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Practice Test #4

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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 of the consummation of this yearning, but I don't 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 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 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. 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

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 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 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 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. 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 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 poor Franklin, of frozen De Long and his men.
 55 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

Chart 1

2010 Population Shares
by Metro Size (%)

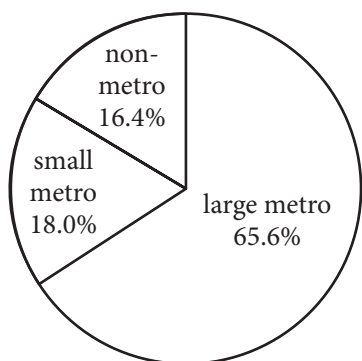
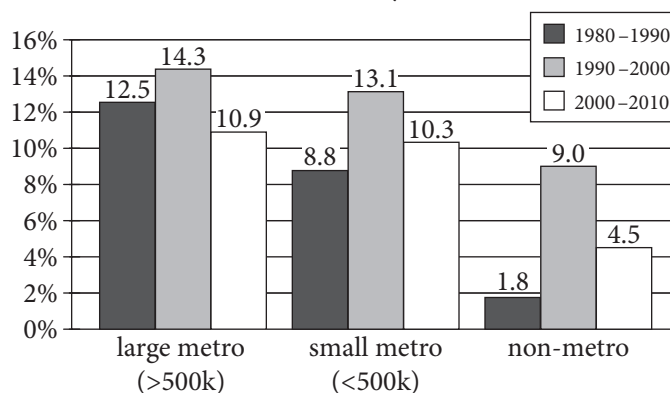


Chart 2

Growth Rates by Metro Size



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. 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 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 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 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 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 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. 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 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

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 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 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. 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 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 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 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 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.

55 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 volcano sent into the stratosphere put it firmly
10 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

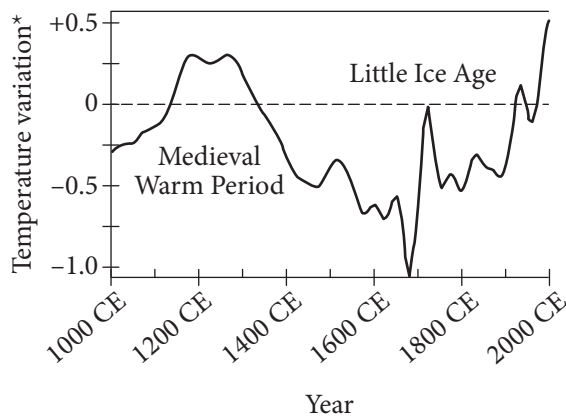
volcano. They examined 130 outcrops on the flanks of the volcano, exposing sequences of pumice—ash hardened into rock—and other pyroclastic material. The volume of ash deposited, and the estimated
50 height of the eruption plume (43 kilometers above sea level) put the eruption's magnitude at a minimum 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.**

Writing and Language Test

35 MINUTES, 44 QUESTIONS

Turn to Section 2 of your answer sheet to answer the questions in this section.

DIRECTIONS

Each passage below is accompanied by a number of questions. For some questions, you will consider how the passage might be revised to improve the expression of ideas. For other questions, you will consider how the passage might be edited to correct errors in sentence structure, usage, or punctuation. A passage or a question may be accompanied by one or more graphics (such as a table or graph) that you will consider as you make revising and editing decisions.

Some questions will direct you to an underlined portion of a passage. Other questions will direct you to a location in a passage or ask you to think about the passage as a whole.

After reading each passage, choose the answer to each question that most effectively improves the quality of writing in the passage or that makes the passage conform to the conventions of standard written English. Many questions include a “NO CHANGE” option. Choose that option if you think the best choice is to leave the relevant portion of the passage as it is.

Questions 1-11 are based on the following passage.

Ghost Mural

In 1932 the well-known Mexican muralist David Alfaro Siqueiros was commissioned to paint a mural on the second-story exterior wall of a historic building in downtown Los Angeles. Siqueiros was asked to celebrate tropical America in his work, **1** he accordingly titled it “América Tropical.” He painted the mural’s first two sections, featuring images of a tropical rainforest and a Maya pyramid, during the day. **2** Also, to avoid

1

- A) NO CHANGE
- B) which he accordingly titled
- C) accordingly he titled it
- D) it was titled accordingly

2

- A) NO CHANGE
- B) However,
- C) Although,
- D) Moreover,

scrutiny, Siqueiros painted the final section of the mural, the **3** centerpiece at night.

4 The reason for Siqueiros's secrecy became clear when the mural was **5** confided. The centerpiece of the work was dominated by images of native people being oppressed and **6** including an eagle symbolizing the United States. Siqueiros's political message did not please the wealthy citizens who had commissioned his work. They eventually ordered the mural to be literally whitewashed, or painted over with white paint.

However, by the 1970s, the white paint had begun to fade, and the bright colors of the mural were beginning to show through. At the same time, a social and civil rights movement for Mexican Americans was working to raise awareness of Mexican American cultural identity. Artists associated with **7** this began to rediscover and promote the work of the Mexican muralists, particularly Siqueiros. To them, "América Tropical" was an example of how art in public spaces could be used to celebrate Mexican American heritage while at the same time making a political statement. Inspired by Siqueiros and the other muralists, this new generation of artists strove to emulate the old mural masters.

3

- A) NO CHANGE
- B) centerpiece,
- C) centerpiece;
- D) centerpiece—

4

Which choice best connects the sentence with the previous paragraph?

- A) NO CHANGE
- B) All three sections of the mural were on display
- C) The community turned out in large numbers
- D) Siqueiros was informed of people's reactions

5

- A) NO CHANGE
- B) promulgated.
- C) imparted.
- D) unveiled.

6

- A) NO CHANGE
- B) included
- C) includes
- D) had included

7

- A) NO CHANGE
- B) it
- C) them
- D) this movement

8 The result was an explosion of mural painting that spread throughout California and the southwestern United States in the 1970s. It was the Chicano mural movement. Hundreds of large, colorful new murals depicting elements of Mexican American life and history appeared during this period, some in designated cultural locations but many more in abandoned lots, on unused buildings, or 9 painted on infrastructure such as highways and bridges. Many of these murals can still be seen today, although some have not been well maintained.

8

Which choice most effectively combines the underlined sentences?

- A) The result was an explosion, the Chicano mural movement, of mural painting that spread throughout California and the southwestern United States in the 1970s.
- B) The result was the Chicano mural movement, an explosion of mural painting that spread throughout California and the southwestern United States in the 1970s.
- C) The explosion of mural painting that spread throughout California and the southwestern United States in the 1970s was the resulting Chicano mural movement.
- D) An explosion of mural painting resulted and it spread throughout California and the southwestern United States in the 1970s; it was the Chicano mural movement.

9

- A) NO CHANGE
- B) they were painted on
- C) on
- D) DELETE the underlined portion.

Fortunately, a new group of artists has discovered the murals, and efforts are underway to clean, restore, and repaint them. Once again, Siqueiros’s “América Tropical” is **10** leading the way. After a lengthy and complex restoration process, this powerful work is now a tourist attraction, complete with a visitor center and a rooftop viewing platform. **11** Advocates hope that Siqueiros’s mural will once more serve as an inspiration, this time inspiring viewers to save and restore an important cultural and artistic legacy.

10

Which choice most effectively sets up the information that follows?

- A) NO CHANGE
- B) being cleaned and restored.
- C) at risk of destruction.
- D) awaiting its moment of appreciation.

11

At this point, the writer is considering adding the following sentence.

When it was painted in 1932, Siqueiros’s mural was considered offensive, but now it is acclaimed.

Should the writer make this addition here?

- A) Yes, because it provides historical context for the changes discussed in the passage.
- B) Yes, because it provides a useful reminder of how people once viewed Siqueiros’s work.
- C) No, because it unnecessarily repeats information from earlier in the passage.
- D) No, because it makes a claim about Siqueiros’s work that is not supported by the passage.

Questions 12-22 are based on the following passage.

The Hype of Healthier Organic Food

Some people buy organic food because they believe organically grown crops are more nutritious and safer for consumption than **12** the people who purchase their conventionally grown counterparts, which are usually produced with pesticides and synthetic fertilizers. In the name of health, **13** spending \$1.60 for every dollar they would have spent on food that is **14** grown in a manner that is considered conventional. Scientific evidence, **15** therefore, suggests that consumers do not reap significant benefits, in terms of either nutritional value or safety, from organic food.

12

- A) NO CHANGE
- B) the purchase of
- C) purchasing
- D) DELETE the underlined portion.

13

- A) NO CHANGE
- B) these consumers spend
- C) having spent
- D) to spend

14

- A) NO CHANGE
- B) grown with conventional methods, using pesticides and synthetic fertilizers.
- C) conventionally and therefore not organically grown.
- D) conventionally grown.

15

- A) NO CHANGE
- B) furthermore,
- C) however,
- D) subsequently,

Although advocates of organic food **16** preserve that organic produce is healthier than conventionally grown produce because it has more vitamins and minerals, this assertion is not supported by scientific research. **17** For instance, one review published in *The American Journal of Clinical Nutrition* provided analysis of the results of comparative studies conducted over a span of 50 years; researchers consistently found no evidence that organic crops are more nutritious than conventionally grown ones in terms of their vitamin and mineral content. **18** Similarly, Stanford University researchers who examined almost 250 studies comparing the nutritional content of different kinds of organic foods with that of their nonorganic counterparts found very little difference between the two.

16

- A) NO CHANGE
- B) carry on
- C) maintain
- D) sustain

17

- A) NO CHANGE
- B) However,
- C) In addition,
- D) Likewise,

18

At this point, the writer is considering adding the following sentence.

The United States Department of Agriculture (USDA) reports that organic agricultural products are now available in approximately 20,000 markets specializing in natural foods.

Should the writer make this addition here?

- A) Yes, because it adds a relevant research finding from a government agency.
- B) Yes, because it supports the passage's argument that organic food is less nutritious than conventionally grown food.
- C) No, because it is not relevant to the paragraph's discussion of scientific evidence.
- D) No, because it introduces a term that has not been defined in the passage.

Evidence also undermines the claim that organic food is safer to eat. While researchers have found lower levels of pesticide residue in organic produce than in nonorganic produce, the pesticide residue detected in conventional produce falls within acceptable safety limits. According to such organizations as the US Environmental Protection Agency, the minute amounts of residue falling within such limits **19** have no negative impact on human health. **20**

19

- A) NO CHANGE
- B) is having
- C) has had
- D) has

20

At this point, the writer wants to further reinforce the paragraph's claim about the safety of nonorganic food. Which choice most effectively accomplishes this goal?

- A) To be labeled organic, a product must meet certain standards determined and monitored by the US Department of Agriculture.
- B) Organic food, however, is regulated to eliminate artificial ingredients that include certain types of preservatives, sweeteners, colorings, and flavors.
- C) Moreover, consumers who are concerned about ingesting pesticide residue can eliminate much of it by simply washing or peeling produce before eating it.
- D) In fact, the Environmental Protection Agency estimates that about one-fifth of the pesticides used worldwide are applied to crops in the United States.

Based on scientific evidence, organic food offers neither significant nutritional nor safety benefits for consumers. Proponents of organic food, of course, are quick to add that **21** their are numerous other reasons to buy organic **22** food, such as, a desire to protect the environment from potentially damaging pesticides or a preference for the taste of organically grown foods. Research regarding these issues is less conclusive than the findings regarding nutritional content and pesticide residue safety limits. What is clear, though, is this: if a consumer's goal is to buy the healthiest and safest food to eat, the increased cost of organic food is a waste of money.

21

- A) NO CHANGE
- B) there are
- C) there is
- D) their is

22

- A) NO CHANGE
- B) food such as:
- C) food such as,
- D) food, such as

Questions 23-33 are based on the following passage and supplementary material.

You Are Where You Say

Research on regional variations in English-language use has not only yielded answers to such **23** life-altering questions as how people in different parts of the United States refer to carbonated beverages (“soda”? “pop”? “coke”?) **24** it also illustrates how technology can change the very nature of research. While traditional, human-intensive data collection **25** has all but disappeared in language studies, the explosion of social media has opened new avenues for investigation.

[1] Perhaps the epitome of traditional methodology is the *Dictionary of American Regional English*, colloquially known as *DARE*. [2] Its fifth and final alphabetical volume—ending with “zydeco”—released in 2012, the dictionary represents decades of arduous work. [3] Over a six-year period from 1965 to 1970, university graduate students conducted interviews in more than a thousand communities across the nation. [4] Their goal was to determine what names people used for such everyday objects and concepts as a submarine sandwich

23

The writer wants to convey an attitude of genuine interest and to avoid the appearance of mockery. Which choice best accomplishes this goal?

- A) NO CHANGE
- B) galvanizing
- C) intriguing
- D) weird

24

- A) NO CHANGE
- B) and also illustrates
- C) but also illustrates
- D) illustrating

25

Which choice most effectively sets up the contrast in the sentence and is consistent with the information in the rest of the passage?

- A) NO CHANGE
- B) still has an important place
- C) remains the only option
- D) yields questionable results

(a “hero” in New York City but a “dagwood” in many parts of Minnesota, Iowa, and Colorado) and a heavy rainstorm (variously a “gully washer,” “pour-down,” or “stump mover”). [5] The work that dictionary founder Frederic G. Cassidy had expected to be finished by 1976 was not, in fact, completed in his lifetime. [6] The wait did not dampen enthusiasm among **26** scholars. Scholars consider the work a signal achievement in linguistics. **27**

Not all research into regional English varieties **28** requires such time, effort, and resources, however. Today’s researchers have found that the veritable army of trained volunteers traveling the country conducting face-to-face interviews can sometimes be **29** replaced by another army the vast array of individuals volunteering details about their lives—and, inadvertently, their language—through social media. Brice Russ of Ohio State University, for example, has employed software to sort through postings on one social media **30** cite in search of particular words and phrases of interest as well as the location from which users are posting. From these data,

26

- A) NO CHANGE
- B) scholars, and these scholars
- C) scholars, but scholars
- D) scholars, who

27

To improve the cohesion and flow of this paragraph, the writer wants to add the following sentence.

Data gathering proved to be the quick part of the project.

The sentence would most logically be placed after

- A) sentence 2.
- B) sentence 3.
- C) sentence 4.
- D) sentence 5.

28

- A) NO CHANGE
- B) are requiring
- C) have required
- D) require

29

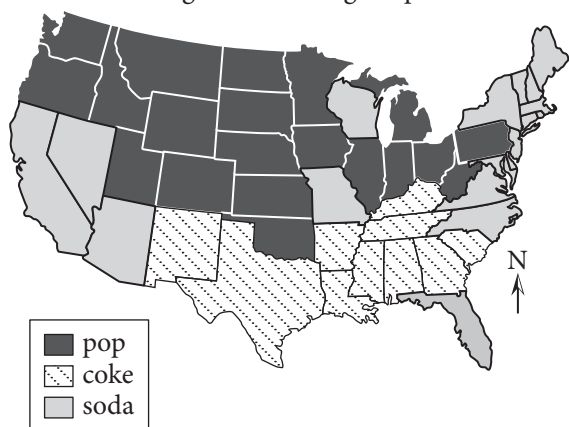
- A) NO CHANGE
- B) replaced—by another army,
- C) replaced by another army;
- D) replaced by another army:

30

- A) NO CHANGE
- B) site in search of
- C) sight in search for
- D) cite in search for

he was able, among other things, to confirm regional variations in people's terms for soft drinks. As the map shows, "soda" is commonly heard in the middle and western portions of the United States; "pop" is frequently used in many southern states; and "coke" is predominant in the northeastern and southwest regions but used elsewhere as well. **31** As interesting as Russ's findings are, though, **32** they're true value lies in their reminder that the Internet is not merely a sophisticated tool for collecting data but is also **33** itself a rich source of data.

Soft Drink Descriptions by State
Highest Percentage Reported



Adapted from Jennifer M. Smith, Department of Geography, The Pennsylvania State University, with data from www.popvssoda.com

31

The writer wants the information in the passage to correspond as closely as possible with the information in the map. Given that goal and assuming that the rest of the previous sentence would remain unchanged, in which sequence should the three terms for soft drinks be discussed?

- A) NO CHANGE
- B) "pop," "soda," "coke"
- C) "pop," "coke," "soda"
- D) "soda," "coke," "pop"

32

- A) NO CHANGE
- B) their true value lies in their
- C) there true value lies in they're
- D) their true value lies in there

33

Which choice most effectively concludes the sentence and paragraph?

- A) NO CHANGE
- B) where we can learn what terms people use to refer to soft drinks.
- C) a useful way to stay connected to friends, family, and colleagues.
- D) helpful to researchers.

Questions 34-44 are based on the following passage.

Creating Worlds: A Career in Game Design

If you love video games and have thought about how the games you play might be changed or improved, or if you've imagined creating a video game of your own, you might want to consider a career as a video game designer. There **34** were a number of steps you can take to determine whether game design is the right field for you and, if it is, to prepare yourself for such a career.

Before making the choice, you should have some sense of what a video game designer does. Every video game, whether for a console, computer, or mobile device, starts with a concept that originates in the mind of a designer. The designer envisions the game's fundamental **35** elements: the settings, characters, and plots that make each game unique, and is thus a primary creative force behind a video game.

