

# Reading Test

65 MINUTES, 52 QUESTIONS

Turn to Section 1 of your answer sheet to answer the questions in this section.

## DIRECTIONS

Each passage or pair of passages below is followed by a number of questions. After reading each passage or pair, choose the best answer to each question based on what is stated or implied in the passage or passages and in any accompanying graphics (such as a table or graph).

### Questions 1-10 are based on the following passage.

This passage is adapted from MacDonald Harris, *The Balloonist*. ©2011 by The Estate of Donald Heiney. During the summer of 1897, the narrator of this story, a fictional Swedish scientist, has set out for the North Pole in a hydrogen-powered balloon.

My emotions are complicated and not readily verifiable. I feel a vast yearning that is simultaneously a pleasure and a pain. I am certain  
 Line of the consummation of this yearning, but I don't  
 5 know yet what form it will take, since I do not understand quite what it is that the yearning desires. For the first time there is borne in upon me the full truth of what I myself said to the doctor only an hour ago: that my motives in this undertaking are not  
 10 entirely clear. For years, for a lifetime, the machinery of my destiny has worked in secret to prepare for this moment; its clockwork has moved exactly toward this time and place and no other. Rising slowly from the earth that bore me and gave me sustenance, I am  
 15 carried helplessly toward an uninhabited and hostile, or at best indifferent, part of the earth, littered with the bones of explorers and the wrecks of ships, frozen supply caches, messages scrawled with chilled fingers and hidden in cairns that no eye will ever see.  
 20 Nobody has succeeded in this thing, and many have died. Yet in freely willing this enterprise, in choosing this moment and no other when the south wind will carry me exactly northward at a velocity of eight knots, I have converted the machinery of my

25 fate into the servant of my will. All this I understand, as I understand each detail of the technique by which this is carried out. What I don't understand is why I am so intent on going to this particular place. Who wants the North Pole! What good is it! Can you eat  
 30 it? Will it carry you from Gothenburg to Malmö like a railway? The Danish ministers have declared from their pulpits that participation in polar expeditions is beneficial to the soul's eternal well-being, or so I read in a newspaper. It isn't clear how this doctrine is to  
 35 be interpreted, except that the Pole is something difficult or impossible to attain which must nevertheless be sought for, because man is condemned to seek out and know everything whether or not the knowledge gives him pleasure. In  
 40 short, it is the same unthinking lust for knowledge that drove our First Parents out of the garden.

And suppose you were to find it in spite of all, this wonderful place that everybody is so anxious to stand on! *What* would you find? Exactly nothing.  
 45 A point precisely identical to all the others in a completely featureless wasteland stretching around it for hundreds of miles. It is an abstraction, a mathematical fiction. No one but a Swedish madman could take the slightest interest in it. Here I am. The  
 50 wind is still from the south, bearing us steadily northward at the speed of a trotting dog. Behind us, perhaps forever, lie the Cities of Men with their

teacups and their brass bedsteads. I am going forth of my own volition to join the ghosts of Bering and  
 55 poor Franklin, of frozen De Long and his men.  
 What I am on the brink of knowing, I now see, is not an ephemeral mathematical spot but myself. The doctor was right, even though I dislike him.  
 Fundamentally I am a dangerous madman, and what  
 60 I do is both a challenge to my egotism and a surrender to it.

1

Over the course of the passage, the narrator's attitude shifts from

- A) fear about the expedition to excitement about it.
- B) doubt about his abilities to confidence in them.
- C) uncertainty of his motives to recognition of them.
- D) disdain for the North Pole to appreciation of it.

2

Which choice provides the best evidence for the answer to the previous question?

- A) Lines 10-12 ("For . . . moment")
- B) Lines 21-25 ("Yet . . . will")
- C) Lines 42-44 ("And . . . stand on")
- D) Lines 56-57 ("What . . . myself")

3

As used in lines 1-2, "not readily verifiable" most nearly means

- A) unable to be authenticated.
- B) likely to be contradicted.
- C) without empirical support.
- D) not completely understood.

4

The sentence in lines 10-13 ("For years . . . other") mainly serves to

- A) expose a side of the narrator that he prefers to keep hidden.
- B) demonstrate that the narrator thinks in a methodical and scientific manner.
- C) show that the narrator feels himself to be influenced by powerful and independent forces.
- D) emphasize the length of time during which the narrator has prepared for his expedition.

