 2 was used to replace the resistor in the Trial 1 circuit in Experiment 1?
- Current would decrease, because resistance in the circuit would increase.
 - Current would decrease, because resistance in the circuit would decrease.
 - Current would increase, because resistance in the circuit would decrease.
 - Current would increase, because resistance in the circuit would increase.
26. The resistance of a length of wire is dependent on the material's conductivity: materials with high conductivities provide less resistance than materials with low conductivity. Based on the data in Experiments 2 and 3, which of the following lists metals in increasing order of conductivity?
- copper, aluminum, tungsten, nickel
 - tungsten, nickel, aluminum, copper
 - copper, aluminum, nickel, tungsten
 - nickel, tungsten, aluminum, copper
27. Experiments 1-3 were completed in a classroom at 20°C. During the previous school year, the air conditioning was broken, so the same lab was completed at 28°C. It is known that conductivity of metals decreases as temperature increases. How would the higher classroom temperature have affected the voltage required to reach 1 A in Experiment 2?
- The same amount of voltage would be required.
 - More voltage would be required.
 - Less voltage would be required.
 - It is impossible to determine from the information provided.

PASSAGE VI

Scientists concerned about significant long-term effects of global warming discuss a *geoengineering* proposal to cool the planet.

Scientist 1

Solar Radiation Management (SRM) could reverse global warming by seeding the stratosphere with sulfuric aerosols (SO₄), recreating past periods of global cooling caused by volcanic activity. Naturally reflective sulfate aerosols resulting from this seeding would be dispersed by atmospheric winds, forming a layer of fine particles that would reflect about 1% of sunlight back into space. On the basis of computer models, scientists have predicted that SRM would reduce the amount of sunlight entering earth's atmosphere, thereby reducing global average temperatures.

Atmospheric CO₂ levels were around 275 parts per

million (ppm) prior to the Industrial Revolution. A level of 350 ppm is the critical threshold beyond which significant global warming occurs; current levels are around 400 ppm. Since CO₂ remains in the atmosphere for a very long time, even eliminating all CO₂ emissions immediately would leave global temperatures elevated far into the future. Reducing CO₂ emissions alone is not enough to preserve our climate; further action is needed. Preliminary research suggests SRM may be a way to stop or even reverse global warming.

Scientist 2

More research needs to be conducted before seriously discussing the injection of sulfate aerosols into the stratosphere. It will do nothing to affect CO₂ levels, and unintended consequences of SRM are so severe that it should not be considered as a possible "solution" to global warming. There is no way to experimentally predict the consequences of manipulating the atmosphere on a worldwide scale, as climate patterns simply cannot be isolated and manipulated on a local scale.

Injecting sulfate particles into the stratosphere would increase acid rain and have a drastic impact on Earth's protective ozone layer. One study concluded that artificial injections of sulfates could destroy between one-fourth and three-fourths of the ozone layer above the Arctic. This could affect a large part of the Northern Hemisphere because of atmospheric circulation patterns. The sulfates would also delay the expected recovery of the ozone hole over the Antarctic by about 30 to 70 years, or until at least the last decade of the century. A healthy ozone layer is critical for life on Earth because it blocks dangerous ultraviolet radiation from the sun.

Adapted from Rotman, David, A Cheap and Easy Plan to Stop Global Warming. MIT Technology Review. 8 Feb 2013. AND National Science Foundation Press Release. 08-069. "Injecting Sulfate Particles into Stratosphere Could Have Drastic Impact on Earth's Ozone Layer."

28. Which of the following statements best explains why Scientist 1 mentioned sulfuric aerosols?
- Seeding the atmosphere with sulfuric aerosols could increase global warming.
 - Seeding the atmosphere with sulfuric aerosols could decrease global warming.
 - Sulfuric aerosols help replenish ozone in the atmosphere.
 - Sulfuric aerosols help replenish CO₂ in the atmosphere.
29. Scientist 1 would most likely state that the elevated atmospheric levels of CO₂ that are present in the atmosphere today were caused by:
- a prolonged period of global volcanic activity.
 - injection of sulfate particles into the stratosphere.
 - unintended consequences of Solar Radiation Management.
 - carbon dioxide emissions from industrial activity.
30. Scientist 2 would most likely agree with which of the following statements?
- Solar Radiation Management could cause atmospheric CO₂ levels to increase.
 - Sulfuric aerosols from SRM would affect only the Northern Hemisphere.
 - Between one-fourth and three-fourths of the ozone layer lies over the Arctic.
 - Ozone levels are expected to rise over the course of the coming century.
31. Both scientists would likely agree that which of the following would NOT be affected if a large-scale Solar Radiation Management program were implemented?
- The amount of radiation reaching the atmosphere.
 - The amount of ultraviolet radiation reaching earth's surface.
 - Global temperature levels.
 - The composition of the ozone layer.
32. Both scientists would most likely agree that the distribution of fine particles throughout the upper atmosphere is largely maintained by:
- high levels of CO₂ in the air.
 - global cooling caused by volcanic activity.
 - circulation caused by wind.
 - injection of sulfate aerosols into the stratosphere.