Conceptualizing a game is only the beginning of a video game designer's **36** job, however, no matter how good a concept is, it will never be translated into a video game unless it is communicated effectively to all the other members of the video game development team. **37** A designer must generate extensive documentation and

34

- A) NO CHANGE
- B) has been
- C) are
- D) was

35

- A) NO CHANGE
- B) elements: the settings, characters, and plots that make each game unique—
- C) elements—the settings, characters, and plots that make each game unique—
- D) elements; the settings, characters, and plots that make each game unique;

36

- A) NO CHANGE
- B) job, however. No
- C) job—however, no
- D) job however no

37

At this point, the writer is considering adding the following sentence.

Successful communication is essential if a designer's idea is to become a reality.

Should the writer make this addition here?

- A) Yes, because it supports the conclusion drawn in the following sentence.
- B) Yes, because it illustrates a general principle discussed in the paragraph.
- C) No, because it distracts from the focus of the paragraph by introducing irrelevant material.
- D) No, because it merely reformulates the thought expressed in the preceding sentence.

38 explain his or her ideas clearly in order to ensure that the programmers, artists, and others on the team all share the same vision. **39** Likewise, anyone considering a career as a video game designer must be **40** skilled writers and speakers. In addition, because video game development is a collaborative effort and because the development of any one game may take months or even years, a designer must be an effective team player as well as detail oriented.

[1] A basic understanding of computer programming is essential. [2] In fact, many designers **41** initially begin their pursuits as programmers. [3] Consider taking some general computer science courses as well as courses in artificial intelligence and graphics in order to increase your understanding of the technical challenges involved in developing a video game. [4] Courses in psychology and human behavior may help you develop **42** emphatic collaboration skills, while courses in the humanities, such as in literature and film, should give you the background necessary to develop effective narrative structures. [5] A

38

Which choice results in a sentence that best supports the point developed in this paragraph?

- A) NO CHANGE
- B) possess a vivid imagination
- C) assess his or her motivations carefully
- D) learn to accept constructive criticism

39

- A) NO CHANGE
- B) Nevertheless,
- C) Consequently,
- D) However,

40

- A) NO CHANGE
- B) a skilled writer and speaker.
- C) skilled both as writers and speakers.
- D) both skilled writers and speakers.

41

- A) NO CHANGE
- B) start to begin their work
- C) initiate their progression
- D) begin their careers

42

- A) NO CHANGE
- B) paramount
- C) eminent
- D) important

designer also needs careful educational preparation.

[6] Finally, because a designer should understand the business aspects of the video game industry, such as budgeting and marketing, you may want to consider taking some business courses. [7] Although demanding and deadline driven, **43** video game design can be a lucrative and rewarding field for people who love gaming and have prepared themselves with the necessary skills and knowledge. **44**

43

- A) NO CHANGE
- B) the choice of video game design
- C) you should choose video game design because it
- D) choosing to design video games

44

To make this paragraph most logical, sentence 5 should be

- A) placed where it is now.
- B) placed before sentence 1.
- C) placed after sentence 3.
- D) DELETED from the paragraph.

STOP

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



Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

Turn to Section 3 of your answer sheet to answer the questions in this section.

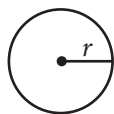
DIRECTIONS

For questions 1-15, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. For questions 16-20, solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 16 on how to enter your answers in the grid. You may use any available space in your test booklet for scratch work.

NOTES

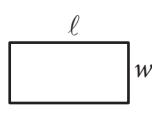
1. The use of a calculator **is not permitted**.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the domain of a given function f is the set of all real numbers x for which $f(x)$ is a real number.

REFERENCE

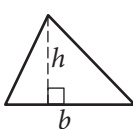


$$A = \pi r^2$$

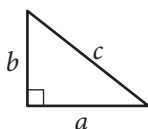
$$C = 2\pi r$$



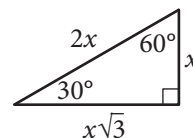
$$A = \ell w$$



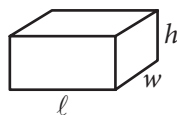
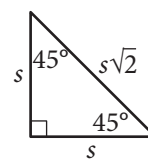
$$A = \frac{1}{2}bh$$



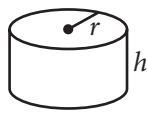
$$c^2 = a^2 + b^2$$



Special Right Triangles



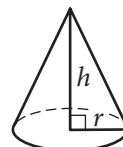
$$V = \ell wh$$



$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



$$V = \frac{1}{3}\ell wh$$

The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is 2π .

The sum of the measures in degrees of the angles of a triangle is 180.



1

Which of the following expressions is equal to 0 for some value of x ?

- A) $|x - 1| - 1$
- B) $|x + 1| + 1$
- C) $|1 - x| + 1$
- D) $|x - 1| + 1$

2

$$f(x) = \frac{3}{2}x + b$$

In the function above, b is a constant. If $f(6) = 7$, what is the value of $f(-2)$?

- A) -5
- B) -2
- C) 1
- D) 7

3

$$\frac{x}{y} = 6$$

$$4(y + 1) = x$$

If (x, y) is the solution to the system of equations above, what is the value of y ?

- A) 2
- B) 4
- C) 12
- D) 24

4

If $f(x) = -2x + 5$, what is $f(-3x)$ equal to?

- A) $-6x - 5$
- B) $6x + 5$
- C) $6x - 5$
- D) $6x^2 - 15x$



5

$$3(2x + 1)(4x + 1)$$

Which of the following is equivalent to the expression above?

- A) $45x$
- B) $24x^2 + 3$
- C) $24x^2 + 18x + 3$
- D) $18x^2 + 6$

6

If $\frac{a-b}{b} = \frac{3}{7}$, which of the following must also be true?

- A) $\frac{a}{b} = -\frac{4}{7}$
- B) $\frac{a}{b} = \frac{10}{7}$
- C) $\frac{a+b}{b} = \frac{10}{7}$
- D) $\frac{a-2b}{b} = -\frac{11}{7}$

7

While preparing to run a marathon, Amelia created a training schedule in which the distance of her longest run every week increased by a constant amount. If Amelia's training schedule requires that her longest run in week 4 is a distance of 8 miles and her longest run in week 16 is a distance of 26 miles, which of the following best describes how the distance Amelia runs changes between week 4 and week 16 of her training schedule?

- A) Amelia increases the distance of her longest run by 0.5 miles each week.
- B) Amelia increases the distance of her longest run by 2 miles each week.
- C) Amelia increases the distance of her longest run by 2 miles every 3 weeks.
- D) Amelia increases the distance of her longest run by 1.5 miles each week.



8

Which of the following equations represents a line that is parallel to the line with equation $y = -3x + 4$?

- A) $6x + 2y = 15$
- B) $3x - y = 7$
- C) $2x - 3y = 6$
- D) $x + 3y = 1$

9

$$\sqrt{x-a} = x-4$$

If $a = 2$, what is the solution set of the equation above?

- A) $\{3, 6\}$
- B) $\{2\}$
- C) $\{3\}$
- D) $\{6\}$

10

If $\frac{t+5}{t-5} = 10$, what is the value of t ?

- A) $\frac{45}{11}$
- B) 5
- C) $\frac{11}{2}$
- D) $\frac{55}{9}$

11

$$x = 2y + 5$$

$$y = (2x - 3)(x + 9)$$

How many ordered pairs (x, y) satisfy the system of equations shown above?

- A) 0
- B) 1
- C) 2
- D) Infinitely many

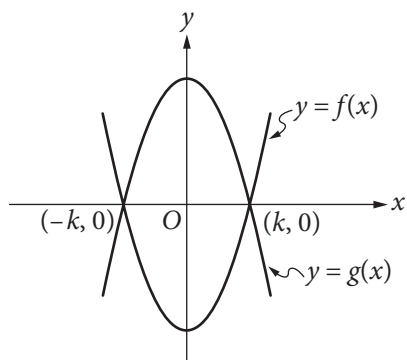


12

Ken and Paul each ordered a sandwich at a restaurant. The price of Ken's sandwich was x dollars, and the price of Paul's sandwich was \$1 more than the price of Ken's sandwich. If Ken and Paul split the cost of the sandwiches evenly and each paid a 20% tip, which of the following expressions represents the amount, in dollars, each of them paid? (Assume there is no sales tax.)

- A) $0.2x + 0.2$
- B) $0.5x + 0.1$
- C) $1.2x + 0.6$
- D) $2.4x + 1.2$

13



The functions f and g , defined by $f(x) = 8x^2 - 2$ and $g(x) = -8x^2 + 2$, are graphed in the xy -plane above. The graphs of f and g intersect at the points $(k, 0)$ and $(-k, 0)$. What is the value of k ?

- A) $\frac{1}{4}$
- B) $\frac{1}{2}$
- C) 1
- D) 2

14

$$\frac{8-i}{3-2i}$$

If the expression above is rewritten in the form $a + bi$, where a and b are real numbers, what is the value of a ? (Note: $i = \sqrt{-1}$)

- A) 2
- B) $\frac{8}{3}$
- C) 3
- D) $\frac{11}{3}$

15

$$x^2 - \frac{k}{2}x = 2p$$

In the quadratic equation above, k and p are constants. What are the solutions for x ?

- A) $x = \frac{k}{4} \pm \frac{\sqrt{k^2 + 2p}}{4}$
- B) $x = \frac{k}{4} \pm \frac{\sqrt{k^2 + 32p}}{4}$
- C) $x = \frac{k}{2} \pm \frac{\sqrt{k^2 + 2p}}{2}$
- D) $x = \frac{k}{2} \pm \frac{\sqrt{k^2 + 32p}}{4}$

**DIRECTIONS**

For questions 16–20, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or $7/2$. (If $\begin{array}{|c|c|c|c|} \hline 3 & 1 & / & 2 \\ \hline \bullet & \bullet & \bullet & \bullet \\ \hline \end{array}$ is entered into the grid, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Write answer in boxes. →

Answer: $\frac{7}{12}$

← Fraction line

Grid in result.

7	/	1	2
•	•	•	•
0	0	0	0
1	1	•	1
2	2	2	•
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
•	7	7	7
8	8	8	8
9	9	9	9

Answer: 2.5

← Decimal point

	2	.	5
•	•	•	•
0	0	0	0
1	1	1	1
2	•	2	2
3	3	3	3
4	4	4	4
5	5	5	•
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Acceptable ways to grid $\frac{2}{3}$ are:

	2	/	3
•	•	•	•
0	0	0	0
1	1	1	1
2	•	2	2
3	3	3	•
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8

.	6	6	6
•	•	•	•
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	•	•	•
7	7	7	7
8	8	8	8

.	6	6	7
•	•	•	•
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	•	•	•
7	7	7	•
8	8	8	8

Answer: 201 – either position is correct

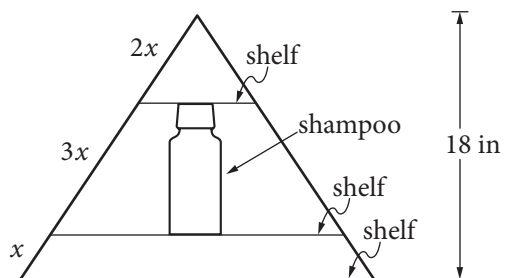
	2	0	1
•	•	•	•
0	0	•	0
1	1	1	•
2	•	2	2
3	3	3	3

2	0	1	
•	•	•	•
0	•	0	0
1	1	•	1
2	•	2	2
3	3	3	3

NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.

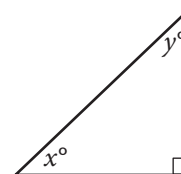


16



Jim has a triangular shelf system that attaches to his showerhead. The total height of the system is 18 inches, and there are three parallel shelves as shown above. What is the maximum height, in inches, of a shampoo bottle that can stand upright on the middle shelf?

17



In the triangle above, the sine of x° is 0.6. What is the cosine of y° ?

18

$$x^3 - 5x^2 + 2x - 10 = 0$$

For what real value of x is the equation above true?



19

$$-3x + 4y = 20$$

$$6x + 3y = 15$$

If (x, y) is the solution to the system of equations above, what is the value of x ?

20

The mesosphere is the layer of Earth's atmosphere between 50 kilometers and 85 kilometers above Earth's surface. At a distance of 50 kilometers from Earth's surface, the temperature in the mesosphere is -5° Celsius, and at a distance of 80 kilometers from Earth's surface, the temperature in the mesosphere is -80° Celsius. For every additional 10 kilometers from Earth's surface, the temperature in the mesosphere decreases by k° Celsius, where k is a constant. What is the value of k ?

STOP

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



Math Test – Calculator

55 MINUTES, 38 QUESTIONS

Turn to Section 4 of your answer sheet to answer the questions in this section.

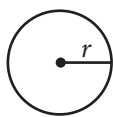
DIRECTIONS

For questions 1-30, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. For questions 31-38, solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 31 on how to enter your answers in the grid. You may use any available space in your test booklet for scratch work.

NOTES

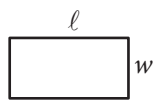
1. The use of a calculator **is permitted**.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the domain of a given function f is the set of all real numbers x for which $f(x)$ is a real number.

REFERENCE

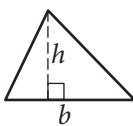


$$A = \pi r^2$$

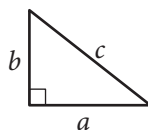
$$C = 2\pi r$$



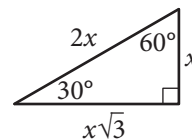
$$A = \ell w$$



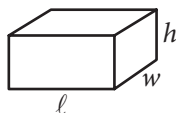
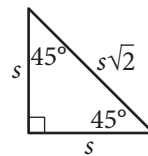
$$A = \frac{1}{2}bh$$



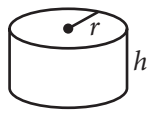
$$c^2 = a^2 + b^2$$



Special Right Triangles



$$V = \ell wh$$



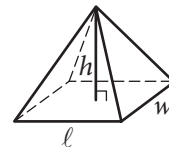
$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



$$V = \frac{1}{3}\ell wh$$

The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is 2π .

The sum of the measures in degrees of the angles of a triangle is 180.



1

The monthly membership fee for an online television and movie service is \$9.80. The cost of viewing television shows online is included in the membership fee, but there is an additional fee of \$1.50 to rent each movie online. For one month, Jill's membership and movie rental fees were \$12.80. How many movies did Jill rent online that month?

- A) 1
- B) 2
- C) 3
- D) 4

2

One of the requirements for becoming a court reporter is the ability to type 225 words per minute. Donald can currently type 180 words per minute, and believes that with practice he can increase his typing speed by 5 words per minute each month. Which of the following represents the number of words per minute that Donald believes he will be able to type m months from now?

- A) $5 + 180m$
- B) $225 + 5m$
- C) $180 + 5m$
- D) $180 - 5m$

3

If a 3-pound pizza is sliced in half and each half is sliced into thirds, what is the weight, in ounces, of each of the slices? (1 pound = 16 ounces)

- A) 4
- B) 6
- C) 8
- D) 16

4

Nick surveyed a random sample of the freshman class of his high school to determine whether the Fall Festival should be held in October or November. Of the 90 students surveyed, 25.6% preferred October. Based on this information, about how many students in the entire 225-person class would be expected to prefer having the Fall Festival in October?

- A) 50
- B) 60
- C) 75
- D) 80



5

The density of an object is equal to the mass of the object divided by the volume of the object. What is the volume, in milliliters, of an object with a mass of 24 grams and a density of 3 grams per milliliter?

- A) 0.125
- B) 8
- C) 21
- D) 72

6

Last week Raul worked 11 more hours than Angelica. If they worked a combined total of 59 hours, how many hours did Angelica work last week?

- A) 24
- B) 35
- C) 40
- D) 48

7

Movies with Greatest Ticket Sales in 2012

MPAA rating	Type of movie				
	Action	Animated	Comedy	Drama	Total
PG	2	7	0	2	11
PG-13	10	0	4	8	22
R	6	0	5	6	17
Total	18	7	9	16	50

The table above represents the 50 movies that had the greatest ticket sales in 2012, categorized by movie type and Motion Picture Association of America (MPAA) rating. What proportion of the movies are comedies with a PG-13 rating?

- A) $\frac{2}{25}$
- B) $\frac{9}{50}$
- C) $\frac{2}{11}$
- D) $\frac{11}{25}$

8

Line ℓ in the xy -plane contains points from each of Quadrants II, III, and IV, but no points from Quadrant I. Which of the following must be true?

- A) The slope of line ℓ is undefined.
- B) The slope of line ℓ is zero.
- C) The slope of line ℓ is positive.
- D) The slope of line ℓ is negative.