5

The narrator indicates that many previous explorers seeking the North Pole have

- A) perished in the attempt.
- B) made surprising discoveries.
- C) failed to determine its exact location.
- D) had different motivations than his own.

6

Which choice provides the best evidence for the answer to the previous question?

- A) Lines 20-21 ("Nobody . . . died")
- B) Lines 25-27 ("All . . . out")
- C) Lines 31-34 ("The . . . newspaper")
- D) Lines 51-53 ("Behind . . . bedsteads")

7

Which choice best describes the narrator's view of his expedition to the North Pole?

- A) Immoral but inevitable
- B) Absurd but necessary
- C) Socially beneficial but misunderstood
- D) Scientifically important but hazardous

8

The question the narrator asks in lines 30-31 (“Will it . . . railway”) most nearly implies that

- A) balloons will never replace other modes of transportation.
- B) the North Pole is farther away than the cities usually reached by train.
- C) people often travel from one city to another without considering the implications.
- D) reaching the North Pole has no foreseeable benefit to humanity.

9

As used in line 49, “take the slightest interest in” most nearly means

- A) accept responsibility for.
- B) possess little regard for.
- C) pay no attention to.
- D) have curiosity about.

10

As used in line 50, “bearing” most nearly means

- A) carrying.
- B) affecting.
- C) yielding.
- D) enduring.

**Questions 11-21 are based on the following passage and supplementary material.**

This passage is adapted from Alan Ehrenhalt, *The Great Inversion and the Future of the American City*. ©2013 by Vintage. Ehrenhalt is an urbanologist—a scholar of cities and their development. Demographic inversion is a phenomenon that describes the rearrangement of living patterns throughout a metropolitan area.

We are not witnessing the abandonment of the suburbs, or a movement of millions of people back to the city all at once. The 2010 census certainly did not  
 Line turn up evidence of a middle-class stampede to the  
 5 nation’s cities. The news was mixed: Some of the larger cities on the East Coast tended to gain population, albeit in small increments. Those in the Midwest, including Chicago, tended to lose substantial numbers. The cities that showed gains in  
 10 overall population during the entire decade tended to be in the South and Southwest. But when it comes to measuring demographic inversion, raw census numbers are an ineffective blunt instrument. A closer look at the results shows that the most powerful  
 15 demographic events of the past decade were the movement of African Americans out of central cities (180,000 of them in Chicago alone) and the settlement of immigrant groups in suburbs, often ones many miles distant from downtown.  
 20 Central-city areas that gained affluent residents in the first part of the decade maintained that population in the recession years from 2007 to 2009. They also, according to a 2011 study by Brookings, suffered considerably less from increased  
 25 unemployment than the suburbs did. Not many young professionals moved to new downtown condos in the recession years because few such residences were being built. But there is no reason to believe that the demographic trends prevailing prior  
 30 to the construction bust will not resume once that bust is over. It is important to remember that demographic inversion is not a proxy for population growth; it can occur in cities that are growing, those whose numbers are flat, and even in those  
 35 undergoing a modest decline in size.

America’s major cities face enormous fiscal problems, many of them the result of public pension obligations they incurred in the more prosperous years of the past two decades. Some, Chicago

40 prominent among them, simply are not producing enough revenue to support the level of public services to which most of the citizens have grown to feel entitled. How the cities are going to solve this problem, I do not know. What I do know is that if  
45 fiscal crisis were going to drive affluent professionals out of central cities, it would have done so by now. There is no evidence that it has.

The truth is that we are living at a moment in which the massive outward migration of the affluent  
50 that characterized the second half of the twentieth century is coming to an end. And we need to adjust our perceptions of cities, suburbs, and urban mobility as a result.