33. Scientists provided historical data of sulfuric aerosol concentrations near active volcanoes to a computer programmed to model global climate change. The model failed to accurately predict any long-term trends in global climate activity. Based on the information provided, if this information were true, it would most likely weaken the viewpoints of:
- Scientist 1 only.
 - Scientist 2 only.
 - both Scientist 1 and Scientist 2.
 - neither Scientist 1 nor Scientist 2.
34. Scientist 2's objections to Solar Radiation Management include all of the following EXCEPT:
- it would destroy significant amounts of the ozone layer.
 - it would be difficult or impossible to thoroughly test before implementing.
 - it would adversely affect global atmospheric circulation patterns.
 - it would increase the amount of harmful radiation reaching earth's surface.

PASSAGE VII

One of the most common ways bacteria are grown in a lab is called batch culture. In batch culture, bacteria are added to a fixed amount of liquid growth media, a solution that contains nutrients for bacterial growth and allowed to grow under defined environmental conditions. Bacterial growth in batch culture follows a predictable pattern of four phases:

- Lag phase:** Immediately after they are added to a new media, bacteria must adjust their metabolism to the new environment before they begin growing and dividing. The number of bacteria in the culture does not change during this phase.
- Log phase:** Bacteria actively grow and divide, and the number of bacteria in the culture grows exponentially.
- Stationary phase:** When an essential nutrient in the media is depleted, growth slows substantially, such that growth rate in the culture becomes equal to death rate. The number of bacteria in the culture is unchanged.
- Death phase:** When culture conditions can no longer sustain any growth, bacteria die off exponentially. Phases 2-4 will happen in every batch culture, given enough time. However, it is possible for no lag phase to be observed if little or no adjustment of metabolism is needed for the bacteria to begin reproducing in their new environment.

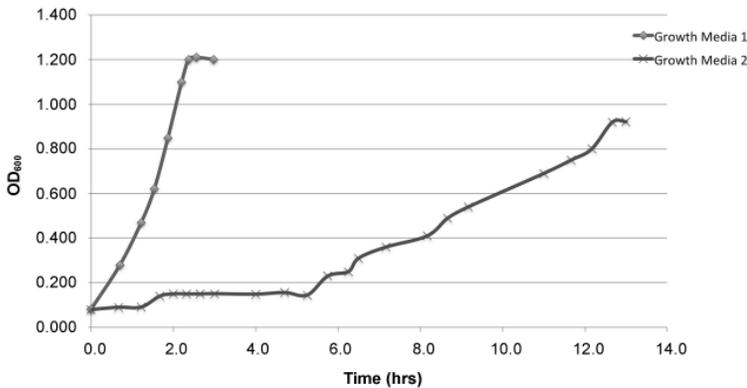
The following experiments were conducted to investigate the variables that affect bacterial growth in batch culture.

Experiment 1

A batch culture of *E. coli*, a common bacterial species used for lab studies, was grown in a nutrient rich media called LB. When this culture reached log phase, 0.5 ml samples of the liquid media was removed and used to inoculate each of two 1L flasks. Each of these flasks contained a different type of liquid growth media. The new cultures were then allowed to grow at 37°C.

Growth of the cultures was monitored by taking periodic measurements of the optical density, or OD_{600} , of the growth media. Optical density is a measurement of how easily light is able to pass through the media, and it is directly related to the concentration of living bacteria in the media. The resulting measurements are graphed in Figure 1.

Figure 1



Experiment 2

Eight 1L flasks of minimal growth media were inoculated with bacteria: four with *E. coli*, and four with *P. aeruginosa*. The flasks were then incubated at 37°C under one of two conditions--either with or without oxygen--and OD₆₀₀ measurements were taken every hour to monitor growth. After OD₆₀₀ measurements stopped rising, the bacteria was separated from the media and weighed. These measurements were used to calculate growth yield, or the percentage of carbon source(s) in the growth media that was converted to biological material. Growth yield can be used to determine how efficiently the bacteria are able to use energy during a given set of growth conditions. The results of these calculations are shown in Table 1.