Number of Registered Voters
in the United States in 2012, in Thousands

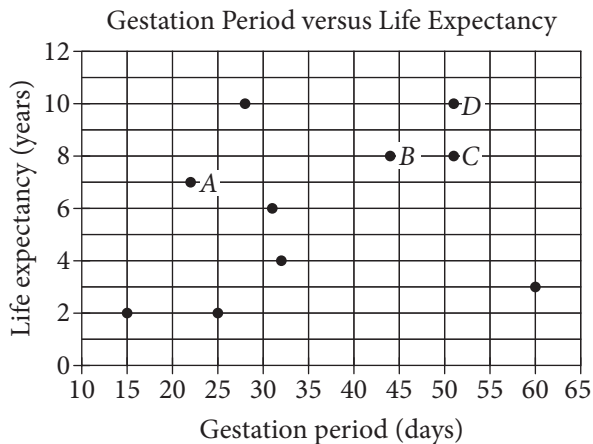
Region	Age, in years					Total
	18 to 24	25 to 44	45 to 64	65 to 74	75 and older	
Northeast	2,713	8,159	10,986	3,342	2,775	27,975
Midwest	3,453	11,237	13,865	4,221	3,350	36,126
South	5,210	18,072	21,346	7,272	4,969	56,869
West	3,390	10,428	11,598	3,785	2,986	32,187
Total	14,766	47,896	57,795	18,620	14,080	153,157

The table above shows the number of registered voters in 2012, in thousands, in four geographic regions and five age groups. Based on the table, if a registered voter who was 18 to 44 years old in 2012 is chosen at random, which of the following is closest to the probability that the registered voter was from the Midwest region?

- A) 0.10
- B) 0.25
- C) 0.40
- D) 0.75



Questions 10 and 11 refer to the following information.



A curator at a wildlife society created the scatterplot above to examine the relationship between the gestation period and life expectancy of 10 species of animals.

10

What is the life expectancy, in years, of the animal that has the longest gestation period?

- A) 3
- B) 4
- C) 8
- D) 10

11

Of the labeled points, which represents the animal for which the ratio of life expectancy to gestation period is greatest?

- A) A
- B) B
- C) C
- D) D

12

In the xy -plane, the graph of function f has x -intercepts at -3 , -1 , and 1 . Which of the following could define f ?

- A) $f(x) = (x - 3)(x - 1)(x + 1)$
- B) $f(x) = (x - 3)(x - 1)^2$
- C) $f(x) = (x - 1)(x + 1)(x + 3)$
- D) $f(x) = (x + 1)^2(x + 3)$



13

The population of mosquitoes in a swamp is estimated over the course of twenty weeks, as shown in the table.

Time (weeks)	Population
0	100
5	1,000
10	10,000
15	100,000
20	1,000,000

Which of the following best describes the relationship between time and the estimated population of mosquitoes during the twenty weeks?

- A) Increasing linear
- B) Decreasing linear
- C) Exponential growth
- D) Exponential decay

14

$$1,000\left(1 + \frac{r}{1,200}\right)^{12}$$

The expression above gives the amount of money, in dollars, generated in a year by a \$1,000 deposit in a bank account that pays an annual interest rate of $r\%$, compounded monthly. Which of the following expressions shows how much additional money is generated at an interest rate of 5% than at an interest rate of 3%?

A) $1,000\left(1 + \frac{5-3}{1,200}\right)^{12}$

B) $1,000\left(1 + \frac{\frac{5}{3}}{1,200}\right)^{12}$

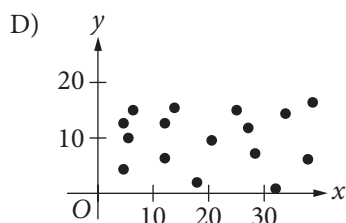
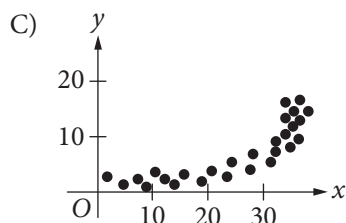
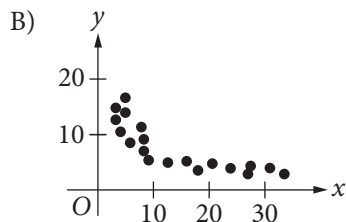
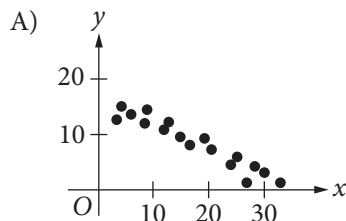
C) $\frac{1,000\left(1 + \frac{5}{1,200}\right)^{12}}{1,000\left(1 + \frac{3}{1,200}\right)^{12}}$

D) $1,000\left(1 + \frac{5}{1,200}\right)^{12} - 1,000\left(1 + \frac{3}{1,200}\right)^{12}$



15

Which of the following scatterplots shows a relationship that is appropriately modeled with the equation $y = ax^b$, where a is positive and b is negative?



Questions 16 and 17 refer to the following information.

Mr. Martinson is building a concrete patio in his backyard and deciding where to buy the materials and rent the tools needed for the project. The table below shows the materials' cost and daily rental costs for three different stores.

Store	Materials' Cost, M (dollars)	Rental cost of wheelbarrow, W (dollars per day)	Rental cost of concrete mixer, K (dollars per day)
A	750	15	65
B	600	25	80
C	700	20	70

The total cost, y , for buying the materials and renting the tools in terms of the number of days, x , is given by $y = M + (W + K)x$.

16

For what number of days, x , will the total cost of buying the materials and renting the tools from Store B be less than or equal to the total cost of buying the materials and renting the tools from Store A?

- A) $x \leq 6$
- B) $x \geq 6$
- C) $x \leq 7.3$
- D) $x \geq 7.3$



17

If the relationship between the total cost, y , of buying the materials and renting the tools at Store C and the number of days, x , for which the tools are rented is graphed in the xy -plane, what does the slope of the line represent?

- A) The total cost of the project
 - B) The total cost of the materials
 - C) The total daily cost of the project
 - D) The total daily rental costs of the tools
-

18

Jim has identical drinking glasses each in the shape of a right circular cylinder with internal diameter of 3 inches. He pours milk from a gallon jug into each glass until it is full. If the height of milk in each glass is about 6 inches, what is the largest number of full milk glasses that he can pour from one gallon of milk? (Note: There are 231 cubic inches in 1 gallon.)

- A) 2
- B) 4
- C) 5
- D) 6

19

If $3p - 2 \geq 1$, what is the least possible value of $3p + 2$?

- A) 5
- B) 3
- C) 2
- D) 1

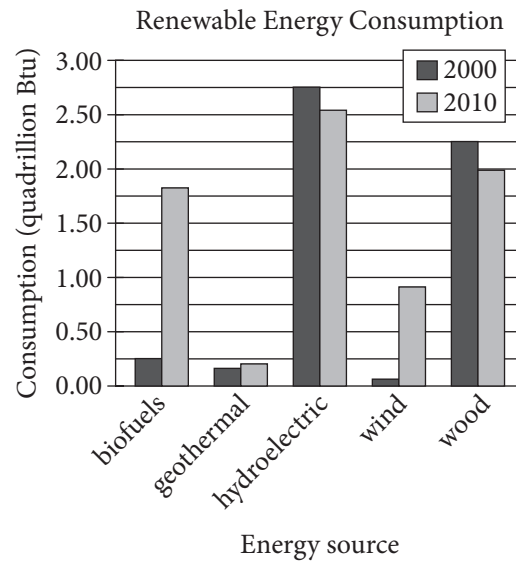


20

The mass of living organisms in a lake is defined to be the biomass of the lake. If the biomass in a lake doubles each year, which of the following graphs could model the biomass in the lake as a function of time? (Note: In each graph below, O represents $(0, 0)$.)

- A)
- B)
- C)
- D)

Questions 21 and 22 refer to the following information.



The bar graph above shows renewable energy consumption in quadrillions of British thermal units (Btu) in the United States, by energy source, for several energy sources in the years 2000 and 2010.

21

In a scatterplot of this data, where renewable energy consumption in the year 2000 is plotted along the x -axis and renewable energy consumption in the year 2010 is plotted along the y -axis for each of the given energy sources, how many data points would be above the line $y = x$?

- A) 1
B) 2
C) 3
D) 4



22

Of the following, which best approximates the percent decrease in consumption of wood power in the United States from 2000 to 2010 ?

- A) 6%
- B) 11%
- C) 21%
- D) 26%

23

The tables below give the distribution of high temperatures in degrees Fahrenheit ($^{\circ}\text{F}$) for City A and City B over the same 21 days in March.

City A

Temperature ($^{\circ}\text{F}$)	Frequency
80	3
79	14
78	2
77	1
76	1

City B

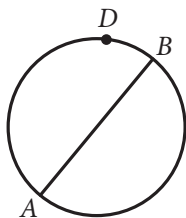
Temperature ($^{\circ}\text{F}$)	Frequency
80	6
79	3
78	2
77	4
76	6

Which of the following is true about the data shown for these 21 days?

- A) The standard deviation of temperatures in City A is larger.
- B) The standard deviation of temperatures in City B is larger.
- C) The standard deviation of temperatures in City A is the same as that of City B.
- D) The standard deviation of temperatures in these cities cannot be calculated with the data provided.



24



In the circle above, segment AB is a diameter. If the length of arc \widehat{ADB} is 8π , what is the length of the radius of the circle?

- A) 2
- B) 4
- C) 8
- D) 16

25

$$f(x) = 2x^3 + 6x^2 + 4x$$

$$g(x) = x^2 + 3x + 2$$

The polynomials $f(x)$ and $g(x)$ are defined above. Which of the following polynomials is divisible by $2x + 3$?

- A) $h(x) = f(x) + g(x)$
- B) $p(x) = f(x) + 3g(x)$
- C) $r(x) = 2f(x) + 3g(x)$
- D) $s(x) = 3f(x) + 2g(x)$

26

Let x and y be numbers such that $-y < x < y$. Which of the following must be true?

I. $|x| < y$

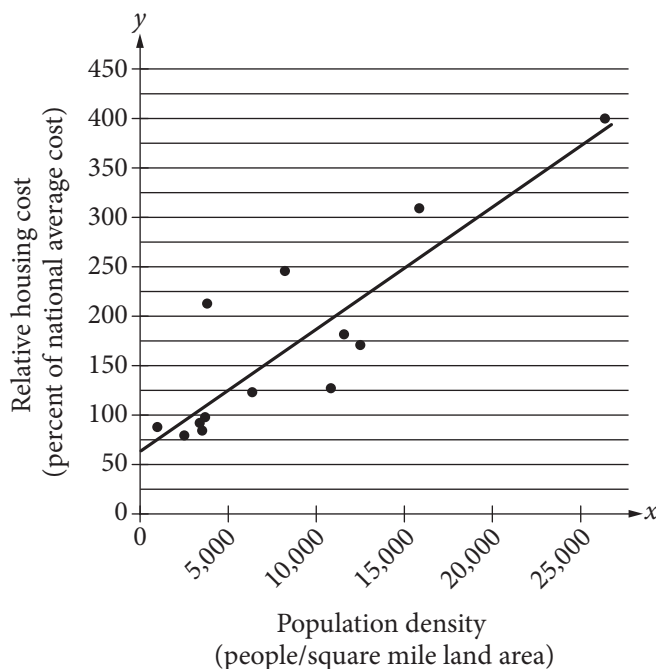
II. $x > 0$

III. $y > 0$

- A) I only
- B) I and II only
- C) I and III only
- D) I, II, and III



The relative housing cost for a US city is defined to be the ratio $\frac{\text{average housing cost for the city}}{\text{national average housing cost}}$, expressed as a percent.



The scatterplot above shows the relative housing cost and the population density for several large US cities in the year 2005. The line of best fit is also shown and has equation $y = 0.0125x + 61$. Which of the following best explains how the number 61 in the equation relates to the scatterplot?

- A) In 2005, the lowest housing cost in the United States was about \$61 per month.
- B) In 2005, the lowest housing cost in the United States was about 61% of the highest housing cost.
- C) In 2005, even in cities with low population densities, housing costs were never below 61% of the national average.
- D) In 2005, even in cities with low population densities, housing costs were likely at least 61% of the national average.



28

$$f(x) = (x + 6)(x - 4)$$

Which of the following is an equivalent form of the function f above in which the minimum value of f appears as a constant or coefficient?

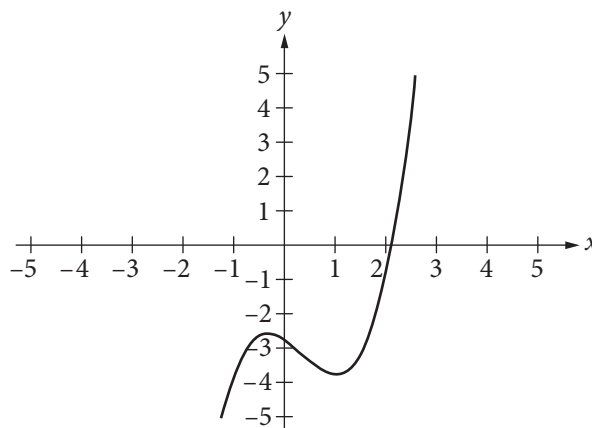
- A) $f(x) = x^2 - 24$
- B) $f(x) = x^2 + 2x - 24$
- C) $f(x) = (x - 1)^2 - 21$
- D) $f(x) = (x + 1)^2 - 25$

29

If x is the average (arithmetic mean) of m and 9, y is the average of $2m$ and 15, and z is the average of $3m$ and 18, what is the average of x , y , and z in terms of m ?

- A) $m + 6$
- B) $m + 7$
- C) $2m + 14$
- D) $3m + 21$

30



The function $f(x) = x^3 - x^2 - x - \frac{11}{4}$ is graphed in the xy -plane above. If k is a constant such that the equation $f(x) = k$ has three real solutions, which of the following could be the value of k ?

- A) 2
- B) 0
- C) -2
- D) -3


DIRECTIONS

For questions 31–38, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or $7/2$. (If $\begin{array}{|c|c|c|c|} \hline 3 & 1 & / & 2 \\ \hline \bullet & \bullet & \bullet & \bullet \\ \hline \end{array}$ is entered into the grid, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Write answer in boxes. →

Answer: $\frac{7}{12}$

7	/	1	2
•	•	•	•
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

Grid in result.

Answer: 2.5

2	.	5
•	•	•
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

← Decimal point

Acceptable ways to grid $\frac{2}{3}$ are:

2	/	3
•	•	•
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

.	6	6	6
•	•	•	•
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

.	6	6	7
•	•	•	•
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Answer: 201 – either position is correct

2	0	1
•	•	•
0	0	0
1	1	1
2	2	2
3	3	3

2	0	1
•	•	•
0	0	0
1	1	1
2	2	2
3	3	3

NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



31

A partially filled pool contains 600 gallons of water. A hose is turned on, and water flows into the pool at the rate of 8 gallons per minute. How many gallons of water will be in the pool after 70 minutes?

32

The normal systolic blood pressure P , in millimeters of mercury, for an adult male x years old can be modeled by the equation $P = \frac{x + 220}{2}$. According to the model, for every increase of 1 year in age, by how many millimeters of mercury will the normal systolic blood pressure for an adult male increase?

33

The *pes*, a Roman measure of length, is approximately equal to 11.65 inches. It is also equivalent to 16 smaller Roman units called digits. Based on these relationships, 75 Roman digits is equivalent to how many feet, to the nearest hundredth? (12 inches = 1 foot)

34

In a study of bat migration habits, 240 male bats and 160 female bats have been tagged. If 100 more female bats are tagged, how many more male bats must be tagged so that $\frac{3}{5}$ of the total number of bats in the study are male?

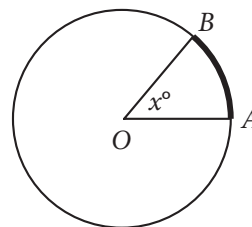


35

$$q = \frac{1}{2}nv^2$$

The dynamic pressure q generated by a fluid moving with velocity v can be found using the formula above, where n is the constant density of the fluid. An aeronautical engineer uses the formula to find the dynamic pressure of a fluid moving with velocity v and the same fluid moving with velocity $1.5v$. What is the ratio of the dynamic pressure of the faster fluid to the dynamic pressure of the slower fluid?

36



Note: Figure not drawn to scale.

In the figure above, the circle has center O and has radius 10. If the length of arc \widehat{AB} (shown in bold) is between 5 and 6, what is one possible integer value of x ?



Questions 37 and 38 refer to the following information.

The stock price of one share in a certain company is worth \$360 today. A stock analyst believes that the stock will lose 28 percent of its value each week for the next three weeks. The analyst uses the equation $V = 360(r)^t$ to model the value, V , of the stock after t weeks.

37

What value should the analyst use for r ?

38

To the nearest dollar, what does the analyst believe the value of the stock will be at the end of three weeks? (Note: Disregard the \$ sign when gridding your answer.)

STOP

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

No Test Material On This Page

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The SAT

GENERAL DIRECTIONS

- You may work on only one section at a time.
- If you finish a section before time is called, check your work on that section. You may NOT turn to any other section.

MARKING ANSWERS

- Be sure to mark your answer sheet properly.

COMPLETE MARK

EXAMPLES OF INCOMPLETE MARKS

- You must use a No. 2 pencil.
- Carefully mark only one answer for each question.
- Make sure you fill the entire circle darkly and completely.
- Do not make any stray marks on your answer sheet.
- If you erase, do so completely. Incomplete erasures may be scored as intended answers.
- Use only the answer spaces that correspond to the question numbers.

USING YOUR TEST BOOK

- You may use the test book for scratch work, but you will not receive credit for anything that you write in your test book.
- After time has been called, you may not transfer answers from your test book to your answer sheet or fill in circles.
- You may not fold or remove pages or portions of a page from this book, or take the book or answer sheet from the testing room.

SCORING

- For each correct answer, you receive one point.
- You do not lose points for wrong answers; therefore, you should try to answer every question even if you are not sure of the correct answer.

