Chapter 9
Practice Test 4

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 Ayn Rand, *Anthem*. ©1938. The protagonist, a street sweeper named Equality 7-2521, lives in a society in which the word "I" is forbidden.

Note: Because the word "I" is forbidden in this society, the narrator refers to himself as "we."

And as we all undress at night, in the dim light of the candles, our brothers are silent, for they dare not speak the thoughts of their minds. For all must agree with all, and they cannot know if their thoughts are the thoughts of all, and so they fear to speak. And they are glad when the candles are blown for the night. But we, Equality 7-2521, look through the window upon the sky, and there is peace in the sky, and cleanliness, and dignity. And beyond the City there lies the plain, and beyond the plain, black upon the black sky, there lies the Uncharted Forest. We do not wish to look upon the Uncharted Forest. We do not wish to think of it. But ever do our eyes return to that black patch upon the sky. Men never enter the Uncharted Forest, for there is no power to explore it and no path to lead among its ancient trees which stand as guards of fearful secrets. It is whispered that once or twice in a hundred years, one among the men of the City escape alone and run to the Uncharted Forest, without call or reason. These men do not return. They perish from hunger and from the claws of the wild beasts which roam the Forest. But our Councils say that this is only a legend. We have heard that there are many Uncharted Forests over the land, among the Cities. And it is whispered that they have grown over the ruins of many cities of the Unmentionable Times. The trees have swallowed the ruins, and the bones under the ruins, and all the things which perished. And as we look upon the Uncharted Forest far in the night, we think of the secrets of the Unmentionable Times. And we wonder how it came to pass that these secrets were lost to the world.

We have heard the legends of the great fighting, in which many men fought on one side and only a few on the other. These few were the Evil Ones and they were conquered. Then great fires raged over the land. And in these fires the Evil Ones and all the things made by the Evil Ones were burned. And the fire which is called the Dawn of the Great Rebirth, was the Script Fire where all the scripts of the Evil Ones were burned, and with them all the words of the Evil Ones. The words of the Evil Ones... The words of the Unmentionable Times... What are the words which we have lost? May the Council have mercy upon us! We had no wish to write such a question, and we knew not what we were doing till we had written it. We shall not ask this question and we shall not think it. We shall not call death upon our head.

And yet . . . And yet . . . There is some word, one single word which is not in the language of men, but which had been. And this is the Unspeakable Word, which no men may speak nor hear. But sometimes, and it is rare, sometimes, somewhere, one among men find that word. They find it upon scraps of old manuscripts or cut into the fragments of ancient stones. But when they speak it they are put to death. There is no crime punished by death in this world, save this one crime of speaking the Unspeakable Word.

CONTINUE

1

In the passage, the narrator's focus shifts from

A) fear of exploring frontiers to preparation for it.

B) disquiet about the unknown to curiosity about it.

C) acknowledgment of an ancient city to dismissal of it.

D) repetition of the Council's rules to acceptance of them.

2

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

A) Lines 1–3 ("And as . . . minds")

B) Line 22 ("But our . . . legend")

C) Lines 35–37 ("And in . . . burned")

D) Lines 47–49 ("And yet . . . been")

3

As used in lines 3–4, "all must agree with all" most nearly means

A) truth is true.

B) language must be accurate.

C) thought must be uniform.

D) words match their meaning.

4

The sentence in lines 12–14 ("But ever . . . sky") mainly serves to

A) confirm that the narrator's job is to guard against outside threats.

B) show that some people find an object of mystery to be of recurring interest.

C) indicate that members of the narrator's society know everyone keeps looking at the horizon.

D) illustrate a repeated action stemming from a confusion about an unexplainable phenomenon.

5

The narrator states that a person who wished to navigate the Uncharted Forest would find

A) no source of electricity.

B) it impossible to locate objects within.

C) answers to many long-forgotten questions.

D) no clear trail through.

6

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

A) Lines 14–16 ("Men never . . . secrets")

B) Lines 20–21 ("They . . . Forest")

C) Lines 26–28 ("The trees . . . perished")

D) Lines 37–40 ("And the . . . Ones")

7

Which of the following most accurately expresses the narrator's perspective about exploring the secrets of the past?

A) Compelling but dangerous

B) Easily pursuable but illegal

C) Unavoidable but unexpectedly challenging

D) Appealing but inauthentic

8

The statement the narrator makes in lines 26–28 ("The trees . . . perished") can be most clearly inferred to mean that

A) people who ask questions in the narrator's society are banished to the Forest.

B) the trees grew in the streets of cities in the Unmentionable Times.