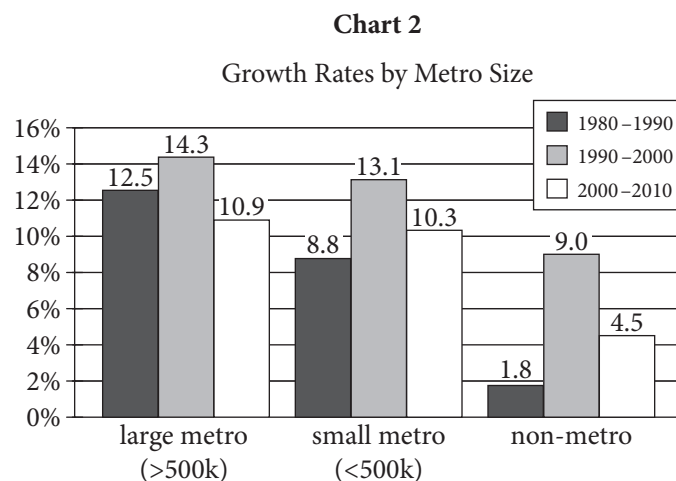
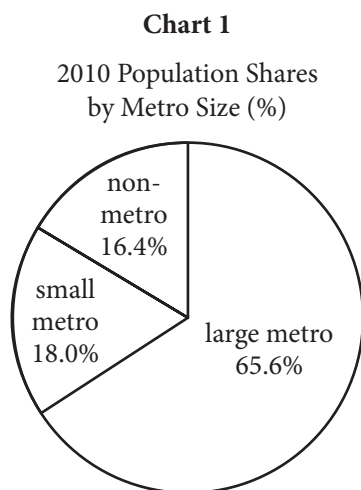
Much of our perspective on the process of  
55 metropolitan settlement dates, whether we realize it or not, from a paper written in 1925 by the University of Chicago sociologist Ernest W. Burgess. It was Burgess who defined four urban/suburban zones of settlement: a central business district; an  
60 area of manufacturing just beyond it; then a residential area inhabited by the industrial and immigrant working class; and finally an outer enclave of single-family dwellings.

Burgess was right about the urban America of  
65 1925; he was right about the urban America of 1974. Virtually every city in the country had a downtown,

where the commercial life of the metropolis was conducted; it had a factory district just beyond; it had districts of working-class residences just beyond that;  
70 and it had residential suburbs for the wealthy and the upper middle class at the far end of the continuum. As a family moved up the economic ladder, it also moved outward from crowded working-class districts to more spacious apartments and,  
75 eventually, to a suburban home. The suburbs of Burgess's time bore little resemblance to those at the end of the twentieth century, but the theory still essentially worked. People moved ahead in life by moving farther out.

80 But in the past decade, in quite a few places, this model has ceased to describe reality. There are still downtown commercial districts, but there are no factory districts lying next to them. There are scarcely any factories at all. These close-in parts of  
85 the city, whose few residents Burgess described as dwelling in "submerged regions of poverty, degradation and disease," are increasingly the preserve of the affluent who work in the commercial core. And just as crucially newcomers to America are  
90 not settling on the inside and accumulating the resources to move out; they are living in the suburbs from day one.

United States Population by Metropolitan Size/Status, 1980–2010



Adapted from William H. Frey, "Population Growth in Metro America since 1980: Putting the Volatile 2000s in Perspective." Published 2012 by Metropolitan Policy Program, Brookings Institution.

11

Which choice best summarizes the first paragraph of the passage (lines 1-35)?

- A) The 2010 census demonstrated a sizeable growth in the number of middle-class families moving into inner cities.
- B) The 2010 census is not a reliable instrument for measuring population trends in American cities.
- C) Population growth and demographic inversion are distinct phenomena, and demographic inversion is evident in many American cities.
- D) Population growth in American cities has been increasing since roughly 2000, while suburban populations have decreased.

12

According to the passage, members of which group moved away from central-city areas in large numbers in the early 2000s?

- A) The unemployed
- B) Immigrants
- C) Young professionals
- D) African Americans

13

In line 34, “flat” is closest in meaning to

- A) static.
- B) deflated.
- C) featureless.
- D) obscure.

14

According to the passage, which choice best describes the current financial situation in many major American cities?

- A) Expected tax increases due to demand for public works
- B) Economic hardship due to promises made in past years
- C) Greater overall prosperity due to an increased inner-city tax base
- D) Insufficient revenues due to a decrease in manufacturing

15

Which choice provides the best evidence for the answer to the previous question?

- A) Lines 36-39 (“America’s . . . decades”)
- B) Lines 43-44 (“How . . . not know”)
- C) Lines 44-46 (“What . . . now”)
- D) Lines 48-51 (“The truth . . . end”)

16

The passage implies that American cities in 1974

- A) were witnessing the flight of minority populations to the suburbs.
- B) had begun to lose their manufacturing sectors.
- C) had a traditional four-zone structure.
- D) were already experiencing demographic inversion.