IMPORTANT

The codes below are unique to your test book.
Copy them on your answer sheet in boxes 8 and 9 and fill in the corresponding circles exactly as shown.

9

TEST ID

(Copy from back of test book.)

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8

FORM CODE

(Copy and grid as on back of test book.)

A	A	A	A	0	0	0
B	B	B	B	1	1	1
C	C	C	C	2	2	2
D	D	D	D	3	3	3
E	E	E	E	4	4	4
F	F	F	F	5	5	5
G	G	G	G	6	6	6
H	H	H	H	7	7	7
I	I	I	I	8	8	8
J	J	J	J	9	9	9
K	K	K	K			
L	L	L	L			
M	M	M	M			
N	N	N	N			
O	O	O	O			
P	P	P	P			
Q	Q	Q	Q			
R	R	R	R			
S	S	S	S			
T	T	T	T			
U	U	U	U			
V	V	V	V			
W	W	W	W			
X	X	X	X			
Y	Y	Y	Y			
Z	Z	Z	Z			

Follow this link for more information on scoring your practice test:
www.sat.org/scoring

The SAT[®]

Practice Essay #4

Make time to take the practice Essay.
It's one of the best ways to get ready
for the SAT Essay.

For information on scoring your essay, view
the SAT Essay scoring rubric at sat.org/essay.



As you read the passage below, consider how Paul Bogard uses

- evidence, such as facts or examples, to support claims.
- reasoning to develop ideas and to connect claims and evidence.
- stylistic or persuasive elements, such as word choice or appeals to emotion, to add power to the ideas expressed.

Adapted from Paul Bogard, “Let There Be Dark.” ©2012 by Los Angeles Times. Originally published December 21, 2012.

- 1 At my family’s cabin on a Minnesota lake, I knew woods so dark that my hands disappeared before my eyes. I knew night skies in which meteors left smoky trails across sugary spreads of stars. But now, when 8 of 10 children born in the United States will never know a sky dark enough for the Milky Way, I worry we are rapidly losing night’s natural darkness before realizing its worth. This winter solstice, as we cheer the days’ gradual movement back toward light, let us also remember the irreplaceable value of darkness.
- 2 All life evolved to the steady rhythm of bright days and dark nights. Today, though, when we feel the closeness of nightfall, we reach quickly for a light switch. And too little darkness, meaning too much artificial light at night, spells trouble for all.
- 3 Already the World Health Organization classifies working the night shift as a probable human carcinogen, and the American Medical Association has voiced its unanimous support for “light pollution reduction efforts and glare reduction efforts at both the national and state levels.” Our bodies need darkness to produce the hormone melatonin, which keeps certain cancers from developing, and our bodies need darkness for sleep. Sleep disorders have been linked to diabetes, obesity, cardiovascular disease and depression, and recent research suggests one main cause of “short sleep” is “long light.” Whether we work at night or simply take our tablets, notebooks and smartphones to bed, there isn’t a place for this much artificial light in our lives.
- 4 The rest of the world depends on darkness as well, including nocturnal and crepuscular species of birds, insects, mammals, fish and reptiles. Some examples are well known—the 400 species of birds that migrate at night in North America, the sea turtles that come ashore to lay their eggs—and some are not, such as the bats that save American farmers billions in pest control and the moths that pollinate 80% of the world’s flora. Ecological light pollution is like the bulldozer of the night, wrecking habitat and disrupting ecosystems several billion years in the making. Simply put, without darkness, Earth’s ecology would collapse. . . .

- 5 In today's crowded, louder, more fast-paced world, night's darkness can provide solitude, quiet and stillness, qualities increasingly in short supply. Every religious tradition has considered darkness invaluable for a soulful life, and the chance to witness the universe has inspired artists, philosophers and everyday stargazers since time began. In a world awash with electric light . . . how would Van Gogh have given the world his "Starry Night"? Who knows what this vision of the night sky might inspire in each of us, in our children or grandchildren?
- 6 Yet all over the world, our nights are growing brighter. In the United States and Western Europe, the amount of light in the sky increases an average of about 6% every year. Computer images of the United States at night, based on NASA photographs, show that what was a very dark country as recently as the 1950s is now nearly covered with a blanket of light. Much of this light is wasted energy, which means wasted dollars. Those of us over 35 are perhaps among the last generation to have known truly dark nights. Even the northern lake where I was lucky to spend my summers has seen its darkness diminish.
- 7 It doesn't have to be this way. Light pollution is readily within our ability to solve, using new lighting technologies and shielding existing lights. Already, many cities and towns across North America and Europe are changing to LED streetlights, which offer dramatic possibilities for controlling wasted light. Other communities are finding success with simply turning off portions of their public lighting after midnight. Even Paris, the famed "city of light," which already turns off its monument lighting after 1 a.m., will this summer start to require its shops, offices and public buildings to turn off lights after 2 a.m. Though primarily designed to save energy, such reductions in light will also go far in addressing light pollution. But we will never truly address the problem of light pollution until we become aware of the irreplaceable value and beauty of the darkness we are losing.

Write an essay in which you explain how Paul Bogard builds an argument to persuade his audience that natural darkness should be preserved. In your essay, analyze how Bogard uses one or more of the features listed in the box above (or features of your own choice) to strengthen the logic and persuasiveness of his argument. Be sure that your analysis focuses on the most relevant features of the passage.

Your essay should not explain whether you agree with Bogard's claims, but rather explain how Bogard builds an argument to persuade his audience.

YOUR NAME (PRINT)

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FIRST

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TEST CENTER

NUMBER

NAME OF TEST CENTER

ROOM NUMBER

Answer Explanations

SAT Practice Test #4

Section 1: Reading Test

QUESTION 1

Choice C is the best answer. The narrator initially expresses uncertainty, or uneasiness, over his decision to set out for the North Pole: “my motives in this undertaking are not entirely clear” (lines 9-10). At the end of the passage, the narrator recognizes that because of this journey he is “on the brink of knowing . . . not an ethereal mathematical spot,” the North Pole, but himself (lines 56-57).

Choices A, B, and D are incorrect because the narrator does not suggest that he fears going on the expedition, doubts his own abilities, or feels disdain for the North Pole.

QUESTION 2

Choice D is the best answer. Lines 56-57 provide evidence that the narrator eventually recognizes his motives for traveling to the North Pole: “What I am on the brink of knowing, I now see, is not an ephemeral mathematical spot but myself.” The narrator initially was unsure of why he was traveling to the North Pole, but realizes that he has embarked on a journey to find himself.

Choices A, B, and C are incorrect because they do not provide the best evidence that the narrator eventually recognizes his motives for traveling to the North Pole. Rather, choices A, B, and C all focus on the narrator’s preparations and expectations for the journey.

QUESTION 3

Choice D is the best answer. In lines 1-6, the narrator says that he feels a “vast yearning” and that his emotions are “complicated.” He explains that he does “not understand quite what it is that the yearning desires.” In this context, his emotions are “not readily verifiable,” or not completely understood.

Choices A, B, and C are incorrect because in this context, “not readily verifiable” does not mean unable to be authenticated, likely to be contradicted, or without empirical support.

QUESTION 4

Choice C is the best answer. In lines 10-13, the narrator explains that “the machinery of [his] destiny has worked in secret” to prepare him for this journey, as “its clockwork” has propelled him to “this time and place.” By using the phrases “the machinery” and “its clockwork,” the narrator is showing that powerful and independent forces are causing him to journey to the North Pole.

Choices A, B, and D are incorrect because they do not indicate the main purpose of lines 10-13. While lines 10-13 mention that these powerful and independent forces have been working “for years, for a lifetime” to convince the narrator to journey to the North Pole, they do not expose a hidden side of the narrator, demonstrate the narrator’s manner, or explain the amount of time the narrator has spent preparing for his expedition.

QUESTION 5

Choice A is the best answer. In lines 20-21, the narrator states that many people have perished while journeying to the North Pole: “Nobody has succeeded in this thing, and many have died.”

Choices B, C, and D are incorrect because the narrator does not indicate that previous explorers have made surprising discoveries, have failed to determine the exact location of the North Pole, or had different motivations than his own.

QUESTION 6

Choice A is the best answer. In lines 20-21, the narrator provides evidence that many previous explorers seeking the North Pole have perished in the attempt: “Nobody has succeeded in this thing, and many have died.”

Choices B, C, and D do not mention previous explorers; therefore, these lines do not provide the best evidence that explorers died while seeking the North Pole.

QUESTION 7

Choice B is the best answer. In lines 27-39, the narrator states that he is “intent” on traveling to the North Pole but acknowledges that the journey is absurd: “Who wants the North Pole! What good is it! Can you eat it? Will it carry you from Gothenburg to Malmö like a railway?” By asking these questions, the narrator recognizes that the North Pole has no practical value. Still, the narrator admits that finding the North Pole is necessary, as it “must nevertheless be sought for.”

Choices A, C, and D are incorrect because the narrator does not view his expedition to the North Pole as immoral, socially beneficial, or scientifically important.

QUESTION 8

Choice D is the best answer. In lines 27-31, the narrator asks a series of rhetorical questions about the North Pole: “Who wants the North Pole! What good is it! Can you eat it? Will it carry you from Gothenburg to Malmö like a railway?” In this context, the narrator is suggesting that reaching the North Pole has no foreseeable benefit or value to humanity; unlike trains that bring travelers to specific destinations, the North Pole does not provide humans with a specific benefit or form of convenience.

Choices A, B, and C are incorrect because the question posed in lines 30-31 does not debate modes of travel, examine the proximity of cities that can be reached by trains, or question how often people travel.

QUESTION 9

Choice D is the best answer. In lines 48-49, the narrator states that the North Pole “is an abstraction, a mathematical fiction” and that “no one but a Swedish madman could take the slightest interest in it.” In this context, the narrator is stating that people would not “take the slightest interest in,” or be curious about, the North Pole.

Choices A, B, and C are incorrect because in this context, “take the slightest interest in” does not mean to accept responsibility for, to possess little regard for, or to pay no attention to something.

QUESTION 10

Choice A is the best answer. In lines 49-51, the narrator describes his balloon journey toward the North Pole: “The wind is still from the south, bearing us steadily northward at the speed of a trotting dog.” In this context, the wind is “bearing,” or carrying, the narrator in a direction to the North.

Choices B, C, and D are incorrect because in this context, “bearing” does not mean affecting, yielding, or enduring.

QUESTION 11

Choice C is the best answer. The author states that “demographic inversion is not a proxy for population growth” (lines 32-33). In other words, demographic inversion is distinct from population growth. The author also notes that demographic inversion is evident in many American cities, as it “can occur in cities that are growing, those whose numbers are flat, and even in those undergoing a modest decline in size” (lines 33-35).

Choices A, B, and D are incorrect because they do not summarize the first paragraph.

QUESTION 12

Choice D is the best answer. The author notes that one of “the most powerful demographic events of the past decade [was] the movement of African Americans out of central cities” (lines 14-17).

Choices A, B, and C are incorrect because the author does not state that the unemployed, immigrants, or young professionals moved away from central-city areas in large numbers in the early 2000s.

QUESTION 13

Choice A is the best answer. The author states that democratic inversion “can occur in cities that are growing, those whose numbers are flat, and even in those undergoing a modest decline in size” (lines 33-35). In this context, cities whose “numbers,” or population size, are “flat” have static, or unchanging, populations.

Choices B, C, and D are incorrect because in this context, “flat” does not mean deflated, featureless, or obscure.

QUESTION 14

Choice B is the best answer. The author states that many major American cities are currently experiencing economic hardship, or “enormous fiscal problems,” because of “public pension obligations they incurred in the more prosperous years of the past two decades” (lines 36-39). The author then provides the example of Chicago, a city that can no longer afford to pay the “public services to which most of [its] citizens have grown to feel entitled” (lines 41-43). The author is arguing that many major American cities face economic hardship due to past promises (such as public services) they made to their constituents.

Choices A, C, and D are incorrect because the passage does not discuss expected tax increases, an inner-city tax base, or manufacturing production as they relate to the financial status of many major American cities.

QUESTION 15

Choice A is the best answer. In lines 36-39, the author provides evidence that many major American cities are currently experiencing economic hardship due to promises made in past years: “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.” America’s major cities made past promises, such as “public pension obligations,” to their citizens, which caused their current financial situation.

Choices B, C, and D are incorrect because they do not provide evidence that many major American cities are currently experiencing economic hardship due to promises made in past years.

QUESTION 16

Choice C is the best answer. The author explains how sociologist Ernest W. Burgess determined that urban areas have a traditional four-zone structure (lines 54-63). He then states that Burgess was “right about the urban America of 1974” (line 65) as it also followed the traditional four-zone structure: “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; and it had residential suburbs for the wealthy and the upper middle class at the far end of the continuum” (lines 66-71).

Choices A, B, and D are incorrect because the passage does not imply that American cities in 1974 were witnessing the flight of minority populations to the suburbs, had begun to lose their manufacturing sectors, or were already experiencing demographic inversion.

QUESTION 17

Choice C is the best answer. In lines 66-71, the author provides evidence that American cities in 1974 had a traditional four-zone structure: “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; and it had residential suburbs for the wealthy and the upper middle class at the far end of the continuum.”

Choices A, B, and D are incorrect because they do not provide evidence that American urban cities in 1974 had a traditional four-zone structure. Choice A references a seminal paper on the layout of American cities, choice B identifies Burgess’s original theory, and choice D focuses on movement to the suburbs.

QUESTION 18

Choice A is the best answer. In lines 66-68, the author notes that American cities in 1974 each had a “downtown, where the commercial life of the metropolis was conducted.” In this context, the author is stating that these cities “conducted,” or carried out, business, the “commercial life,” in downtown areas.

Choices B, C, and D are incorrect because in this context, “conducted” does not mean supervised, regulated, or inhibited.

QUESTION 19

Choice B is the best answer. Chart 1 shows the percentage of the US population in 2010 that lived in non-metro, small metro, and large metro areas. While the author cites census numbers, he notes that “when it comes to measuring demographic inversion, raw census numbers are an ineffective blunt instrument” (lines 11-13). Census data refer to the number of people living in a specific area

and the demographic information that's been collected on them. The author would most likely consider the information in chart 1 to be possibly accurate but an "ineffective blunt instrument" that's not truly informative.

Choices A and C are incorrect because the author would not consider census data to be excellent or compelling. Choice D is incorrect because while the author does not believe the census completely explains demographic inversion, he would be unlikely to disagree with the census data.

QUESTION 20

Choice A is the best answer. Chart 2 shows that the growth of all metropolitan areas in the 1990s was higher than the growth in all metropolitan areas in the 2000s: large metro areas experienced a growth of 14.3% in the 1990s versus a growth of 10.9% in the 2000s, small metro areas experienced a growth of 13.1% in the 1990s versus a growth of 10.3% in the 2000s, and non-metro areas experienced a growth of 9.0% in the 1990s versus a growth of 4.5% in the 2000s.

Choices B, C, and D are incorrect because they do not accurately characterize the US growth rate by metro size from 2000-2010 as illustrated in chart 2.

QUESTION 21

Choice D is the best answer. Chart 2 shows that in the 1990s the US population increased in large metro, small metro, and non-metro areas when compared to the population growth experienced in the 1980s. Large metro areas experienced a growth of 12.5% in the 1980s versus a growth of 14.3% in the 1990s, small metro areas experienced a growth of 8.8% in the 1980s versus a growth of 13.1% in the 1990s, and non-metro areas experienced a growth of 1.8% in the 1980s versus a growth of 9.0% in the 1990s. Given this information, the population grew more in all metro areas in the 1990s when compared to the growth of those areas in the 1980s.

Choices A, B, and C are incorrect because they do not draw an accurate conclusion about the US growth rate in the 1990s.

QUESTION 22

Choice A is the best answer. Lines 9-11 introduce the focus of the passage: "Welcome to the world of 'pharming,' in which simple genetic tweaks turn animals into living pharmaceutical factories." The passage then discusses the chronological development of "pharming," and describes ATryn, a useful drug produced after decades of laboratory experiments.

Choices B and C are incorrect because the passage does not primarily evaluate research or summarize long-term research findings. Choice D is incorrect because "pharming" is not a branch of scientific study.

QUESTION 23

Choice C is the best answer. The author is appreciative of pharming and describes it as turning “animals into living pharmaceutical factories” (lines 10-11). She expresses a positive view of pharming in line 70, when she describes its end result: “*Et voilà* — human medicine!”

Choices A, B, and D are incorrect because the author’s attitude about pharming is not accurately characterized as one of fear, disinterest, or surprise.

QUESTION 24

Choice C is the best answer. In lines 19-21, the author explains that dairy animals are “expert,” or capable, “protein producers.”

Choices A, B, and D are incorrect because in this context “expert” does not mean knowledgeable, professional, or trained.

QUESTION 25

Choice B is the best answer. In line 36, the author explains that the initial transgenic studies were “lab-bound thought experiments come true.” Those first studies, in other words, were considered to be of theoretical value only. They were not expected to yield products ready for human use.

Choices A and D are incorrect because the cost of animal research and the molecular properties of certain animals are not discussed in the passage. Choice C is incorrect because the passage does not suggest that all of the transgenic studies were focused on anticoagulants.

QUESTION 26

Choice C is the best answer. In lines 35-36, the author provides evidence that the transgenic studies done in the 1980s and 1990s were not expected to yield products ready for human use. The author explains that the initial transgenic studies were “merely gee-whiz, scientific geekery, lab-bound thought experiments come true.”