Table 1

Species	Condition	Food source	Growth Yield (%)
<i>P. aeruginosa</i>	With oxygen	glucose	25.2
<i>P. aeruginosa</i>	With oxygen	pyruvate	39.1
<i>P. aeruginosa</i>	Without oxygen	glucose	0
<i>P. aeruginosa</i>	Without oxygen	pyruvate	0
<i>E. coli</i>	With oxygen	glucose	37.7
<i>E. coli</i>	With oxygen	pyruvate	45.2
<i>E. coli</i>	Without oxygen	glucose	12.6
<i>E. coli</i>	Without oxygen	pyruvate	12.0

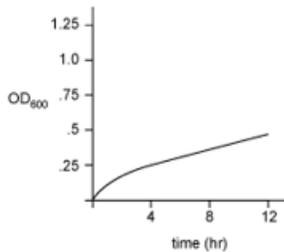
35. Which of the following is true of the relationship between OD₆₀₀ values and bacterial growth?
- OD₆₀₀ levels may increase, decrease, or remain stable during stationary phase.
 - OD₆₀₀ levels always increase when culture is in stationary phase.
 - OD₆₀₀ levels always stay stable when culture is in stationary phase.
 - OD₆₀₀ levels always decrease when culture is in stationary phase.
36. Three hours after the media in Experiment 1 was inoculated, which stage was each culture in?
- Medium 1: log phase; Medium 2: stationary phase
 - Medium 1: stationary phase; Medium 2: log phase
 - Medium 1: stationary phase; Medium 2: lag phase
 - Medium 1: lag phase; Medium 2: stationary phase
37. Growth media can be minimal or nutrient rich. Minimal media contains only the bare minimum necessary to support growth. Nutrient rich growth media contains a wide variety of compounds used in growth, such as amino acids and vitamins. Of the two types of media tested in Experiment 1, which is more likely to be a minimal media?
- Growth Media 2 because the long lag phase suggests the bacteria needed to turn on new metabolic pathways before they could begin dividing.
 - Growth Media 2 because bacteria divide more quickly in minimal media.
 - Growth Media 1 because the long lag phase suggests the bacteria needed to turn on new metabolic pathways before they could begin dividing.
 - Growth Media 1 because bacteria divide more quickly in minimal media.
38. Bacteria that require oxygen for growth are called obligate aerobes, while bacteria that cannot grow in the presence of oxygen are called obligate anaerobes. Facultative aerobes can grow with or without oxygen, though they may grow better in one condition than in the other. Considering the data in Table 1, which of the following is most likely to be true?
- P. aeruginosa* is an obligate anaerobe, while *E. coli* is an obligate aerobe.
 - P. aeruginosa* is an obligate anaerobe, while *E. coli* is a facultative aerobe.
 - P. aeruginosa* is an obligate aerobe, while *E. coli* is a facultative aerobe.
 - P. aeruginosa* is an obligate aerobe, while *E. coli* is an obligate anaerobe.

39. *P. aeruginosa* uses the ED metabolic pathway to convert glucose to pyruvate, while *E. coli* uses the EMP metabolic pathway to convert glucose to pyruvate. In the presence of oxygen, both bacteria use the citric acid cycle (CAC) to convert pyruvate to energy. Based on this information and the data in Table 1, which of the following lists the three pathways in increasing order of their efficiency at converting food sources to energy?

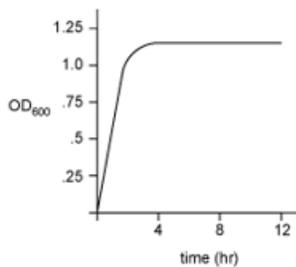
- A. ED, EMP, CAC
- B. EMP, ED, CAC
- C. CAC, ED, EMP
- D. CAC, EMP, ED

40. An *E. coli* culture in LB media growing in aerobic conditions was used to inoculate a new flask of LB media, which was then allowed to grow in anaerobic conditions. Given that in *E. coli*, different metabolic pathways are used for growth in anaerobic conditions than aerobic conditions, which of the following could be a growth curve for the the culture grown in anaerobic conditions?