C) the visible traces of the past have been completely obscured.

D) the city buries its dead in the Forest.

CONTINUE

9

As used in lines 30–31, "how it came to pass" most nearly means

A) what crossed each other.

B) what went in circles.

C) what happened historically.

D) how time elapsed.

10

As used in line 39, "scripts" most nearly means

A) clothes.

B) habits.

C) screenplays.

D) writings.

CONTINUE

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

This passage is adapted from James Ellsmoor, "Smart Cities: The Future Of Urban Development." ©2019 by James Ellsmoor.

As the world becomes increasingly interconnected and technology-dependent, a new wave of smart applications is changing how we approach everyday activities. Utility appliances such as intelligent fridges (yes, you read that right), personal assistants like Amazon's Alexa or smart home security applications create opportunities for more efficient living. While the idea of "Smart Cities" has been proposed as the future of urbanism, the question remains: how do we connect this new technology for the ultimately "efficient" society? Smart cities bring together infrastructure and technology to improve the quality of life of citizens and enhance their interactions with the urban environment. But how can data from areas such as public transport, air quality meters and energy production be integrated and effectively used?

The Internet of Things (IoT), could have some of the answers. Created as part of the smart technology movement, the IoT enables various objects and entities to communicate with each other through the internet. By creating a network of objects capable of smart interactions, the door is opened to a wide range of technological innovations that could help improve public transport, give accurate traffic reports or provide real-time energy consumption data. By rendering more technology capable of communicating across platforms, IoT generates more data that can help improve various aspects of daily life. Cities can identify both opportunities and challenges in real-time, reducing costs by pinpointing issues prior to their emergence and allocating resources more accurately to maximize impact.

By investing in public spaces, smart cities can be places where people want to spend more time. The city of Barcelona has adopted smart technologies by implementing a network of fiber optics throughout the city, providing free high-speed Wi-Fi that supports the IoT. By integrating smart water, lighting and parking management, Barcelona saved €75 million of city funds and created 47,000 new jobs in the smart technology sector. The Netherlands have tested the use of IoT-based infrastructure in Amsterdam, where traffic flow, energy usage and public safety are monitored and adjusted based on real-time data. Meanwhile, in the United States, major cities like Boston and Baltimore have deployed smart trash cans that relay how full they are and determine the most efficient pick-up route for sanitation workers.

The Internet of Things has led to a plethora of opportunities for cities willing to implement new smart technology to improve the efficiency of operations. Furthermore, tertiary institutions are also looking into maximizing the impact of integrated smart technology. Places such as university campuses and island communities provide smaller laboratories to implement technology in a more manageable environment that can be then replicated on a larger scale. Universities are essentially smaller, more condensed versions of cities, often boasting their own transport systems, small businesses as well as their own citizens (students). This makes campuses the perfect testing ground as Manchester Metropolitan University's IT portfolio manager Tori Brown explains in The Guardian: "The smart campus idea was first floated in spring 2016. As more projects and initiatives kept coming to light, it felt right to bring these together to tell a story around student engagement and how we can use technology to support this."

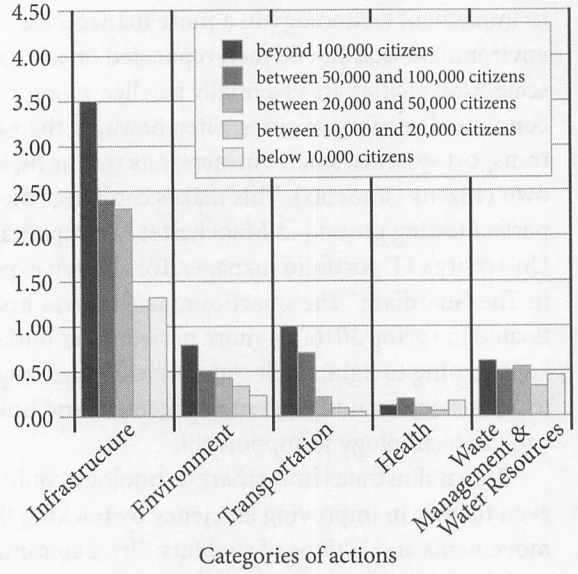
Brown illustrates how smart technology could go even further in improving efficiency by tracking the movements and actions of students: "It's a continually evolving plan. There are possibilities around smart kiosks with personalized information, true cross-campus digital and personalized wayfinding. These include wearable tech like smartwatches and phones." On campus, your phone or smartwatch could remind you of a class and how to reach it, give you updates on your assignment due dates as well as warn you about overdue books you have borrowed from the library. Whilst these may seem like small improvements compared to the ones implemented in various cities worldwide, they can help form a blueprint for future development that can be upscaled to fit larger developmental needs.