Choices A, B, and D are incorrect because they do not provide evidence that the transgenic studies done in the 1980s and 1990s were not expected to yield products ready for human use. Choices A and B do not address the transgenic studies, and choice D focuses on ATryn, a drug that was intended for human use.

QUESTION 27

Choice A is the best answer. Lines 42-44 explain that ATryn “acts as a molecular bouncer, sidling up to clot-forming compounds and escorting them out of the bloodstream.” Antithrombin can thus be seen as an agent that reduces the amount of dangerous clots in the bloodstream.

Choices B, C, and D are incorrect because the passage does not suggest that antithrombin stems from a rare genetic mutation, is a sequence of DNA, or occurs naturally in goats' mammary glands.

QUESTION 28

Choice B is the best answer. Lines 42-44 provide evidence that antithrombin reduces compounds that lead to blood clots, as it acts as a “molecular bouncer, sidling up to clot-forming compounds and escorting them out of the bloodstream.”

Choices A, C, and D do not provide evidence that antithrombin reduces compounds that lead to blood clots; these lines describe proteins, people unable to produce antithrombin, and the production of ATryn.

QUESTION 29

Choice B is the best answer. In lines 60-62, the description of female goats' kids mentions that “some of them proved to be transgenic, the human gene nestled safely in their cells.” The statement “some of them” indicates that while a number of the newborn goats were transgenic, others were not.

Choices A, C, and D are incorrect because the passage does not suggest that the female goats used in the initial experiment secreted antithrombin in their milk after giving birth, were the first animals to receive the microinjections, or had cells that contained genes usually found in humans.

QUESTION 30

Choice D is the best answer. In lines 63-64, the parenthetical is added after the phrase “a promoter,” which is “(. . . a sequence of DNA that controls gene activity).” The parenthetical's purpose is to define the term “promoter.”

Choices A, B, and C are incorrect because they do not correctly identify the purpose of the parenthetical information in lines 63-64.

QUESTION 31

Choice D is the best answer. Gold is a valuable element that commands high prices, so calling something “liquid gold” implies that it has great value. Because the pharmaceutical company GTC was producing the drug in order to sell it, it can be inferred that describing ATryn as “liquid gold” means it proved to be a lucrative product for GTC.

Choices A, B, and C are incorrect because the phrase “liquid gold” does not refer to the microinjection technique, efficiency in dairy production, or transgenic goats being beneficial to dairy farmers.

QUESTION 32

Choice D is the best answer. In lines 25-29, Burke describes the contract between a person and society as one that 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.”

Describing that contract as a partnership in all things indicates its seriousness, while describing it as not being a “temporary and perishable nature” implies its permanence.

Choice A is incorrect because line 27 states that the contract between a person and society is not “temporary or perishable,” meaning it is not brief. Choices B and C are incorrect because the passage does not compare the contracts in terms of complexity or precision.

QUESTION 33

Choice D is the best answer. In lines 1-9, Burke explains that people have “consecrated the state” to “avoid . . . the evils of inconstancy and versatility,” and that people should examine “the faults of the state . . . with pious awe and trembling solitude.” Burke then explains that society is taught to “look with horror on those children of their country who want to hack that aged parent in pieces” (lines 10-12). Burke is arguing that children want to revise the state, or “this aged parent,” by amending its faults. In this context, “state” refers to a political entity, or government, that attempts to protect its citizens from “the evils of inconstancy and versatility.”

Choices A, B, and C are incorrect because in this context, “state” does not mean style of living, position in life, or temporary condition.

QUESTION 34

Choice A is the best answer. In lines 17-29, Burke argues that “subordinate contracts,” are simply business agreements over traded goods, while the state is not merely “a partnership agreement in a trade . . . or some other such low concern . . . but a partnership in all science; a partnership in all art; a partnership in every virtue, and in all perfection.” In this context, Burke is stating that the state is not a contract consisting of “low” or petty concerns.

Choices B, C, and D are incorrect because in this context, “low” does not mean weak, inadequate, or depleted.

QUESTION 35

Choice D is the best answer. In lines 41-43, Paine asserts that “Every age and generation must be as free to act for itself, *in all cases*, as the ages and generations which preceded it.” He later states that deceased citizens of a state should no longer have “any authority in directing who shall be its governors, or how its government shall be organized,

or how administered” (lines 61-63). Paine doesn’t believe, in other words, that the decisions of previous generations should dictate the conditions of modern life and government.

Choices A, B, and C are incorrect because they do not accurately characterize the way Paine views historical precedents.

QUESTION 36

Choice B is the best answer. In lines 30-34, Burke describes societal contracts as long-term agreements that preserve the interests of past generations and link the living and the dead into a “partnership.” Paine, however, states that past generations have no “control” over the decisions made by living (line 71) because the dead have “no longer any participation in the concerns of this world” (lines 59-60).

Choices A, C, and D are incorrect because they do not accurately characterize how Paine would respond to Burke’s claim that societal contracts link past and current generations.

QUESTION 37

Choice D is the best answer. Lines 67-72 provide the best evidence that Paine would respond to Burke’s statement that society is a “partnership” between past and current generations (lines 30-34) with the explanation that the current generation cannot know what judgments the dead would make about contemporary issues. In these lines Paine explains: “What possible obligation, then, can exist between them; what rule or principle can be laid down, that two nonentities, the one out of existence, 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?”

Choices A, B, and C are incorrect because the lines cited do not provide the best evidence that Paine would respond to Burke’s statement that society is a “partnership” between past and current generations (lines 30-34) by arguing that the current generation cannot know what judgments the dead would make about contemporary issues.

QUESTION 38

Choice D is the best answer. Paine concludes Passage 2 with the argument that because social issues change over time, the living should not try to adhere to decisions made by former generations (lines 73-80). Burke, however, states that living citizens exist within a “universal kingdom” (line 35) comprised of the living, the dead, and those who are not yet born. Burke argues that the living do not have the right to change their government based on “their speculations of a contingent improvement” (lines 36-37). Therefore, Burke would

disapprove of Paine's concluding argument, as he believes the living do not have sufficient justification for changing the existing governmental structure.

Choices A, B, and C are incorrect because they do not accurately describe how Burke would likely have responded to Paine's remarks in the final paragraph of Passage 2.

QUESTION 39

Choice D is the best answer. Lines 34-38 provide the best evidence that Burke would disapprove of Paine's remarks in the final paragraph of Passage 2: "The municipal corporations of that universal kingdom are not morally at liberty at [the living's] pleasure, and on their speculations of a contingent improvement, wholly to separate and tear asunder the bands of their subordinate community." In these lines, Burke is arguing that the living do not have sufficient justification to change the existing governmental structure.

Choices A, B, and C do not provide the best evidence that Burke would disapprove of Paine's remarks in the final paragraph of Passage 2, as Burke believes the living do not have sufficient justification for changing the existing governmental structure.

QUESTION 40

Choice A is the best answer. The primary argument of Passage 1 is that an inviolable contract exists between a people and its government, one that is to be "looked on with other reverence" (lines 24-25). Passage 1 suggests that this contract exists between past and future generations as well; in effect, current and future generations should be governed by decisions made in the past. Passage 2 challenges these points, as it argues that current and future generations are not obligated to preserve past generations' beliefs: "The Parliament or the people of 1688, or of any other period, had no more right to dispose of the 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" (lines 48-54).

Choices B, C, and D are incorrect because Passage 2 does not offer an alternative approach to Passage 1, support an idea introduced in Passage 1, or exemplify an attitude promoted in Passage 1.

QUESTION 41

Choice B is the best answer. Passage 1 argues that the government is sacred (lines 3-6) and that no person should interfere with it (lines 6-9). Passage 2 argues that people have the right to make changes to their government: "The circumstances of the world are continually

changing, and the opinions of men change also; and as government is for the living, and not for the dead, it is the living only that has any right in it” (lines 73-76).

Choices A, C, and D are incorrect because they do not identify the main purpose of both passages.

QUESTION 42

Choice C is the best answer. The author explains that a “powerful volcano” erupted around 750 years ago and caused “a centuries-long cold snap known as the Little Ice Age” (lines 1-3). The author then states that a group of scientists believe the volcano Samalas was this “powerful volcano,” and she explains how the scientists’ research supports this claim (lines 17-78).

Choices A, B, and D are incorrect because they do not identify the main purpose of the passage.

QUESTION 43

Choice B is the best answer. The author begins the passage by explaining how the Little Ice Age was a “centuries-long cold snap” that was likely caused by a volcanic eruption (lines 1-3). The author then explains how scientists used radiocarbon analysis to determine when the Little Ice Age began and how a volcanic eruption triggered the cooling temperatures (lines 17-25).

Choices A, C, and D are incorrect because the passage does not criticize a scientific model, offer a new method of measuring sulfates, or shift from the use of radiocarbon dating to an examination of volcanic glass.

QUESTION 44

Choice A is the best answer. In lines 17-25, the passage shifts focus from describing a recorded event to providing evidence that the Little Ice Age was likely caused by a volcanic eruption. The passage states that scientists used “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 when the Little Ice Age began and how it was connected to the “mystery” volcanic eruption.

Choices B, C, and D are incorrect because they do not provide the best evidence that the passage shifts focus from a description of a recorded event to its likely cause. Choices B, C, and D all focus on the scientists’ research but do not explain what caused the Little Ice Age.

QUESTION 45

Choice D is the best answer. According to lines 5-8, “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.” The phrase “is written in” reinforces the idea that the polar ice caps contain evidence of the volcanic eruption, and that scientists can interpret this evidence by examining the “sulfate deposits and tiny shards of volcanic glass.”

Choices A, B, and C are incorrect because the author does not use the phrase “is written in” to demonstrate the concept of the hands-on nature of the scientists’ work, highlight the fact that scientists often write about their work, or underscore the sense of importance scientists have about their work.

QUESTION 46

Choice A is the best answer. The scientists believe the volcano Samalas, located in Indonesia, was most likely the medieval volcanic eruption (lines 33-35). The eruption likely occurred near the equator because an equatorial location is “consistent with the apparent climate impacts” the scientists observed (lines 61-67).

Choices B, C, and D are incorrect because the scientists do not suggest that the medieval volcanic eruption was located in the Arctic region, the Antarctic region, or Ecuador.

QUESTION 47

Choice D is the best answer. In lines 61-64, the author cites geochemist Gifford Miller’s findings that provide evidence that the medieval volcanic eruption most likely occurred in Indonesia near the equator: “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.’”

Choices A, B, and C are incorrect because they do not provide evidence that the medieval volcanic eruption most likely occurred in Indonesia near the equator. Rather, choices A, B, and C focus on the medieval volcano’s power, impact, and magnitude.

QUESTION 48

Choice C is the best answer. In lines 68-71, the author states, “Another possible candidate — both in terms of timing and geographical location — is Ecuador’s Quilotoa, estimated to have last erupted between 1147 and 1320 C.E.” The phrase “another possible candidate” implies that the scientists believe that in the Middle Ages a different volcanic eruption, such as an eruption from the volcano Quilotoa, could have been responsible for the onset of the Little Ice Age.

Choices A, B, and D are incorrect because the phrase “another possible candidate” does not imply the frequency or effects of volcanic eruptions, or that some volcanoes have large calderas.

QUESTION 49

Choice D is the best answer. In lines 71-75, the author explains how Lavigne’s team proved that Quilotoa’s eruption did not cause the Little Ice Age:

“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, whereas the Samalas glass is a much closer match.” These findings show that Samalas, not Quilotoa, was responsible for the onset of the Little Ice Age.

Choices A, B, and C are incorrect because they focus on the difficulty of identifying the volcano responsible for the Little Ice Age, the magnitude of the volcanic eruption, and the researchers’ experiment.

QUESTION 50

Choice C is the best answer. The data in the figure show the greatest below-average temperature variation occurred in 1675 CE, as the temperature reached a variation of -1.0° Celsius.

Choice A is incorrect because the figure shows that the temperature in 1200 CE was above average ($+0.25^{\circ}$ Celsius). Choices B and D are incorrect because the below-average temperature variation reported in 1675 CE (at -1.0° Celsius) was greater than the below-average temperature variation reported for 1375 CE (around -0.25° Celsius) and 1750 CE (around -0.5° Celsius).

QUESTION 51

Choice B is the best answer. The passage says that the Little Ice Age began “about 750 years ago” (line 1) and that “the cold summers and ice growth began abruptly between 1275 and 1300 C.E.” (lines 23-24). The figure indicates that average temperatures in central England began to drop around 1275 CE, and this drop in temperatures continued “through the 1700s” (line 32).

Choices A, C, and D are incorrect because the passage and figure do not indicate that the Little Ice Age began around 1150 CE, just before 1500 CE, or around 1650 CE.

QUESTION 52

Choice A is the best answer. The figure shows that the greatest cooling period of the Little Ice Age occurred between 1500 and 1700 CE; it also shows that the greatest warming period of the Medieval Warm Period occurred between 1150 and 1250 CE. Therefore, the Little Ice Age’s greatest cooling occurred a couple of centuries, or “hundreds of years,” after the temperature peaks of the Medieval Warm Period.

Choices B, C, and D are incorrect because the figure does not focus on equatorial volcanic eruptions, pyroclastic flows, or radiocarbon analysis.

Section 2: Writing and Language Test

QUESTION 1

Choice B is the best answer because the relative clause appropriately modifies the noun “work” in the preceding independent clause.

Choices A, C, and D are incorrect because each creates a comma splice.

QUESTION 2

Choice B is the best answer because it creates the appropriate contrasting transition from the fact that the first two panels were painted during the day to the fact that the third panel was painted at night.

Choices A, C, and D are incorrect because each creates an inappropriate transition from the previous sentence. Choice A and choice D imply addition rather than contrast. Choice C results in an incomplete sentence.

QUESTION 3

Choice B is the best answer because it creates an appropriate appositive to the subject “mural,” and is correctly set off by commas on both sides.

Choices A, C, and D are incorrect because each is incorrectly punctuated. Choice A lacks a comma after “centerpiece,” choice C unnecessarily introduces an independent clause, and choice D contains an em dash that has no parallel earlier in the sentence.

QUESTION 4

Choice A is the best answer because it explicitly introduces the explanation for the behavior (painting at night) described in the previous paragraph.

Choices B, C, and D are incorrect because none alludes to the artist’s painting at night, which is described at the end of the previous paragraph and explained in this paragraph.

QUESTION 5

Choice D is the best answer because it refers to an action that can be performed on a physical object such as a mural.

Choices A, B, and C are incorrect because each refers to an action that is performed on information rather than on a physical object.

QUESTION 6

Choice B is the best answer because it creates a past tense construction consistent with the verb “was dominated.”

Choices A, C, and D are incorrect because none is consistent with the verb tense established earlier in the sentence.

QUESTION 7

Choice D is the best answer because it is the most precise choice, specifying the noun that the demonstrative pronoun “this” refers to.

Choices A, B, and C are incorrect because each provides a vague, nonspecific pronoun that does not concretely define a referent.

QUESTION 8

Choice B is the best answer because it correctly places and punctuates the appositive phrase that describes the “Chicano mural movement.”

Choices A, C, and D are incorrect because each contains awkward syntax that obscures the relationship between the key noun phrases “an explosion of mural painting” and “the Chicano mural movement.”

QUESTION 9

Choice C is the best answer because it creates parallel construction within the list of locations (“*in* abandoned lots, *on* unused buildings, or *on* infrastructure”).

Choices A, B, and D are incorrect because none follows the construction established within the list of locations.

QUESTION 10

Choice A is the best answer because it alludes to the uniquely high level of investment, described in the next sentence, that the new group of artists is making in restoring and publicizing “América Tropical.”

Choices B, C, and D are incorrect because each fails to express the connection between the general restoration efforts mentioned in the previous sentence and the specific role of “América Tropical” in these efforts, which is described in the next sentence.

QUESTION 11

Choice C is the best answer because details of the initial reaction to Siqueiros’s mural and its subsequent rediscovery are given previously in the passage and are not needed to set up the forward-looking sentence that follows.

Choices A, B, and D are incorrect because each provides an inaccurate interpretation of the sentence that the writer is considering adding.

QUESTION 12

Choice D is the best answer because without the underlined portion, the sentence contains an appropriate parallel contrast between the phrases “organically grown crops” and “conventionally grown counterparts,” each of which describes crops.

Choices A, B, and C are incorrect because each creates an illogical comparison: crops to “people,” crops to “purchase,” and crops to “purchasing.”

QUESTION 13

Choice B is the best answer because it provides the subject “consumers,” creating a complete sentence and providing a referent for the pronoun “they” that appears later in the sentence.

Choices A, C, and D are incorrect because each lacks the subject that the sentence requires and none provide a referent for “they.”

QUESTION 14

Choice D is the best answer because it efficiently creates a contrast with “organically grown.”

Choices A, B, and C are incorrect because they are unnecessarily wordy and repeat information given in previous sentences.

QUESTION 15

Choice C is the best answer because it sets up the contrast between the added expense of organic food and the evidence that suggests a lack of benefits from eating organic food.

Choices A, B, and D are incorrect because each fails to acknowledge the contrast between the last sentence in the paragraph and the previous sentences.

QUESTION 16

Choice C is the best answer because “maintain” is commonly used to describe advocating a position in an argument.

Choices A, B, and D are incorrect because none is appropriate in the context of describing an opinion advocated by a group of people.