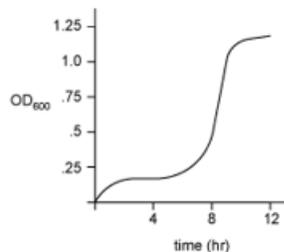
A.



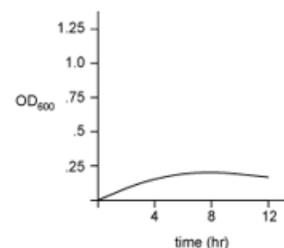
B.



C.



D.



END OF TEST 4

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

If you are taking the ACT with Writing, continue to the Writing test on page 49.

If you are not taking the ACT with Writing, skip to page 51 for directions on how to score the multiple-choice tests.

Writing Test

INSTRUCTIONS: The following test assesses your writing skills. You have **forty** (40) minutes to read the prompt, plan, and write your essay in English. Before you start, read all of the information carefully, and be sure to understand what the assignment is asking you to do.

Your essay will be graded based on the evidence it provides of your ability to:

- Clearly communicate your personal position on a complex issue and analyze the relationship between your perspective and at least one other perspective.
- Develop and support your position with reasoning and examples.
- Organize your ideas in a clear and logical manner.
- Successfully state your ideas in standard written English.

Note: On the ACT exam, you will write your essay on the lined pages in the answer document. All writing on the lined pages will be scored. You will be able to use the unlined pages in the test booklet to plan your response. Your work on the unlined pages will not be scored. You will wait to open the writing booklet until told to do so, and will put your pencil down immediately when time is called.

Censorship

Almost since human beings first began sharing ideas, the issue of censorship (officially suppressing ideas or writing) has been debated. Proponents of censorship argue, for example, that offensive material might morally corrupt children or that governments have the right to protect their national secrets. Opponents argue that censorship infringes on individual freedom and hinders progress. Censorship has long been an issue regarding books and papers; now, it has become a critical issue concerning the seemingly infinite amount of information on the Internet. Given the continued impact of censorship on various aspects of our lives, it is an issue worth examining.

Read and carefully consider these perspectives. Each suggests a particular way of thinking about the impact of censorship.

Perspective One

Selective censorship prevents children from being exposed to offensive material. It allows parents and caretakers to determine what material children are ready for and when, based on their maturity level, they are ready for such material.

Perspective Two

Censorship intrudes upon freedom of the press and freedom of speech. Individuals have the right to learn about their world—both its positive and negative aspects—and to express their ideas on it.

Perspective Three

Censorship should not be condoned, because it places too much power in the hands of a few: no government or leadership system should be allowed to decide what information should reach the public.

Essay Task

Write a unified, coherent essay in which you evaluate multiple perspectives on the impact of censorship on society. In your essay, be sure to:

- analyze and evaluate the perspectives given
- state and develop your own perspective on the issue
- explain the relationship between your perspective and those given

Your perspective may be in full agreement with any of the others, in partial agreement, or wholly different. Whatever the case, support your ideas with logical reasoning and detailed, persuasive examples.

You have completed the test!

Grading Your Practice ACT

Congratulations! You finished a full-length ACT Practice Test. Now it's time to see how you scored.

Step 1: Answer Key

The first step in grading your ACT Practice Test is to figure out how many questions you answered correctly. Use the answer key below to grade your test.

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

Step 2: Raw Score

Add up the number of questions that you answered correctly in each test to determine your raw score for that test (also known as your sectional sub-score).

For example, if you answered 43 questions correctly on the Mathematics test, then your raw score for that test is 43.

Step 3: Scaled Score

Now that you know your raw subscores, it's time to approximate your scaled scores for each test. Scaled scores range from 1-36.

Use the table below to convert your raw score in each section into a scaled score.*

Here's how you do it: For each of the four tests, find your raw score in the corresponding column. Then, see what scaled score corresponds to the same row in the "Scaled Score" column.

For example, if you answered 71 questions correctly on the English test, then your English test scaled score is 34.

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

*Remember that each official ACT exam has a different raw-to-scaled score conversion chart, based on the performance of students on that particular test. This conversion chart may not exactly correlate to your score on the official test, but don't worry—it'll give you a really good estimate of how you're likely to score on the ACT!

Step 4: Composite Score

Now for the moment of truth! Your composite score is your overall score on the ACT exam. Like your scaled scores, it ranges from 1-36. It is an average of your four scaled scores. Here's how to calculate your composite score:

- Enter your scaled scores for each test in the table below.
- Add up all of your scaled scores and enter that number into the "Sum of Scores" row.
- Divide your "Sum of Scores" number by 4.
- Enter that value in the "Composite Score" row. That's your ACT Practice Test score!