17

Which choice provides the best evidence for the answer to the previous question?

- A) Lines 54-57 (“Much . . . Ernest W. Burgess”)
- B) Lines 58-59 (“It was . . . settlement”)
- C) Lines 66-71 (“Virtually . . . continuum”)
- D) Lines 72-75 (“As . . . home”)

18

As used in line 68, “conducted” is closest in meaning to

- A) carried out.
- B) supervised.
- C) regulated.
- D) inhibited.

19

The author of the passage would most likely consider the information in chart 1 to be

- A) excellent evidence for the arguments made in the passage.
- B) possibly accurate but too crude to be truly informative.
- C) compelling but lacking in historical information.
- D) representative of a perspective with which the author disagrees.

20

According to chart 2, the years 2000–2010 were characterized by

- A) less growth in metropolitan areas of all sizes than had taken place in the 1990s.
- B) more growth in small metropolitan areas than in large metropolitan areas.
- C) a significant decline in the population of small metropolitan areas compared to the 1980s.
- D) roughly equal growth in large metropolitan areas and nonmetropolitan areas.

21

Chart 2 suggests which of the following about population change in the 1990s?

- A) Large numbers of people moved from suburban areas to urban areas in the 1990s.
- B) Growth rates fell in smaller metropolitan areas in the 1990s.
- C) Large numbers of people moved from metropolitan areas to nonmetropolitan areas in the 1990s.
- D) The US population as a whole grew more in the 1990s than in the 1980s.

**Questions 22-31 are based on the following passage.**

This passage is adapted from Emily Anthes, *Frankenstein's Cat*. ©2013 by Emily Anthes.

When scientists first learned how to edit the genomes of animals, they began to imagine all the ways they could use this new power. Creating brightly colored novelty pets was not a high priority.   
 5 Instead, most researchers envisioned far more consequential applications, hoping to create genetically engineered animals that saved human lives. One enterprise is now delivering on this dream. Welcome to the world of “pharming,” in which   
 10 simple genetic tweaks turn animals into living pharmaceutical factories.

Many of the proteins that our cells crank out naturally make for good medicine. Our bodies’ own enzymes, hormones, clotting factors, and antibodies   
 15 are commonly used to treat cancer, diabetes, autoimmune diseases, and more. The trouble is that it’s difficult and expensive to make these compounds on an industrial scale, and as a result, patients can face shortages of the medicines they need. Dairy   
 20 animals, on the other hand, are expert protein producers, their udders swollen with milk. So the creation of the first transgenic animals—first mice, then other species—in the 1980s gave scientists an idea: What if they put the gene for a human antibody   
 25 or enzyme into a cow, goat, or sheep? If they put the gene in just the right place, under the control of the right molecular switch, maybe they could engineer animals that produced healing human proteins in their milk. Then doctors could collect medicine by   
 30 the bucketful.

Throughout the 1980s and ’90s, studies provided proof of principle, as scientists created transgenic mice, sheep, goats, pigs, cattle, and rabbits that did in fact make therapeutic compounds in their milk.   
 35 At first, this work was merely gee-whiz, scientific geekery, lab-bound thought experiments come true. That all changed with ATryn, a drug produced by the Massachusetts firm GTC Biotherapeutics. ATryn is antithrombin, an anticoagulant that can be used to   
 40 prevent life-threatening blood clots. The compound, made by our liver cells, plays a key role in keeping our bodies clot-free. It acts as a molecular bouncer, sidling up to clot-forming compounds and escorting them out of the bloodstream. But as many as 1 in

45 2,000 Americans are born with a genetic mutation that prevents them from making antithrombin. These patients are prone to clots, especially in their legs and lungs, and they are at elevated risk of suffering from fatal complications during surgery   
 50 and childbirth. Supplemental antithrombin can reduce this risk, and GTC decided to try to manufacture the compound using genetically engineered goats.