QUESTION 17

Choice A is the best answer because the transitional phrase “For instance” sets up an example supporting the point, made in the previous sentence, that organic food may not contain more vitamins and minerals than conventionally grown food.

Choices B, C, and D are incorrect because none indicates that the sentence is providing an example supporting the point made in the previous sentence.

QUESTION 18

Choice C is the best answer because it accurately identifies the reason that the writer should not add the proposed sentence: the paragraph is about evidence of nutritional content, not the availability of organic food.

Choices A, B, and D are incorrect because each provides an inaccurate interpretation of the proposed sentence’s relationship to the passage.

QUESTION 19

Choice A is the best answer because the plural verb “have” is consistent with the plural subject “amounts.”

Choices B, C, and D are incorrect because each is a singular verb, which is inconsistent with the plural subject “amounts.”

QUESTION 20

Choice C is the best answer because the example it supplies, that pesticides can be minimized by washing or peeling produce, supports the claim that nonorganic food is safe.

Choices A, B, and D are incorrect because none supports the paragraph’s claim about the safety of nonorganic food.

QUESTION 21

Choice B is the best answer because the plural noun phrase “numerous other reasons” must be preceded by a plural verb and a pronoun that does not indicate possession: “there are.”

Choices A, C, and D are incorrect because each contains the singular verb “is,” the possessive pronoun “their,” or both.

QUESTION 22

Choice D is the best answer because a nonrestrictive clause must be preceded by a comma; in addition, “such as” is never followed by a comma. In this case, the list of reasons supporting the claim that there are benefits to buying organic food is nonrestrictive; the list tells the reader something about organic food but does not restrict or place limits on organic food.

Choices A, B, and C are incorrect because each places erroneous punctuation after the phrase “such as.” Choices B and C also lack the necessary comma preceding “such as.”

QUESTION 23

Choice C is the best answer because “intriguing” conveys a realistic level of interest for the entertaining but ultimately inconsequential question of regional differences in words for carbonated beverages.

Choices A, B, and D are incorrect because each mocks the topic of regional words for carbonated beverages.

QUESTION 24

Choice C is the best answer because “but also” is the appropriate transition to complete the correlative pair “not only . . . but also,” which begins earlier in the sentence.

Choices A, B, and D are incorrect because each fails to complete the phrase “not only . . . but also.”

QUESTION 25

Choice B is the best answer because it is consistent with the fact that there remains a “veritable army of trained volunteers traveling the country” and because it uses “still” to contrast this method with the “new avenues.”

Choices A, C, and D are incorrect because none is consistent with the information contained later in the passage.

QUESTION 26

Choice D is the best answer because it uses the relative pronoun “who” to avoid needless repetition of the word “scholars.”

Choices A, B, and C are incorrect because each unnecessarily repeats the word “scholars.”

QUESTION 27

Choice C is the best answer because the new sentence provides a logical transition from sentences 3 and 4, which describe the data collection, to sentence 5, which explains that completing the dictionary took far longer than expected.

Choices A, B, and D are incorrect because each fails to create a logical transition between the preceding and subsequent sentences.

QUESTION 28

Choice A is the best answer because the singular verb “requires” agrees with the singular subject “research.”

Choices B, C, and D are incorrect because they do not create subject-verb agreement.

QUESTION 29

Choice D is the best answer because a colon is the correct punctuation to introduce the elaborating phrase that follows the word “army.”

Choices A, B, and C are incorrect because none provides the appropriate punctuation.

QUESTION 30

Choice B is the best answer because it contains both the correct word to refer to an Internet location — “site” — and the correct preposition to complete the collocation “in search of.”

Choices A, C, and D are incorrect because each contains a word that does not refer to an Internet location, and choices C and D contain the wrong preposition.

QUESTION 31

Choice C is the best answer because it correctly associates each beverage term with the region described in the sentence according to the information contained in the map.

Choices A, B, and D are incorrect because each contradicts the information contained in the map.

QUESTION 32

Choice B is the best answer because it contains the two plural possessive pronouns needed to refer to the subject “findings” — “their” and “their.”

Choices A, C, and D are incorrect because each contains a word frequently confused with “their.”

QUESTION 33

Choice A is the best answer because it provides a summary and evaluation of gathering data from the Internet, which is the focus of the paragraph.

Choices B, C, and D are incorrect because each is either irrelevant to the main point of the paragraph or unnecessarily repeats information.

QUESTION 34

Choice C is the best answer because it uses the present tense, which is consistent with the verbs that appear later in the sentence.

Choices A, B, and D are incorrect because they create awkward shifts in tense.

QUESTION 35

Choice C is the best answer because the em dashes correctly bracket the examples of the types of elements.

Choices A, B, and D are incorrect because each uses either inconsistent or incorrect punctuation to set off the types of elements.

QUESTION 36

Choice B is the best answer because a period is an appropriate way to separate the two independent clauses that meet at the underlined text.

Choices A, C, and D are incorrect because each either creates a comma splice or lacks necessary punctuation.

QUESTION 37

Choice D is the best answer because the proposed sentence to be added is a paraphrase of the sentence before it, containing the same ideas.

Choices A, B, and C are incorrect because none fully acknowledges the relationship between the proposed sentence to be added and the other sentences in the paragraph.

QUESTION 38

Choice A is the best answer because it highlights the importance of the game designer's communication with others, which is the paragraph's main point.

Choices B, C, and D are incorrect because none describes communication originating with the game designer, which is the main focus of the paragraph.

QUESTION 39

Choice C is the best answer because the importance of communication is established in the previous sentences. The transition "consequently" best captures the fact that the designer must be skilled in this area.

Choices A, B, and D are incorrect because each contains a transition that either repeats information or creates an illogical relationship between this sentence and the previous sentences.

QUESTION 40

Choice B is the best answer because it provides the singular nouns "writer" and "speaker" to agree with the singular pronoun "anyone."

Choices A, C, and D are incorrect because none creates pronoun-referent agreement.

QUESTION 41

Choice D is the best answer because it expresses in the clearest, simplest way the idea that many game designers start out as programmers.

Choices A, B, and C are incorrect because each is unnecessarily wordy and obscures meaning.

QUESTION 42

Choice D is the best answer because it logically and appropriately modifies the phrase "collaboration skills."

Choices A, B, and C are incorrect because none appropriately describes the value of collaboration skills.

QUESTION 43

Choice A is the best answer because it provides a logical subject for the modifying phrase "demanding and deadline driven."

Choices B, C, and D are incorrect because each creates a dangling modifier.

QUESTION 44

Choice B is the best answer because sentence 5 expresses the main point upon which the paragraph elaborates.

Choices A, C, and D are incorrect because none places sentence 5 in the appropriate position to set up the details contained in the paragraph.

Section 3: Math Test – No Calculator

QUESTION 1

Choice A is correct. The expression $|x - 1| - 1$ will equal 0 if $|x - 1| = 1$. This is true for $x = 2$ and for $x = 0$. For example, substituting $x = 2$ into the expression $|x - 1| - 1$ and simplifying the result yields $|2 - 1| - 1 = |1| - 1 = 1 - 1 = 0$. Therefore, there is a value of x for which $|x - 1| - 1$ is equal to 0.

Choices B, C, and D are incorrect. By definition, the absolute value of any expression is a nonnegative number. For example, in answer choice B, substituting any value for x into the expression $|x + 1|$ will yield a nonnegative number. Because the sum of a nonnegative number and a positive number is positive, $|x + 1| + 1$ will be a positive number for any value of x . Therefore, $|x + 1| + 1 \neq 0$ for any value of x . Similarly, the expressions given in answer choices C and D are not equivalent to zero for any value of x .

QUESTION 2

Choice A is correct. Since $f(x) = \frac{3}{2}x + b$ and $f(6) = 7$, substituting 6 for x in $f(x) = \frac{3}{2}x + b$ gives $f(6) = \frac{3}{2}(6) + b = 7$. Then, solving the equation $\frac{3}{2}(6) + b = 7$ for b gives $\frac{18}{2} + b = 7$, or $9 + b = 7$. Thus,

$b = 7 - 9 = -2$. Substituting -2 for the constant b gives

$f(x) = \frac{3}{2}x - 2$; therefore, one can evaluate $f(-2)$ by substituting -2

for x : $\frac{3}{2}(-2) - 2 = -\frac{6}{2} - 2 = -3 - 2 = -5$.

Choice B is incorrect as it is the value of b , not of $f(-2)$. Choice C is incorrect as it is the value of $f(2)$, not of $f(-2)$. Choice D is incorrect as it is the value of $f(6)$, not of $f(-2)$.

QUESTION 3

Choice A is correct. The first equation can be rewritten as $x = 6y$. Substituting $6y$ for x in the second equation gives $4(y + 1) = 6y$. The left-hand side can be rewritten as $4y + 4$, giving $4y + 4 = 6y$. Subtracting $4y$ from both sides of the equation gives $4 = 2y$, or $y = 2$.

Choices B, C, and D are incorrect and may be the result of a computational or conceptual error when solving the system of equations.

QUESTION 4

Choice B is correct. If $f(x) = -2x + 5$, then one can evaluate $f - 3x$ by substituting $-3x$ for every instance of x . This yields $f - 3x = -2(-3x + 5)$, which simplifies to $6x + 5$.

Choices A, C, and D are incorrect and may be the result of miscalculations in the substitution or of misunderstandings of how to evaluate $f - 3x$.

QUESTION 5

Choice C is correct. The expression $3(2x + 1)(4x + 1)$ can be simplified by first distributing the 3 to yield $(6x + 3)(4x + 1)$, and then multiplying the binomials together to obtain $24x^2 + 12x + 6x + 3$. Combining like terms gives $24x^2 + 18x + 3$.

Choice A is incorrect and may be the result of performing the multiplication of $3(2x + 1)(4x + 1)$ to result in $24x^2 + 18x + 3$, then incorrectly combining terms to result in $45x$. Choice B is incorrect and may be the result of correctly finding $(6x + 3)(4x + 1)$, but then multiplying only the first terms, $(6x)(4x)$, and the last terms, $(3)(1)$, but not the outer or inner terms, $(6x)(1)$ and $(3)(4x)$. Choice D is incorrect and may be the result of incorrectly distributing the 3 to both $(2x + 1)$ and $(4x + 1)$ to obtain $(6x + 3)(12x + 3)$, and then adding $3 + 3$ and $6x + 12x$ and incorrectly adding the exponents of x .

QUESTION 6

Choice B is correct. The equation $\frac{a-b}{b} = \frac{3}{7}$ can be rewritten as $\frac{a}{b} - \frac{b}{b} = \frac{3}{7}$, from which it follows that $\frac{a}{b} - 1 = \frac{3}{7}$, or $\frac{a}{b} = \frac{3}{7} + 1 = \frac{10}{7}$.

Choices A, C, and D are incorrect and may be the result of calculation errors in rewriting $\frac{a-b}{b} = \frac{3}{7}$. For example, choice A may be the result of a sign error in rewriting $\frac{a-b}{b}$ as $\frac{a}{b} + \frac{b}{b} = \frac{a}{b} + 1$.

QUESTION 7

Choice D is correct. In Amelia's training schedule, her longest run in week 16 will be 26 miles and her longest run in week 4 will be 8 miles. Thus, Amelia increases the distance of her longest run by 18 miles over the course of 12 weeks. Since Amelia increases the distance of her longest run each week by a constant amount, her rate of increase is $\frac{26 - 8}{16 - 4} = \frac{18}{12}$ miles per week, which is equal to 1.5 miles per week. So each week she increases the distance of her longest run by 1.5 miles.

Choices A, B, and C are incorrect because none of these training schedules would result in increasing Amelia's longest run from 8 miles in week 4 to 26 miles in week 16. For example, choice A is incorrect because if Amelia increases the distance of her longest run by 0.5 miles each week and has her longest run of 8 miles in week 4, her longest run in week 16 would be $8 + 0.5 \cdot 12 = 14$ miles, not 26 miles.

QUESTION 8

Choice A is correct. For an equation of a line in the form $y = mx + b$, the constant m is the slope of the line. Thus, the line represented by $y = -3x + 4$ has slope -3 . Lines that are parallel have the same slope. To determine which of the given equations represents a line with the same slope as the line represented by $y = -3x + 4$, one can rewrite each equation in the form $y = mx + b$, that is, solve each equation for y . Choice A, $6x + 2y = 15$, can be rewritten as $2y = -6x + 15$ by subtracting $6x$ from each side of the equation. Then, dividing each side of $2y = -6x + 15$ by 2 gives $y = -\frac{6}{2}x + \frac{15}{2}$, which simplifies to $y = -3x + \frac{15}{2}$. Therefore, this line has slope -3 and is parallel to the line represented by $y = -3x + 4$. (The lines are parallel, not coincident, because they have different y -intercepts.)

Choices B, C, and D are incorrect and may be the result of common misunderstandings about which value in the equation of a line represents the slope of the line.

QUESTION 9

Choice D is correct. The question states that $\sqrt{x-2} = x-4$ and that $a = 2$, so substituting 2 for a in the equation yields $\sqrt{x-2} = x-4$. To solve for x , square each side of the equation, which gives $(\sqrt{x-2})^2 = (x-4)^2$, or $x-2 = (x-4)^2$. Then, expanding $(x-4)^2$ yields $x-2 = x^2 - 8x + 16$, or $0 = x^2 - 9x + 18$. Factoring the right-hand side gives $0 = (x-3)(x-6)$, and so $x = 3$ or $x = 6$. However, for $x = 3$, the original equation becomes $\sqrt{3-2} = 3-4$, which yields $1 = -1$, which is not true. Hence, $x = 3$ is an extraneous solution that arose from squaring each side of the equation. For $x = 6$, the original equation becomes $\sqrt{6-2} = 6-4$, which yields $\sqrt{4} = 2$, or $2 = 2$. Since this is true, the solution set of $\sqrt{x-2} = x-4$ is $\{6\}$.

Choice A is incorrect because it includes the extraneous solution in the solution set. Choice B is incorrect and may be the result of a calculation or factoring error. Choice C is incorrect because it includes only the extraneous solution, and not the correct solution, in the solution set.

QUESTION 10

Choice D is correct. Multiplying each side of $\frac{t+5}{t-5} = 10$ by $t-5$ gives $t+5 = 10(t-5)$. Distributing the 10 to the binomial $(t-5)$ yields $t+5 = 10t-50$. Subtracting t from each side of this equation gives $5 = 9t-50$, and then adding 50 to each side gives $55 = 9t$. Finally, dividing each side of the equation $55 = 9t$ by 9 yields $t = \frac{55}{9}$.

Choices A, B, and C are incorrect and may be the result of calculation errors or incorrectly applying the distribution property.

QUESTION 11

Choice C is correct. It is given that $x = 2y + 5$ and $y = (2x - 3)(x + 9)$. To solve the system of equations, the quantity $(2x - 3)(x + 9)$ can be substituted for y in the first equation to yield $x = 2((2x - 3)(x + 9)) + 5$, which simplifies to $x = 4x^2 + 30x - 49$ and can be rewritten as $4x^2 + 29x - 49 = 0$. The discriminant of a quadratic equation in the form $ax^2 + bx + c = 0$, where a , b , and c are constants, is $b^2 - 4ac$. The discriminant for this quadratic equation is $29^2 - 4(4)(-49)$. This is a positive number which indicates that this quadratic equation has 2 distinct roots. The roots to the quadratic equation are the two x -coordinates of the ordered pairs which satisfy the system of equations. Since no other value of x satisfies $4x^2 + 29x - 49 = 0$, there are no other ordered pairs that satisfy the given system. Therefore, there are 2 ordered pairs (x, y) that satisfy the given system of equations.

Choices A and B are incorrect and may be the result of either a miscalculation or a conceptual error. Choice D is incorrect because a system of one quadratic equation and one linear equation cannot have infinitely many solutions.

QUESTION 12

Choice C is correct. Since the price of Ken's sandwich was x dollars, and Paul's sandwich was \$1 more, the price of Paul's sandwich was $x + 1$ dollars. Thus, the total cost of the sandwiches was $2x + 1$ dollars. Since this cost was split evenly between two people, Ken and Paul each paid $\frac{2x + 1}{2} = x + 0.5$ dollars plus a 20% tip. After adding the 20% tip, each of them paid $(x + 0.5) + 0.2(x + 0.5) = 1.2(x + 0.5) = 1.2x + 0.6$ dollars.

Choices A, B, and D are incorrect. These expressions do not model the given context. They may be the result of errors in setting up the expression or of calculation errors.

QUESTION 13

Choice B is correct. The points where the two graphs intersect can be found by setting the functions $f(x)$ and $g(x)$ equal to one another and then solving for x . This yields $8x^2 - 2 = -8x^2 + 2$. Adding $8x^2$ and 2 to each side of the equation gives $16x^2 = 4$. Then dividing each side by 16 gives $x^2 = \frac{1}{4}$; therefore, x must be either $\frac{1}{2}$ or $-\frac{1}{2}$. From the graph, the value of k is the x -coordinate of the point of intersection on the positive x -axis. Therefore, $k = \frac{1}{2}$.