As smart technology continues to improve and urban centers expand, both will become interconnected. For example, the United Kingdom has plans to integrate smart technology in future development and use big data to make better decisions to upgrade the country's infrastructure.

CONTINUE

Better decisions could be a boom to the economy. The potential to improve several aspects of public service systems as well as quality of life and reduce costs has driven the demand for smart cities. By taking a step towards the future, we will improve not only how we interact with our general environment but how cities interact with us, ensuring that we receive the best quality options and waste fewer resources.

Mean Values of Implemented Actions Per Category and Population Range



Charalabidis, Yannis & Alexopoulos, Charalampos & Vogiatzis, Nikolaos & Kolokotronis, Dimitris. (2019). A 360-Degree Model for Prioritizing Smart Cities Initiatives, with the Participation of Municipality Officials, Citizens and Experts. 10.1007/978-3-319-89474-4_7.

The graph above shows the number of smart cities developments and actions per identified smart city category and population category.

11

Which choice best summarizes the first two paragraphs of the passage (lines 1–32)?

A) Smart cities are a good idea, but making them a reality is a complicated problem.

B) The Internet of Things can help smart appliances, such as intelligent fridges and personal assistants, communicate with each other.

C) Smart cities integrate infrastructure and technology to make more efficient decisions about cost management.

D) The Internet of Things can make smart cities a reality by providing a network for various technologies to connect.

12

As used in line 13, "enhance" most nearly means

A) emphasize.

B) enrich.

C) convey.

D) increase.

13

According to the passage, which aspect of the city's infrastructure did Barcelona improve through integration with the IoT?

A) Lighting

B) Traffic flow

C) Trash cans

D) Energy

14

The passage implies that universities using smart technology

A) implemented smart technology before cities.

B) practice implementing technology in laboratories before implementing it on campuses.

C) have infrastructure needs similar to those of cities.

D) can serve as models for cities.

15

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

A) Lines 52–54 ("Furthermore . . . technology")

B) Lines 54–58 ("Places . . . scale")

C) Lines 69–71 ("Brown . . . students")

D) Lines 76–79 ("On campus . . . library")

CONTINUE

16

As used in line 65, "floated" most nearly means

A) buoyed.

B) suggested.

C) suspended.

D) claimed.

17

According to the passage, which choice best describes a potential effect of implementing smart technology in cities?

A) Rising employment due to a spike in building projects

B) Lack of housing due to rapid growth in population

C) Increased efficiency due to the improved responsiveness of cities

D) Growing privacy concerns due to increased tracking by smart devices

18

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

A) Lines 85–87 ("As smart . . . interconnected")

B) Lines 87–90 ("For example . . . infrastructure")

C) Line 91 ("Better . . . economy")

D) Lines 91–94 ("The potential . . . cities")

19

In relationship to the passage, the information in the chart provides

A) an illustration of drawbacks that the author fails to mention.

B) historical perspective on the developments the author examines.

C) a comparison of some of the applications mentioned by the author.

D) analysis of the effectiveness of the author's proposed solutions.

20

According to the chart, cities with between 20,000 and 50,000 citizens implemented

A) an almost equal number of projects in infrastructure and environment.

B) fewer projects in four of the categories of action than cities with 50,000 to 100,000 citizens.

C) more projects in the transportation category than the environment category.

D) fewer than half of the number of projects in infrastructure compared to cities with beyond 100,000 citizens.

21

The chart suggests which of the following about smart cities developments?

A) Cities with the largest populations implemented more projects than cities with the smallest populations.

B) More money was spent on waste-management projects than on projects in the environment category.

C) Projects in the health category were implemented more often than were projects in the environment category.

D) Infrastructure projects were better received than were waste-management projects.

CONTINUE

Questions 22–32 are based on the following passage and supplementary material.

This passage is adapted from Schmitt et al., "Identifying the Volcanic Eruption Depicted in a Neolithic Painting at Çatalhöyük, Central Anatolia, Turkey." ©2014 by PLOS ONE.

A mural excavated at the Neolithic Çatalhöyük site (Central Anatolia, Turkey) has been interpreted as the oldest known map. Dating to around 6600 B.C.E., it putatively depicts an explosive summit eruption of the Hasan Dağı twin-peaks volcano located about 130 km northeast of Çatalhöyük, and a birds-eye view of a town plan in the foreground. This interpretation, however, has remained controversial not least because independent evidence for a contemporaneous explosive volcanic eruption of Hasan Dağı has been lacking.