To create its special herd of goats, GTC used   
 55 microinjection, the same technique that produced GloFish and AquAdvantage salmon. The company’s scientists took the gene for human antithrombin and injected it directly into fertilized goat eggs. Then they implanted the eggs in the wombs of female goats.   
 60 When the kids were born, some of them proved to be transgenic, the human gene nestled safely in their cells. The researchers paired the antithrombin gene with a promoter (which is a sequence of DNA that controls gene activity) that is normally active in the   
 65 goat’s mammary glands during milk production. When the transgenic females lactated, the promoter turned the transgene on and the goats’ udders filled with milk containing antithrombin. All that was left to do was to collect the milk, and extract and purify   
 70 the protein. *Et voilà*—human medicine! And, for GTC, liquid gold. ATryn hit the market in 2006, becoming the world’s first transgenic animal drug. Over the course of a year, the “milking parlors” on   
 75 GTC’s 300-acre farm in Massachusetts can collect more than a kilogram of medicine from a single animal.

22

The primary purpose of the passage is to

- A) present the background of a medical breakthrough.
- B) evaluate the research that led to a scientific discovery.
- C) summarize the findings of a long-term research project.
- D) explain the development of a branch of scientific study.

23

The author's attitude toward pharming is best described as one of

- A) apprehension.
- B) ambivalence.
- C) appreciation.
- D) astonishment.

24

As used in line 20, "expert" most nearly means

- A) knowledgeable.
- B) professional.
- C) capable.
- D) trained.

25

What does the author suggest about the transgenic studies done in the 1980s and 1990s?

- A) They were limited by the expensive nature of animal research.
- B) They were not expected to yield products ready for human use.
- C) They were completed when an anticoagulant compound was identified.
- D) They focused only on the molecular properties of cows, goats, and sheep.

26

Which choice provides the best evidence for the answer to the previous question?

- A) Lines 16-19 ("The trouble . . . need")
- B) Lines 25-29 ("If they . . . milk")
- C) Lines 35-36 ("At first . . . true")
- D) Lines 37-40 ("That all . . . clots")

27

According to the passage, which of the following is true of antithrombin?

- A) It reduces compounds that lead to blood clots.
- B) It stems from a genetic mutation that is rare in humans.
- C) It is a sequence of DNA known as a promoter.
- D) It occurs naturally in goats' mammary glands.

28

Which choice provides the best evidence for the answer to the previous question?

- A) Lines 12-16 ("Many . . . more")
- B) Lines 42-44 ("It acts . . . bloodstream")
- C) Lines 44-46 ("But as . . . antithrombin")
- D) Lines 62-65 ("The researchers . . . production")

29

Which of the following does the author suggest about the "female goats" mentioned in line 59?

- A) They secreted antithrombin in their milk after giving birth.
- B) Some of their kids were not born with the antithrombin gene.
- C) They were the first animals to receive microinjections.
- D) Their cells already contained genes usually found in humans.

30

The most likely purpose of the parenthetical information in lines 63-64 is to

- A) illustrate an abstract concept.
- B) describe a new hypothesis.
- C) clarify a claim.
- D) define a term.



31

The phrase “liquid gold” (line 71) most directly suggests that

- A) GTC has invested a great deal of money in the microinjection technique.
- B) GTC’s milking parlors have significantly increased milk production.
- C) transgenic goats will soon be a valuable asset for dairy farmers.
- D) ATryn has proved to be a financially beneficial product for GTC.

**Questions 32-41 are based on the following passages.**

Passage 1 is adapted from Edmund Burke, *Reflections on the Revolution in France*. Originally published in 1790. Passage 2 is adapted from Thomas Paine, *Rights of Man*. Originally published in 1791.

**Passage 1**

To avoid . . . the evils of inconstancy and versatility, ten thousand times worse than those of obstinacy and the blindest prejudice, we have  
 Line consecrated the state, that no man should approach  
 5 to look into its defects or corruptions but with due caution; that he should never dream of beginning its reformation by its subversion; that he should approach to the faults of the state as to the wounds of a father, with pious awe and trembling solicitude. By  
 10 this wise prejudice we are taught to look with horror on those children of their country who are prompt rashly to hack that aged parent in pieces, and put him into the kettle of magicians, in hopes that by their poisonous weeds, and wild incantations, they may  
 15 regenerate the paternal constitution, and renovate their father’s life.