Alternatively, since $(k, 0)$ lies on the graph of both f and g , it follows that $f(k) = g(k) = 0$. Thus, evaluating $f(x) = 8x^2 - 2$ at $x = k$ gives $0 = 8k^2 - 2$. Adding 2 to each side yields $2 = 8k^2$ and then dividing each side by 8 gives $\frac{1}{4} = k^2$. Therefore, the value of k must be $\frac{1}{2}$ or $-\frac{1}{2}$. From the graph, k is positive, so $k = \frac{1}{2}$.

Choices A, C, and D are incorrect and may be the result of calculation errors in solving for x or k .

QUESTION 14

Choice A is correct. To rewrite $\frac{8-i}{3-2i}$ in the standard form $a + bi$, multiply the numerator and denominator of $\frac{8-i}{3-2i}$ by the conjugate of the denominator, $3 + 2i$. This gives $\left(\frac{8-i}{3-2i}\right)\left(\frac{3+2i}{3+2i}\right) = \frac{24 + 16i - 3i + (-i)(2i)}{3^2 - 6i + 6i - (2i)^2}$. Since $i^2 = -1$, this can be rewritten as $\frac{24 + 16i - 3i + 2}{9 - (-4)} = \frac{26 + 13i}{13}$, which simplifies to $2 + i$. Therefore, when $\frac{8-i}{3-2i}$ is rewritten in the standard form $a + bi$, the value of a is 2.

Choices B, C, and D are incorrect and may be the result of errors in symbolic manipulation. For example, choice B could be the result of mistakenly rewriting $\frac{8-i}{3-2i}$ as $\frac{8}{3} + \frac{1}{2}i$.

QUESTION 15

Choice B is correct. The given quadratic equation can be rewritten as $2x^2 - kx - 4p = 0$. Applying the quadratic formula, $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$, to this equation with $a = 2$, $b = -k$, and $c = -4p$ gives the solutions $\frac{k}{4} \pm \frac{\sqrt{k^2 + 32p}}{4}$.

Choices A, C, and D are incorrect and may be the result of errors in applying the quadratic formula.

QUESTION 16

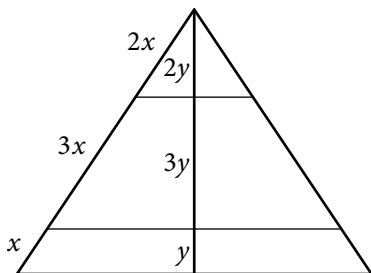
The correct answer is 9. Since the three shelves of the triangular shelf system are parallel, the three triangles in the figure are similar. Since the shelves divide the left side of the largest triangle in the ratio 2 to 3 to 1, the similarity ratios of the triangles are as follows.

- Smallest to middle: 2 to 5
- Smallest to largest: 2 to 6, or 1 to 3
- Middle to largest: 5 to 6

The height of the largest shampoo bottle that can stand upright on the middle shelf is equal to the height of the middle shelf. The height of the entire triangular shelf system is 18 inches. This is the height of the largest triangle. The height of the middle shelf is the height of the middle triangle minus the height of the smallest triangle. Since the similarity ratio of the middle triangle to the largest triangle is 5 to 6, the height of the middle triangle is $\frac{5}{6}(18) = 15$ inches. Since the similarity ratio of the smallest triangle to the largest triangle is 1 to 3,

the height of the smallest triangle is $\frac{1}{3}(18) = 6$ inches. Therefore the height of the largest shampoo bottle that can fit on the middle shelf is $15 - 6 = 9$ inches.

Alternatively, in the diagram below, the altitude of the largest triangle has been drawn and is a line segment that intersects and is perpendicular to each of the parallel lines.



Using the proportional segment theorem, it follows that the lengths of the three segments formed by the altitude are in the ratio 2:3:1 (from top to bottom). If y is the length of the shortest segment, then the lengths of the three segments are $2y$, $3y$, and y , with $3y$ being the height of the middle shelf. Since $2y + 3y + y = 18$, it follows that $3y = 9$.

QUESTION 17

The correct answer is .6 or $\frac{3}{5}$. The angles marked x° and y° are acute angles in a right triangle. Thus, they are complementary angles. By the complementary angle relationship between sine and cosine, it follows that $\sin(x^\circ) = \cos(y^\circ)$. Therefore, the cosine of y° is .6. Either .6 or the equivalent fraction $3/5$ may be gridded as the correct answer.

Alternatively, since the sine of x° is .6, the ratio of the side opposite the x° angle to the hypotenuse is .6. The side opposite the x° angle is the side adjacent to the y° angle. Thus, the ratio of the side adjacent to the y° angle to the hypotenuse, which is equal to the cosine of y° , is equal to .6.

QUESTION 18

The correct answer is 5. The four-term polynomial expression can be factored completely, by grouping, as follows:

$$(x^3 - 5x^2) + (2x - 10) = 0$$

$$x^2(x - 5) + 2(x - 5) = 0$$

$$(x - 5)(x^2 + 2) = 0$$

By the zero product property, set each factor of the polynomial equal to 0 and solve each resulting equation for x . This gives $x = 5$ or $x = \pm i\sqrt{2}$, respectively. Because the question asks for the real value of x that satisfies the equation, the correct answer is 5.

QUESTION 19

The correct answer is 0. Multiplying each side of $-3x + 4y = 20$ by 2 gives $-6x + 8y = 40$. Adding each side of $-6x + 8y = 40$ to the corresponding side of $6x + 3y = 15$ gives $11y = 55$, or $y = 5$. Finally, substituting 5 for y in $6x + 3y = 15$ gives $6x + 3(5) = 15$, or $x = 0$.

QUESTION 20

The correct answer is 25. In the mesosphere, an increase of 10 kilometers in the distance above Earth results in a decrease in the temperature by k° Celsius where k is a constant. Thus, the temperature in the mesosphere is linearly dependent on the distance above Earth. Using the values provided, one can calculate the unit rate of change

for the temperature in the mesosphere to be $\frac{-80 - (-5)}{80 - 50} = \frac{-75}{30} = \frac{-25}{10}$.

Therefore, within the mesosphere, if the distance above Earth increases by 1 kilometer, the temperature decreases by 2.5° Celsius. Therefore, if the distance above Earth increases by $(1 \times 10) = 10$ kilometers, the temperature will decrease by $(2.5 \times 10) = 25^\circ$ Celsius. Thus, the value of k is 25.

Section 4: Math Test – Calculator

QUESTION 1

Choice B is correct. Let m be the number of movies Jill rented online during the month. Since the monthly membership fee is \$9.80 and there is an additional fee of \$1.50 to rent each movie online, the total of the membership fee and the movie rental fees, in dollars, can be written as $9.80 + 1.50m$. Since the total of these fees for the month was \$12.80, the equation $9.80 + 1.50m = 12.80$ must be true. Subtracting 9.80 from each side and then dividing each side by 1.50 yields $m = 2$.

Choices A, C, and D are incorrect and may be the result of errors in setting up or solving the equation that represents the context.

QUESTION 2

Choice C is correct. Donald believes he can increase his typing speed by 5 words per minute each month. Therefore, in m months, he believes he can increase his typing speed by $5m$ words per minute. Because he is currently able to type at a speed of 180 words per minute, he believes that in m months, he will be able to increase his typing speed to $180 + 5m$ words per minute.

Choice A is incorrect because the expression indicates that Donald currently types 5 words per minute and will increase his typing speed by 180 words per minute each month. Choice B is incorrect because the expression indicates that Donald currently types 225 words per

minute, not 180 words per minute. Choice D is incorrect because the expression indicates that Donald will decrease, not increase, his typing speed by 5 words per minute each month.

QUESTION 3

Choice C is correct. Because there are 16 ounces in 1 pound, a 3-pound pizza weighs $3 \times 16 = 48$ ounces. One half of the pizza weighs $\frac{1}{2} \times 48 = 24$ ounces, and one-third of the half weighs $\frac{1}{3} \times 24 = 8$ ounces.

Alternatively, since $\frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$, cutting the pizza into halves and then into thirds results in a pizza that is cut into sixths. Therefore, each slice of the 48-ounce pizza weighs $\frac{1}{6} \times 48 = 8$ ounces.

Choice A is incorrect and is the result of cutting each half into sixths rather than thirds. Choice B is incorrect and is the result of cutting each half into fourths rather than thirds. Choice D is incorrect and is the result of cutting the whole pizza into thirds.

QUESTION 4

Choice B is correct. Because Nick surveyed a random sample of the freshman class, his sample was representative of the entire freshman class. Thus, the percent of students in the entire freshman class expected to prefer the Fall Festival in October is appropriately estimated by the percent of students who preferred it in the sample, 25.6%. Thus, of the 225 students in the freshman class, approximately $225 \times 0.256 = 57.6$ or about 60 students would be expected to prefer having the Fall Festival in October.

Choices A, C, and D are incorrect. These choices may be the result of misapplying the concept of percent or of calculation errors.

QUESTION 5

Choice B is correct. The density of an object is equal to the mass of the object divided by the volume of the object, which can be expressed as $\text{density} = \frac{\text{mass}}{\text{volume}}$. Thus, if an object has a density of 3 grams per milliliter and a mass of 24 grams, the equation becomes $3 \text{ grams/milliliter} = \frac{24 \text{ grams}}{\text{volume}}$. This can be rewritten as $\text{volume} = \frac{24 \text{ grams}}{3 \text{ grams/milliliter}} = 8 \text{ milliliters}$.

Choice A is incorrect and may be the result of confusing the density and the volume and setting up the density equation as $24 = \frac{3}{\text{volume}}$.

Choice C is incorrect and may be the result of a conceptual error that leads to subtracting 3 from 24. Choice D is incorrect and may be the result of confusing the mass and the volume and setting up the density equation as $24 = \frac{\text{volume}}{3}$.

QUESTION 6

Choice A is correct. Let a be the number of hours Angelica worked last week. Since Raul worked 11 more hours than Angelica, Raul worked $a + 11$ hours last week. Since they worked a combined total of 59 hours, the equation $a + (a + 11) = 59$ can represent this situation. This equation can be simplified to $2a + 11 = 59$, or $2a = 48$. Therefore, $a = 24$, and Angelica worked 24 hours last week.

Choice B is incorrect because it is the number of hours Raul worked last week. Choice C is incorrect. If Angelica worked 40 hours and Raul worked 11 hours more, Raul would have worked 51 hours, and the combined total number of hours they worked would be 91, not 59. Choice D is incorrect and may be the result of solving the equation $a + 11 = 59$ rather than $a + (a + 11) = 59$.

QUESTION 7

Choice A is correct. According to the table, of the 50 movies with the greatest ticket sales in 2012, 4 are comedy movies with a PG-13 rating. Therefore, the proportion of the 50 movies with the greatest ticket sales in 2012 that are comedy movies with a PG-13 rating is $\frac{4}{50}$, or equivalently, $\frac{2}{25}$.

Choice B is incorrect; $\frac{9}{50}$ is the proportion of the 50 movies with the greatest ticket sales in 2012 that are comedy movies, regardless of rating. Choice C is incorrect; $\frac{2}{11} = \frac{4}{22}$ is the proportion of movies with a PG-13 rating that are comedy movies. Choice D is incorrect; $\frac{11}{25} = \frac{22}{50}$ is the proportion of the 50 movies with the greatest ticket sales in 2012 that have a rating of PG-13.

QUESTION 8

Choice D is correct. The quadrants of the xy -plane are defined as follows: Quadrant I is above the x -axis and to the right of the y -axis; Quadrant II is above the x -axis and to the left of the y -axis; Quadrant III is below the x -axis and to the left of the y -axis; and Quadrant IV is below the x -axis and to the right of the y -axis. It is possible for line ℓ to pass through Quadrants II, III, and IV, but not Quadrant I, only if line ℓ has negative x - and y -intercepts. This implies that line ℓ has a negative slope, since between the negative x -intercept and the negative y -intercept the value of x increases (from negative to zero) and the value of y decreases (from zero to negative); so the quotient of the change in y over the change in x , that is, the slope of line ℓ , must be negative.

Choice A is incorrect because a line with an undefined slope is a vertical line, and if a vertical line passes through Quadrant IV, it must pass through Quadrant I as well. Choice B is incorrect because a line with a slope of zero is a horizontal line and, if a horizontal line passes

through Quadrant II, it must pass through Quadrant I as well. Choice C is incorrect because if a line with a positive slope passes through Quadrant IV, it must pass through Quadrant I as well.

QUESTION 9

Choice B is correct. According to the table, in 2012 there was a total of $14,766 + 47,896 = 62,662$ registered voters between 18 and 44 years old, and $3,453 + 11,237 = 14,690$ of them were from the Midwest region. Therefore, the probability that a randomly chosen registered voter who was between 18 and 44 years old in 2012 was from the Midwest region is $\frac{14,690}{62,662} \approx 0.234$. Of the given choices, 0.25 is closest to this value.

Choice A is incorrect; this is the probability of selecting at random a registered voter from the Midwest who is 18 to 24 years old. Choice C is incorrect; this is the probability of selecting at random a registered voter from the Midwest who is 18 to 44 years old. Choice D is incorrect and may be the result of errors made when choosing the correct proportion or in calculating the probability.

QUESTION 10

Choice A is correct. According to the graph, the animal with the longest gestation period (60 days) has a life expectancy of 3 years.

Choices B, C, and D are incorrect. All the animals that have a life expectancy of 4, 8, or 10 years have a gestation period that is shorter than 60 days, which is the longest gestation period.

QUESTION 11

Choice A is correct. The ratio of life expectancy to gestation period for the animal represented by point A is approximately $\frac{7 \text{ years}}{23 \text{ days}}$, or about 0.3 years/day, which is greater than the ratio for the animals represented by the other labeled points (the ratios for points B, C, and D, in units of years of life expectancy per day of gestation, are approximately $\frac{8}{44}$, $\frac{8}{51}$, and $\frac{10}{51}$ respectively, each of which is less than 0.2 years/day).

Choices B, C, and D are incorrect and may be the result of errors in calculating the ratio or in reading the graph.

QUESTION 12

Choice C is correct. All of the given choices are polynomials. If the graph of a polynomial function f in the xy -plane has an x -intercept at b , then $(x - b)$ must be a factor of $f(x)$. Since -3 , -1 , and 1 are each x -intercepts of the graph of f , it follows that $(x + 3)$, $(x + 1)$, and $(x - 1)$ must each be a factor of $f(x)$. Of the given equations, only the equation in choice C has these 3 factors. Therefore, only the equation in choice C could define the function f .

Choices A, B, and D are incorrect because these equations do not contain all three factors necessary in order for the graph of the polynomial function f to have x -intercepts at -3 , -1 , and 1 .

QUESTION 13

Choice C is correct. The mosquito population starts at 100 in week 0 and then is multiplied by a factor of 10 every 5 weeks. Thus, if $P(t)$ is the mosquito population after t weeks, then based on the table, $P(t) = 100 (10)^{\frac{t}{5}}$, which indicates an exponential growth relationship.

Choice A is incorrect. Increasing linearly means that the estimated population grows by the same amount every 5 weeks. According to the table, from week 0 to week 5, the estimated population grows by 900 mosquitoes, and from week 5 to week 10, it grows by 9,900 mosquitoes. Therefore, the estimated population is not increasing linearly. Choices B and C are incorrect because according to the table, the estimated population is increasing, not decreasing.

QUESTION 14

Choice D is correct. According to the given formula, the amount of money generated for a year at 5% interest, compounded monthly, is $1,000\left(1 + \frac{5}{1,200}\right)^{12}$, whereas the amount of money generated at 3% interest, compounded monthly, is $1,000\left(1 + \frac{3}{1,200}\right)^{12}$. Therefore, the difference between these two amounts, $1,000\left(1 + \frac{5}{1,200}\right)^{12} - 1,000\left(1 + \frac{3}{1,200}\right)^{12}$, shows how much additional money is generated at an interest rate of 5% than at an interest rate of 3%.

Choices A, B, and C are incorrect and may be the result of misinterpreting the given formula. For example, the expression in choice C gives how many times as much money, not how much additional money, is generated at an interest rate of 5% than at an interest rate of 3%.

QUESTION 15

Choice B is correct. The graph of $y = ax^b$, where a is positive and b is negative, would show a trend that is decreasing, but with a rate of decrease that slows as x increases. Of the scatterplots shown, only the one in choice B would be appropriately modeled by such a function.

Choice A is incorrect, as this scatterplot is appropriately modeled by a linear function. Choice C is incorrect, as this scatterplot is appropriately modeled by an increasing function. Choice D is incorrect, as this scatterplot shows no clear relationship between x and y .

QUESTION 16

Choice A is correct. The total cost y , in dollars, of buying the materials and renting the tools for x days from Store A and Store B is found by substituting the respective values for these stores from the table into the given equation, $y = M + (W + K)x$, as shown below.

$$\text{Store A: } y = 750 + (15 + 65)x = 750 + 80x$$

$$\text{Store B: } y = 600 + (25 + 80)x = 600 + 105x$$

Thus, the number of days, x , for which the total cost of buying the materials and renting the tools from Store B is less than or equal to the total cost of buying the materials and renting the tools from Store A can be found by solving the inequality $600 + 105x \leq 750 + 80x$. Subtracting $80x$ and 600 from each side of $600 + 105x \leq 750 + 80x$ and combining like terms yields $25x \leq 150$. Dividing each side of $25x \leq 150$ by 25 yields $x \leq 6$.

Choice B is incorrect. The inequality $x \geq 6$ is the number of days for which the total cost of buying the materials and renting the tools from Store B is greater than or equal to the total cost of buying the materials and renting the tools from Store A. Choices C and D are incorrect and may be the result of an error in setting up or simplifying the inequality.