Here, we document the presence of andesitic pumice veneer on the summit of Hasan Dağı, which we dated using (U-Th)/He zircon geochronology. Collectively, our results reveal protracted intrusive activity at Hasan Dağı punctuated by explosive venting, and provide the first radiometric ages for a Holocene explosive eruption which was most likely witnessed by humans in the area. Geologic and geochronologic lines of evidence thus support previous interpretations that residents of Çatalhöyük artistically represented an explosive eruption of Hasan Dağı volcano.

Starting from the discovery of the Neolithic settlement of Çatalhöyük in the early 1960s by British archaeologist James Mellaart, the excavations at this location have provided unique insights into the living conditions of humans at the transition from hunter-gatherer to settled agriculture societies. One outstanding find is a mural from level VII of Çatalhöyük famously described by its discoverer as depicting a volcanic eruption.

Similar interpretations, differing in detail, have been put forward since then, implicating this painting not only as the oldest depiction of a volcanic eruption, but as a contender for being the first graphical representation of a landscape or a map. Detailed volcanological interpretations of the painting include reconstructions of the eruptive style with the summit region showing "falling volcanic 'bombs' or large semiliquid lava." According to these interpreters, the most likely candidate for the erupting volcano depicted in the upper register of the painting is the twin-peak volcano of Hasan Dağı, located about 130 km NE of Çatalhöyük.

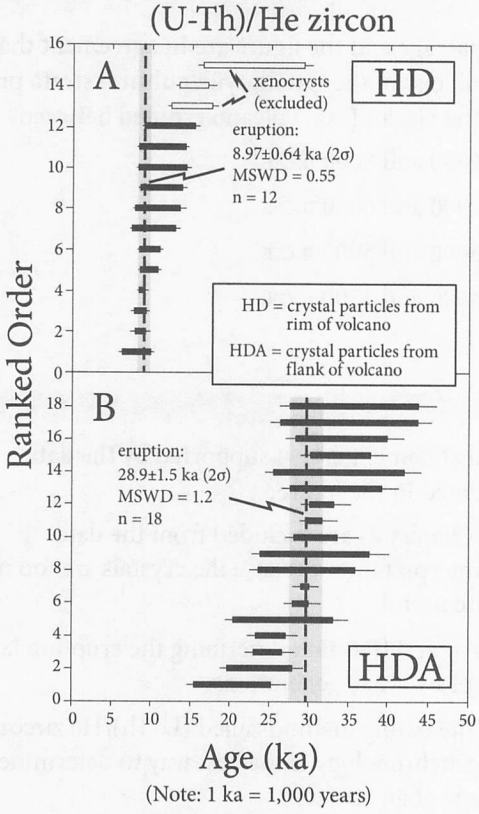
This view, however, has been contested, largely because of the extraordinary age of the mural, and the absence of any other landscape art or map until much later in history. The depiction of a leopard skin underlain by geometric patterns has been proposed instead.

A testable prediction of the volcanic eruption hypothesis for the Çatalhöyük mural is a geologic record of an eruption that would fall into, or briefly predate, the time when the Çatalhöyük mural was painted.

Protracted periods of oral tradition over 250 generations have been proposed for prehistoric native North American myths following the Mount Mazama eruption at around 5700 B.C.E. For the Çatalhöyük map (and volcano) hypothesis to be plausible, however, we surmise that a brief line of oral tradition, or even an eyewitness portrayal, is perhaps more likely than tradition of a myth that detached itself from its inspiration in the physical world. This is not to say that realism must prevail in Neolithic art, but many of the apparent details can be reasonably expected to become lost or obscured during a long period of oral tradition. A tradition that predated the settlement of Çatalhöyük thus appears very unlikely, and hence we would predict a time period for the eruption between 7400 and 6600 B.C.E. based on the ^{14}C chronology of the Çatalhöyük cultural strata.

Neither proponents nor opponents of the "volcano" hypothesis for the Çatalhöyük painting have thus far scrutinized if and when such a volcanic eruption might have occurred. The radiometric age, and the following geologic evidence, corroborates the "volcano" hypothesis.

CONTINUE



This table shows the (U-Th)/He zircon dated ages of sample particles removed from the rim and the flank of the Hasan Dağı volcano.

22

The main purpose of the passage is to

A) describe periods in Turkey's ancient geologic history.

B) explain the ways scientists use radiometric aging.

C) describe opposing views regarding an ancient mural and cautiously endorse one view.

D) explain how andesitic pumice veneer forms after volcanic eruptions.