Society is indeed a contract. Subordinate contracts for objects of mere occasional interest may be dissolved at pleasure—but the state ought not to be  
 20 considered as nothing better than a partnership agreement in a trade of pepper and coffee, calico or tobacco, or some other such low concern, to be taken up for a little temporary interest, and to be dissolved by the fancy of the parties. It is to be looked on with  
 25 other reverence; because it is not a partnership in things subservient only to the gross animal existence of a temporary and perishable nature. It is a partnership in all science; a partnership in all art; a partnership in every virtue, and in all perfection.  
 30 As the ends of such a partnership cannot be obtained in many generations, it becomes a partnership not only between those who are living, but between those who are living, those who are dead, and those who are to be born. . . . The municipal corporations of  
 35 that universal kingdom are not morally at liberty at their pleasure, and on their speculations of a contingent improvement, wholly to separate and tear asunder the bands of their subordinate community, and to dissolve it into an unsocial, uncivil,  
 40 unconnected chaos of elementary principles.

**Passage 2**

Every age and generation must be as free to act for itself, *in all cases*, as the ages and generations which preceded it. The vanity and presumption of governing beyond the grave, is the most ridiculous  
45 and insolent of all tyrannies.

Man has no property in man; neither has any generation a property in the generations which are to follow. The Parliament or the people of 1688, or of any other period, had no more right to dispose of the  
50 people of the present day, or to bind or to control them in any shape whatever, than the parliament or the people of the present day have to dispose of, bind, or control those who are to live a hundred or a thousand years hence.

Every generation is, and must be, competent to all the purposes which its occasions require. It is the living, and not the dead, that are to be accommodated. When man ceases to be, his power and his wants cease with him; and having no longer  
60 any participation in the concerns of this world, he has no longer any authority in directing who shall be its governors, or how its government shall be organized, or how administered. . . .

Those who have quitted the world, and those who  
65 are not yet arrived at it, are as remote from each other, as the utmost stretch of mortal imagination can conceive. What possible obligation, then, can exist between them; what rule or principle can be laid down, that two nonentities, the one out of existence,  
70 and the other not in, and who never can meet in this world, that the one should control the other to the end of time? . . .

The circumstances of the world are continually changing, and the opinions of men change also; and  
75 as government is for the living, and not for the dead, it is the living only that has any right in it. That which may be thought right and found convenient in one age, may be thought wrong and found inconvenient in another. In such cases, who is to  
80 decide, the living, or the dead?

32

In Passage 1, Burke indicates that a contract between a person and society differs from other contracts mainly in its

- A) brevity and prominence.
- B) complexity and rigidity.
- C) precision and usefulness.
- D) seriousness and permanence.

33

As used in line 4, “state” most nearly refers to a

- A) style of living.
- B) position in life.
- C) temporary condition.
- D) political entity.

34

As used in line 22, “low” most nearly means

- A) petty.
- B) weak.
- C) inadequate.
- D) depleted.

35

It can most reasonably be inferred from Passage 2 that Paine views historical precedents as

- A) generally helpful to those who want to change society.
- B) surprisingly difficult for many people to comprehend.
- C) frequently responsible for human progress.
- D) largely irrelevant to current political decisions.

36

How would Paine most likely respond to Burke’s statement in lines 30-34, Passage 1 (“As the . . . born”)?

- A) He would assert that the notion of a partnership across generations is less plausible to people of his era than it was to people in the past.
- B) He would argue that there are no politically meaningful links between the dead, the living, and the unborn.
- C) He would question the possibility that significant changes to a political system could be accomplished within a single generation.
- D) He would point out that we cannot know what judgments the dead would make about contemporary issues.

37

Which choice provides the best evidence for the answer to the previous question?

- A) Lines 41-43 (“Every . . . it”)
- B) Lines 43-45 (“The vanity . . . tyrannies”)
- C) Lines 56-58 (“It is . . . accommodated”)
- D) Lines 67-72 (“What . . . time”)

38

Which choice best describes how Burke would most likely have reacted to Paine’s remarks in the final paragraph of Passage 2?

- A) With approval, because adapting to new events may enhance existing partnerships.
- B) With resignation, because changing circumstances are an inevitable aspect of life.
- C) With skepticism, because Paine does not substantiate his claim with examples of governments changed for the better.
- D) With disapproval, because changing conditions are insufficient justification for changing the form of government.

39

Which choice provides the best evidence for the answer to the previous question?

- A) Lines 1-4 (“To avoid . . . state”)
- B) Lines 7-9 (“he should . . . solicitude”)
- C) Lines 27-29 (“It is . . . perfection”)
- D) Lines 34-38 (“The municipal . . . community”)

40

Which choice best states the relationship between the two passages?