	Your Scaled Scores
English	
Mathematics	
Reading	
Science	
Sum of Scores	
Composite Score (sum ÷ 4)	

Have questions about ACT scoring? Read [ACT Score Range: What Is a Good ACT Score?](#) to learn more!

Grading Your Writing Test

Your ACT Writing test score is not a part of your composite score. But, if you plan to take the ACT with Writing, it's important to evaluate your practice essay to see how you can improve.

As with any timed writing you'd do in school, there's no one perfect way to respond to an essay prompt. So, how do you grade your ACT Writing test?

First, review the official [Writing Test Scoring Rubric](#) from act.org. Then, try to be objective as you grade your own essay. You can also ask a friend, parent, or teacher to grade it for you and give you a second opinion. Just understanding the ACT's essay scoring rubric can help you tailor your writing process toward the standards that the ACT most values when grading the Writing test.

ACT Practice Test PDF Explanations

The single best way to improve your ACT score is to learn from your mistakes. Now that you've looked at the Answer Key and determined your composite score, it's time to review the questions that you missed.

In [Magoosh ACT Prep](#), our ACT experts explain in detail how to answer each question and solve each problem. They break down the concepts and strategies needed to improve your score and show you how to avoid common tricks and traps.

Click the button below to see the text and video explanations for each question in this PDF.

[VIEW EXPLANATIONS](#)

Ready to take the next step towards your goal ACT score? [Sign up for Magoosh ACT Prep.](#)

ANSWER SHEET

TEST 1

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

TEST 2

1 (A)(B)(C)(D)(E)	11 (A)(B)(C)(D)(E)	21 (A)(B)(C)(D)(E)	31 (A)(B)(C)(D)(E)	41 (A)(B)(C)(D)(E)	51 (A)(B)(C)(D)(E)
2 (A)(B)(C)(D)(E)	12 (A)(B)(C)(D)(E)	22 (A)(B)(C)(D)(E)	32 (A)(B)(C)(D)(E)	42 (A)(B)(C)(D)(E)	52 (A)(B)(C)(D)(E)
3 (A)(B)(C)(D)(E)	13 (A)(B)(C)(D)(E)	23 (A)(B)(C)(D)(E)	33 (A)(B)(C)(D)(E)	43 (A)(B)(C)(D)(E)	53 (A)(B)(C)(D)(E)
4 (A)(B)(C)(D)(E)	14 (A)(B)(C)(D)(E)	24 (A)(B)(C)(D)(E)	34 (A)(B)(C)(D)(E)	44 (A)(B)(C)(D)(E)	54 (A)(B)(C)(D)(E)
5 (A)(B)(C)(D)(E)	15 (A)(B)(C)(D)(E)	25 (A)(B)(C)(D)(E)	35 (A)(B)(C)(D)(E)	45 (A)(B)(C)(D)(E)	55 (A)(B)(C)(D)(E)
6 (A)(B)(C)(D)(E)	16 (A)(B)(C)(D)(E)	26 (A)(B)(C)(D)(E)	36 (A)(B)(C)(D)(E)	46 (A)(B)(C)(D)(E)	56 (A)(B)(C)(D)(E)
7 (A)(B)(C)(D)(E)	17 (A)(B)(C)(D)(E)	27 (A)(B)(C)(D)(E)	37 (A)(B)(C)(D)(E)	47 (A)(B)(C)(D)(E)	57 (A)(B)(C)(D)(E)
8 (A)(B)(C)(D)(E)	18 (A)(B)(C)(D)(E)	28 (A)(B)(C)(D)(E)	38 (A)(B)(C)(D)(E)	48 (A)(B)(C)(D)(E)	58 (A)(B)(C)(D)(E)
9 (A)(B)(C)(D)(E)	19 (A)(B)(C)(D)(E)	29 (A)(B)(C)(D)(E)	39 (A)(B)(C)(D)(E)	49 (A)(B)(C)(D)(E)	59 (A)(B)(C)(D)(E)
10 (A)(B)(C)(D)(E)	20 (A)(B)(C)(D)(E)	30 (A)(B)(C)(D)(E)	40 (A)(B)(C)(D)(E)	50 (A)(B)(C)(D)(E)	60 (A)(B)(C)(D)(E)

TEST 3

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

TEST 4

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