QUESTION 17

Choice D is correct. The total cost, y , of buying the materials and renting the tools in terms of the number of days, x , is given as $y = M + (W + K)x$. If this relationship is graphed in the xy -plane, the slope of the graph is equal to $W + K$, which is the daily rental cost of the wheelbarrow plus the daily rental cost of the concrete mixer, that is, the total daily rental costs of the tools.

Choice A is incorrect because the total cost of the project is y . Choice B is incorrect because the total cost of the materials is M , which is the y -intercept of the graph of $y = M + (W + K)x$. Choice C is incorrect because the total daily cost of the project is the total cost of the project divided by the total number of days the project took and, since materials cost more than 0 dollars, this is not the same as the total daily rental costs.

QUESTION 18

Choice C is correct. The volume V of a right circular cylinder is given by the formula $V = \pi r^2 h$, where r is the base radius of the cylinder and h is the height of the cylinder. Since each glass has an internal diameter of 3 inches, each glass has a base radius of $\frac{3}{2}$ inches. Since the height of the milk in each glass is 6 inches, the volume of milk in each glass is $V = \pi \left(\frac{3}{2}\right)^2 6 \approx 42.41$ cubic inches. The total number of glasses Jim can pour from 1 gallon is equal to $\frac{\text{number of cubic inches in 1 gallon}}{\text{number of cubic inches in 1 glass}} = \frac{231}{42.41}$, which is approximately 5.45 glasses. Since the question asks for the largest number of full glasses Jim can pour, the number of glasses needs to be rounded down to 5.

Choices A, B, and D are incorrect and may be the result of conceptual errors or calculation errors. For example, choice D is incorrect because even though Jim can pour more than 5 full glasses, he will not have enough milk to pour a full 6th glass.

QUESTION 19

Choice A is correct. Adding 4 to each side of the inequality $3p - 2 \geq 1$ yields the inequality $3p + 2 \geq 5$. Therefore, the least possible value of $3p + 2$ is 5.

Choice B is incorrect because it gives the least possible value of $3p$, not of $3p + 2$. Choice C is incorrect. If the least possible value of $3p + 2$ were 2, then it would follow that $3p + 2 \geq 2$. Subtracting 4 from each side of this inequality would yield $3p - 2 \geq -2$. This contradicts the given inequality, $3p - 2 \geq 1$. Therefore, the least possible value of $3p + 2$ cannot be 2. Choice D is incorrect because it gives the least possible value of p , not of $3p + 2$.

QUESTION 20

Choice C is correct. Since the biomass of the lake doubles each year, the biomass starts at a positive value and then increases exponentially over time. Of the graphs shown, only the graph in choice C is of an increasing exponential function.

Choice A is incorrect because the biomass of the lake must start at a positive value, not zero. Furthermore, this graph shows linear growth, not exponential growth. Choice B is incorrect because the biomass of the lake must start at a positive value, not zero. Furthermore, this graph has vertical segments and is not a function. Choice D is incorrect because the biomass of the lake does not remain the same over time.

QUESTION 21

Choice C is correct. For a data point to be above the line $y = x$, the value of y must be greater than the value of x . That is, the consumption in 2010 must be greater than the consumption in 2000. This occurs for 3 types of energy sources shown in the bar graph: biofuels, geothermal, and wind.

Choices A, B, and D are incorrect and may be the result of a conceptual error in presenting the data shown in a scatterplot. For example, choice B is incorrect because there are 2 data points in the scatterplot that lie below the line $y = x$.

QUESTION 22

Choice B is correct. Reading the graph, the amount of wood power used in 2000 was 2.25 quadrillion BTUs and the amount used in 2010 was 2.00 quadrillion BTUs. To find the percent decrease, find the positive difference between the two amounts, divide by the earlier amount (from 2000),

and then multiply by 100: $\frac{2.25 - 2.00}{2.25} \times 100 = \frac{0.25}{2.25} \times 100 \approx 11.1$ percent.

Of the choices given, 11% is closest to the percent decrease in the consumption of wood power from 2000 to 2010.

Choices A, C, and D are incorrect and may be the result of errors in reading the bar graph or in calculating the percent decrease.

QUESTION 23

Choice B is correct. The standard deviation is a measure of how far the data set values are from the mean. In the data set for City A, the large majority of the data are in three of the five possible values, which are the three values closest to the mean. In the data set for City B, the data are more spread out, with many values at the minimum and maximum values. Therefore, by observation, the data for City B have a larger standard deviation.

Alternatively, one can calculate the mean and visually inspect the difference between the data values and the mean. For City A the mean is $\frac{1,655}{21} \approx 78.8$, and for City B the mean is $\frac{1,637}{21} \approx 78.0$. The data for City A are closely clustered near 79, which indicates a small standard deviation. The data for City B are spread out away from 78, which indicates a larger standard deviation.

Choices A, C, and D are incorrect and may be the result of misconceptions about the standard deviation.

QUESTION 24

Choice C is correct. Since segment AB is a diameter of the circle, it follows that arc ADB is a semicircle. Thus, the circumference of the circle is twice the length of arc ADB which is $2(8\pi) = 16\pi$. Since the circumference of a circle is 2π times the radius of the circle, the radius of this circle is 16π divided by 2π , which is equal to 8.

Choice A is incorrect. If the radius of the circle is 2, the circumference of the circle would be $2(2\pi)$ and the length of arc ADB would be 2π , not 8π . Choice B is incorrect. If the radius of the circle is 4, the circumference of the circle would be $2(4\pi)$ and the length of arc ADB would be 4π , not 8π . Choice D is incorrect; 16 is the length of the diameter of the circle, not of the radius.

QUESTION 25

Choice B is correct. In $f(x)$, factoring out the greatest common factor, $2x$, yields $f(x) = 2x(x^2 + 3x + 2)$. It is given that $g(x) = x^2 + 3x + 2$, so using substitution, $f(x)$ can be rewritten as $f(x) = 2x \cdot g(x)$. In the equation $p(x) = f(x) + 3g(x)$, substituting $2x \cdot g(x)$ for $f(x)$ yields $p(x) = 2x \cdot g(x) + 3 \cdot g(x)$. In $p(x)$, factoring out the greatest common factor, $g(x)$, yields $p(x) = g(x)(2x + 3)$. Because $2x + 3$ is a factor of $p(x)$, it follows that $p(x)$ is divisible by $2x + 3$.

Choices A, C, and D are incorrect because $2x + 3$ is not a factor of the polynomials $h(x)$, $r(x)$, or $s(x)$. Using the substitution $f(x) = 2x \cdot g(x)$, and factoring further, $h(x)$, $r(x)$, and $s(x)$ can be rewritten as follows:

$$h(x) = (x + 1)(x + 2)(2x + 1)$$

$$r(x) = (x + 1)(x + 2)(4x + 3)$$

$$s(x) = 2(x + 1)(x + 2)(3x + 1)$$

Because $2x + 3$ is not a factor of $h(x)$, $r(x)$, or $s(x)$, it follows that $h(x)$, $r(x)$, and $s(x)$ are each not divisible by $2x + 3$.

QUESTION 26

Choice C is correct. If $-y < x < y$, the value of x is either 0 or between $-y$ and 0 or between 0 and y , so statement I, $|x| < y$ is true. It is possible that the value of x is greater than zero, but x could be negative. For example, a counterexample to statement II, $x > 0$, is $x = -2$ and $y = 3$, yielding $-3 < -2 < 3$, so the given condition is satisfied. Statement III must be true since $-y < x < y$ implies that $-y < y$, so y must be greater than 0. Therefore, statements I and III are the only statements that must be true.

Choices A, B, and D are incorrect because each of these choices either omits a statement that must be true or includes a statement that could be false.

QUESTION 27

Choice D is correct. To interpret what the number 61 in the equation of the line of best fit represents, one must first understand what the data in the scatterplot represent. Each of the points in the scatterplot represents a large US city, graphed according to its population density (along the horizontal axis) and its relative housing cost (along the vertical axis). The line of best fit for this data represents the expected relative housing cost for a certain population density, based on the data points in the graph. Thus, one might say, on average, a city of population density x is expected to have a relative housing cost of $y\%$, where $y = 0.0125x + 61$. The number 61 in the equation represents the y -intercept of the line of best fit, in that when the population density, x , is 0, there is an expected relative housing cost of 61%. This might not have meaning within the context of the problem, in that when the population density is 0, the population is 0, so there probably wouldn't be any housing costs. However, it could be interpreted that for cities with low population densities, housing costs were likely around or above 61% (since below 61% would be for cities with negative population densities, which is impossible).

Choice A is incorrect because it interprets the values of the vertical axis as dollars and not percentages. Choice B is incorrect because the lowest housing cost is about 61% of the national average, not 61% of the highest housing cost. Choice C is incorrect because one cannot absolutely assert that no city with a low population density had housing costs below 61% of the national average, as the model shows that it is unlikely, but not impossible.

QUESTION 28

Choice D is correct. The minimum value of a quadratic function appears as a constant in the vertex form of its equation, which can be found from the standard form by completing the square. Rewriting $f(x) = (x + 6)(x - 4)$ in standard form gives $f(x) = x^2 + 2x - 24$. Since the coefficient of the linear term is 2, the equation for $f(x)$ can be rewritten in terms of $(x + 1)^2$ as follows:

$$f(x) = x^2 + 2x - 24 = (x^2 + 2x + 1) - 1 - 24 = (x + 1)^2 - 25$$

The vertex form $f(x) = (x + 1)^2 - 25$ shows that the minimum value of f is -25 (and occurs at $x = -1$).

Alternatively, since $f(-6) = f(4) = 0$, by symmetry the vertex must have an x -coordinate at the midpoint between -6 and 4 , which is -1 . Since $f(-1) = (-1)(-5) = -5$, the vertex must be at $(-1, -25)$. Finally since the coefficient of x^2 is 1, the vertex form must be $f(x) = (x + 1)^2 - 25$.

Choices A and C are incorrect because they are not equivalent to the given equation for f . Choice B is incorrect because the minimum value of f , which is -25 , does not appear as a constant or a coefficient.

QUESTION 29

Choice B is correct. Since the average of 2 numbers is the sum of the 2 numbers divided by 2, the equations $x = \frac{m + 9}{2}$, $y = \frac{2m + 15}{2}$ and $z = \frac{3m + 18}{2}$ are true. The average of x , y , and z is given by $\frac{x + y + z}{3}$. Because x , y , and z are defined in terms of m ,

the expressions in terms of m can be substituted for each variable

to give $\frac{\frac{m + 9}{2} + \frac{2m + 15}{2} + \frac{3m + 18}{2}}{3}$. This fraction can be simplified to $\frac{6m + 42}{6}$, or $m + 7$.

Choices A, C, and D are incorrect and may be the result of conceptual errors or calculation errors. For example, choice D is the sum of x , y , and z , not the average.

QUESTION 30

Choice D is correct. The equation $f(x) = k$ gives the solutions to the system of equations $y = f(x) = x^3 - x^2 - x - \frac{11}{4}$ and $y = k$. A real solution of a system of two equations corresponds to a point of intersection of the graphs of the two equations in the xy -plane. The graph of $y = k$ is a horizontal line that contains the point $(0, k)$. Thus, the line with equation $y = -3$ is a horizontal line that intersects the graph of the cubic equation three times, and it follows that the equation $f(x) = x^3 - x^2 - x - \frac{11}{4} = -3$ has three real solutions.

Choices A, B, and C are incorrect because the graphs of $y = 2$, $y = 0$, and $y = -2$ are horizontal lines that do not intersect the graph of the cubic equation three times.

QUESTION 31

The correct answer is 1160. The pool contains 600 gallons of water before the hose is turned on, and water flows from the hose into the pool at a rate of 8 gallons per minute. Thus, the number of gallons of water in the pool m minutes after the hose is turned on is given by the expression $600 + 8m$. Therefore, after 70 minutes, there will be $600 + 8(70) = 1160$ gallons of water in the pool.

QUESTION 32

The correct answer is $\frac{1}{2}$ or .5. The equation that models the normal systolic blood pressure P , in millimeters of mercury, for a male x years old, $P = \frac{x + 220}{2}$, can be rewritten as $P = \frac{1}{2}x + 110$. For each increase of 1 year in age, the value of x increases by 1; hence, P becomes $\frac{1}{2}(x + 1) + 110 = \left(\frac{1}{2}x + 110\right) + \frac{1}{2}$. That is, P increases by $\frac{1}{2}$ millimeter of mercury. Either the fraction $\frac{1}{2}$ or its decimal equivalent, .5, may be gridded as the correct answer.

QUESTION 33

The correct answer is 4.55. Since there are 16 Roman digits in a Roman pes, 75 digits is equal to $\frac{75}{16}$ pes. Since 1 pes is equal to 11.65 inches, $\frac{75}{16}$ pes is equal to $\frac{75}{16}(11.65)$ inches. Since 12 inches is equal to 1 foot, $\frac{75}{16}(11.65)$ inches is equal to $\frac{75}{16}(11.65)\left(\frac{1}{12}\right) = 4.55078125$ feet. Therefore, 75 digits is equal to $\frac{75}{16}(11.65)\left(\frac{1}{12}\right) = 4.55078125$ feet. Rounded to the nearest hundredth of a foot, 75 Roman digits is equal to 4.55 feet.

QUESTION 34

The correct answer is 150. In the study, 240 male and 160 plus another 100 female bats have been tagged, so that 500 bats have been tagged altogether. If x more male bats must be tagged for $\frac{3}{5}$ of the total number of bats to be male, the proportion $\frac{\text{male bats}}{\text{total bats}} = \frac{240 + x}{500 + x} = \frac{3}{5}$ must be true. Multiplying each side of $\frac{240 + x}{500 + x} = \frac{3}{5}$ by $5(500 + x)$ gives $5(240 + x) = 3(500 + x)$, which simplifies to $1200 + 5x = 1500 + 3x$. Subtracting 1200 from both sides and subtracting $3x$ from both sides yields $2x = 300$, and dividing both sides by 2 gives $x = 150$. Therefore, 150 more male bats must be tagged; this will bring the total to 390 male bats out of 650 bats, which is equal to $\frac{3}{5}$.

QUESTION 35

The correct answer is 2.25 or $\frac{9}{4}$. Let q_s be the dynamic pressure of the slower fluid moving with velocity v_s , and let q_f be the dynamic pressure of the faster fluid moving with velocity v_f . Then $v_f = 1.5v_s$.

Given the equation $q = \frac{1}{2}nv^2$, substituting the dynamic pressure and velocity of the faster fluid gives $q_f = \frac{1}{2}nv_f^2$. Since $v_f = 1.5v_s$, the expression $1.5v_s$ can be substituted for v_f in this equation, giving $q_f = \frac{1}{2}n(1.5v_s)^2$. This can be rewritten as $q_f = (2.25)\frac{1}{2}nv_s^2 = (2.25)q_s$.

Therefore, the ratio of the dynamic pressure of the faster fluid is $\frac{q_f}{q_s} = \frac{2.25q_s}{q_s} = 2.25$. Either 2.25 or the equivalent improper fraction $9/4$ may be gridded as the correct answer.

Alternatively, since q is directly proportional to the square of v , scaling v by 1.5 should scale q by $(1.5)^2 = 2.25$.

QUESTION 36

The correct answer is 29, 30, 31, 32, 33, or 34. Since the radius of the circle is 10, its circumference is 20π . The full circumference of a circle is 360° . Thus, an arc of length s on the circle corresponds to a central angle of x° , where $\frac{x}{360} = \frac{s}{20\pi}$, or $x = \frac{360}{20\pi}(s)$. Since $5 < s < 6$, it follows that $\frac{360}{20\pi}(5) < x < \frac{360}{20\pi}(6)$, which becomes, to the nearest tenth, $28.6 < x < 34.4$. Therefore, the possible integer values of x are 29, 30, 31, 32, 33, and 34. Any one of these numbers may be gridded as the correct answer.

QUESTION 37

The correct answer is .72. According to the analyst's estimate, the value V , in dollars, of the stock will decrease by 28% each week for t weeks, where $t = 1, 2$, or 3 , with its value being given by the formula $V = 360(r)^t$. This equation is an example of exponential decay. A stock losing 28% of its value each week is the same as the stock's value decreasing to 72% of its value from the previous week, since $V - (.28)V = (.72)V$. Using this information, after 1 week the value, in dollars, of the stock will be $V = 360(.72)$; after 2 weeks the value of the stock will be $V = 360(.72)(.72) = 360(.72)^2$; and after 3 weeks the value of the stock will be $V = 360(.72)(.72)(.72) = 360(.72)^3$. For all of the values of t in question, namely $t = 1, 2$, and 3 , the equation $V = 360(.72)^t$ is true. Therefore, the analyst should use .72 as the value of r .

QUESTION 38

The correct answer is 134. The analyst's prediction is that the stock will lose 28 percent of its value for each of the next three weeks. Thus, the predicted value of the stock after 1 week is $\$360 - (.28)\$360 = \$259.20$; after 2 weeks, $\$259.20 - (.28)\$259.20 \approx \$186.62$; and after 3 weeks, $\$186.62 - (.28)\$186.62 \approx \$134.37$. Therefore, to the nearest dollar, the stock analyst believes the stock will be worth 134 dollars after three weeks.