- A) Passage 2 challenges the primary argument of Passage 1.
- B) Passage 2 advocates an alternative approach to a problem discussed in Passage 1.
- C) Passage 2 provides further evidence to support an idea introduced in Passage 1.
- D) Passage 2 exemplifies an attitude promoted in Passage 1.

41

The main purpose of both passages is to

- A) suggest a way to resolve a particular political struggle.
- B) discuss the relationship between people and their government.
- C) evaluate the consequences of rapid political change.
- D) describe the duties that governments have to their citizens.

**Questions 42-52 are based on the following passage and supplementary material.**

This passage is adapted from Carolyn Gramling, “Source of Mysterious Medieval Eruption Identified.” ©2013 by American Association for the Advancement of Science.

About 750 years ago, a powerful volcano erupted somewhere on Earth, kicking off a centuries-long cold snap known as the Little Ice Age. Identifying the volcano responsible has been tricky.

Line  
5 That a powerful volcano erupted somewhere in the world, sometime in the Middle Ages, is written in polar ice cores in the form of layers of sulfate deposits and tiny shards of volcanic glass. These cores suggest that the amount of sulfur the mystery  
10 volcano sent into the stratosphere put it firmly among the ranks of the strongest climate-perturbing eruptions of the current geological epoch, the Holocene, a period that stretches from 10,000 years ago to the present. A haze of stratospheric sulfur  
15 cools the climate by reflecting solar energy back into space.

In 2012, a team of scientists led by geochemist Gifford Miller strengthened the link between the mystery eruption and the onset of the Little Ice Age  
20 by using radiocarbon dating of dead plant material from beneath the ice caps on Baffin Island and Iceland, as well as ice and sediment core data, to determine that the cold summers and ice growth began abruptly between 1275 and 1300 C.E. (and  
25 became intensified between 1430 and 1455 C.E.). Such a sudden onset pointed to a huge volcanic eruption injecting sulfur into the stratosphere and starting the cooling. Subsequent, unusually large and frequent eruptions of other volcanoes, as well as  
30 sea-ice/ocean feedbacks persisting long after the aerosols have been removed from the atmosphere, may have prolonged the cooling through the 1700s.

Volcanologist Franck Lavigne and colleagues now think they’ve identified the volcano in question:  
35 Indonesia’s Samalas. One line of evidence, they note, is historical records. According to Babad Lombok, records of the island written on palm leaves in Old Javanese, Samalas erupted catastrophically before the end of the 13th century, devastating surrounding  
40 villages—including Lombok’s capital at the time, Pamatatan—with ash and fast-moving sweeps of hot rock and gas called pyroclastic flows.

The researchers then began to reconstruct the formation of the large, 800-meter-deep caldera [a  
45 basin-shaped volcanic crater] that now sits atop the

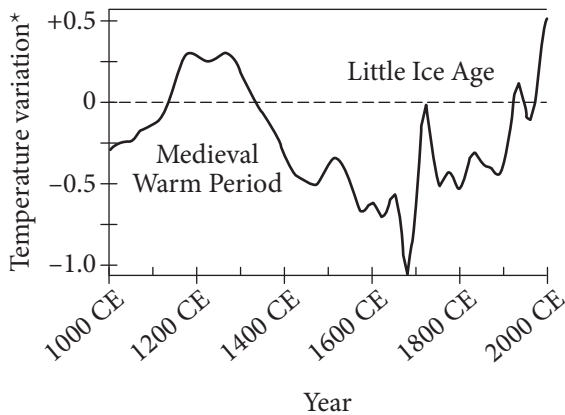
volcano. They examined 130 outcrops on the flanks of the volcano, exposing sequences of pumice—ash hardened into rock—and other pyroclastic material. The volume of ash deposited, and the estimated  
50 height of the eruption plume (43 kilometers above sea level) put the eruption’s magnitude at a minimum of 7 on the volcanic explosivity index (which has a scale of 1 to 8)—making it one of the largest known in the Holocene.

55 The team also performed radiocarbon analyses on carbonized tree trunks and branches buried within the pyroclastic deposits to confirm the date of the eruption; it could not, they concluded, have happened before 1257 C.E., and certainly happened  
60 in the 13th century.

It’s not a total surprise that an Indonesian volcano might be the source of the eruption, Miller says. “An equatorial eruption is more consistent with the apparent climate impacts.” And, he adds, with sulfate  
65 appearing in both polar ice caps—Arctic and Antarctic—there is “a strong consensus” that this also supports an equatorial source.

Another possible candidate—both in terms of timing and geographical location—is Ecuador’s  
70 Quilotoa, estimated to have last erupted between 1147 and 1320 C.E. But when Lavigne’s team examined shards of volcanic glass from this volcano, they found that they didn’t match the chemical composition of the glass found in polar ice cores,  
75 whereas the Samalas glass is a much closer match. That, they suggest, further strengthens the case that Samalas was responsible for the medieval “year without summer” in 1258 C.E.

Estimated Temperature in Central England  
1000 CE to 2000 CE



\*Variation from the 1961-1990 average temperature, in °C, represented at 0.

Adapted from John P. Rafferty, "Little Ice Age." Originally published in 2011. ©2014 by Encyclopedia Britannica, Inc.

42

The main purpose of the passage is to

- A) describe periods in Earth's recent geologic history.
- B) explain the methods scientists use in radiocarbon analysis.
- C) describe evidence linking the volcano Samalas to the Little Ice Age.
- D) explain how volcanic glass forms during volcanic eruptions.

43

Over the course of the passage, the focus shifts from

- A) a criticism of a scientific model to a new theory.
- B) a description of a recorded event to its likely cause.
- C) the use of ice core samples to a new method of measuring sulfates.
- D) the use of radiocarbon dating to an examination of volcanic glass.

44

Which choice provides the best evidence for the answer to the previous question?

- A) Lines 17-25 ("In 2012 . . . 1455 C.E.")
- B) Lines 43-46 ("The researchers . . . atop the volcano")
- C) Lines 46-48 ("They examined . . . material")
- D) Lines 55-60 ("The team . . . 13th century")

45

The author uses the phrase "is written in" (line 6) most likely to

- A) demonstrate the concept of the hands-on nature of the work done by scientists.
- B) highlight the fact that scientists often write about their discoveries.
- C) underscore the sense of importance that scientists have regarding their work.
- D) reinforce the idea that the evidence is there and can be interpreted by scientists.

46

Where does the author indicate the medieval volcanic eruption most probably was located?

- A) Near the equator, in Indonesia
- B) In the Arctic region
- C) In the Antarctic region
- D) Near the equator, in Ecuador

47

Which choice provides the best evidence for the answer to the previous question?

- A) Lines 1-3 ("About 750 . . . Ice Age")
- B) Lines 26-28 ("Such a . . . the cooling")
- C) Lines 49-54 ("The volume . . . the Holocene")
- D) Lines 61-64 ("It's not . . . climate impacts")

48

As used in line 68, the phrase “Another possible candidate” implies that

- A) powerful volcanic eruptions occur frequently.
- B) the effects of volcanic eruptions can last for centuries.
- C) scientists know of other volcanoes that erupted during the Middle Ages.
- D) other volcanoes have calderas that are very large.

49

Which choice best supports the claim that Quilotoa was not responsible for the Little Ice Age?

- A) Lines 3-4 (“Identifying . . . tricky”)
- B) Lines 26-28 (“Such a . . . cooling”)
- C) Lines 43-46 (“The researchers . . . atop the volcano”)
- D) Lines 71-75 (“But . . . closer match”)

50

According to the data in the figure, the greatest below-average temperature variation occurred around what year?

- A) 1200 CE
- B) 1375 CE
- C) 1675 CE
- D) 1750 CE

51

The passage and the figure are in agreement that the onset of the Little Ice Age began

- A) around 1150 CE.
- B) just before 1300 CE.
- C) just before 1500 CE.
- D) around 1650 CE.

52

What statement is best supported by the data presented in the figure?

- A) The greatest cooling during the Little Ice Age occurred hundreds of years after the temperature peaks of the Medieval Warm Period.
- B) The sharp decline in temperature supports the hypothesis of an equatorial volcanic eruption in the Middle Ages.
- C) Pyroclastic flows from volcanic eruptions continued for hundreds of years after the eruptions had ended.
- D) Radiocarbon analysis is the best tool scientists have to determine the temperature variations after volcanic eruptions.

**STOP**

**If you finish before time is called, you may check your work on this section only.  
Do not turn to any other section.**