23

Over the course of the passage, the focus shifts from

A) an explanation of a theory to a response to criticism of this theory.

B) a depiction of an event to its proof in oral history.

C) the use of (U-Th)/He zircon geochronology to a new method.

D) the use of radiometric aging to an examination of andesitic pumice veneer.

24

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

A) Lines 12–14 ("Here . . . geochronology")

B) Lines 46–49 ("This . . . history")

C) Lines 69–70 ("A tradition . . . unlikely")

D) Lines 77–79 ("The radiometric . . . hypothesis")

25

The author uses the phrase "it putatively depicts" (line 4) most likely to

A) detail the hands-on nature of the work done by those who study science.

B) emphasize the fact that scientists must always question theories.

C) underscore the need for clarification of the work of scientists.

D) bolster the idea that the evidence to support the claim is imperfect.

26

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

A) Near Central Anatolia, in Turkey

B) In the British Isles

C) In the Middle East

D) In the central region of North America

CONTINUE

27

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

A) Lines 1–6 ("A mural . . . Çatalhöyük")

B) Lines 24–29 ("Starting . . . societies")

C) Lines 57–60 ("Protracted . . . B.C.E.")

D) Lines 60–65 ("For the . . . world")

28

As used in line 65, the phrase "This is not to say" implies that

A) the lost details are crucial for proving the truth.

B) oral traditions describe stories but not real events.

C) the scientists don't expect the mural to be completely true to life.

D) Neolithic artists used realism to portray the natural world.

29

Which choice best supports the claim that the mural was painted near the time of the volcanic eruption?

A) Lines 7–11 ("This . . . lacking")

B) Lines 49–51 ("The depiction . . . instead")

C) Lines 65–68 ("This . . . tradition")

D) Lines 74–77 ("Neither . . . occurred")

30

According to the data, the youngest Holocene eruption age for Hasan Dağı is approximately

A) 1.2 ka.

B) 8.97 ka.

C) 18 ka.

D) 28.9 ka.

31

The passage and the figure are in agreement that the chronology of the Çatalhöyük cultural strata predicts that the Hasan Dağı volcano erupted between

A) 9000 and 8000 B.C.E.

B) 7000 and 6000 B.C.E.

C) 6000 and 5000 B.C.E.

D) 4500 and 3500 B.C.E.

32

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

A) Xenocrysts are excluded from the data interpretation because the crystals are too new to be useful.

B) An oral tradition describing the eruption lasted for over 250 generations.

C) The dating method called (U-Th)/He zircon geochronology is the best way to determine the age of an artifact.

D) Particles on the rim of a volcano are more likely to be from recent eruptions than particles on the flank of the volcano.

CONTINUE

Questions 33–42 are based on the following passages.

Passage 1 is excerpted from Edmund Burke, *Reflections on the Revolution in France*, originally published in 1790. Passage 2 is excerpted from Thomas Paine, *Common Sense*, originally published in 1776.

Passage 1

A few years ago I should be ashamed to overload a matter so capable of supporting itself by the then unnecessary support of any argument; but this Line seditious, unconstitutional doctrine is now publicly 5 taught, avowed, and printed.

The people of England will not ape the fashions they have never tried, nor go back to those which they have found mischievous on trial. They look upon the legal hereditary succession of their crown as among 10 their rights, not as among their wrongs; as a benefit, not as a grievance; as a security for their liberty, not as a badge of servitude. They look on the frame of their commonwealth, *such as it stands*, to be of inestimable value; and they conceive the undisturbed succession of 15 the crown to be a pledge of the stability and perpetuity of all the other members of our Constitution.

I shall beg leave, before I go any further, to take notice of some paltry artifices which the abettors of election as the only lawful title to the crown are 20 ready to employ, in order to render the support of the just principles of our Constitution a task somewhat invidious. These sophisters substitute a fictitious cause, and feigned personages, in whose favor they suppose you engaged, whenever you defend the inheritable 25 nature of the crown. It is common with them to dispute as if they were in a conflict with some of those exploded fanatics of slavery who formerly maintained, what I believe no creature now maintains, "that the crown is held by divine, hereditary, and indefeasible 30 right."

These old fanatics of single arbitrary power dogmatized as if hereditary royalty was the only lawful government in the world, just as our new fanatics of popular arbitrary power maintain that a popular 35 election is the sole lawful source of authority. The old prerogative enthusiasts, it is true, did speculate foolishly, and perhaps impiously too, as if monarchy had more of a divine sanction than any other mode of government; and as if a right to govern by inheritance 40 were in strictness *indefeasible* in every person who should be found in the succession to a throne, and under every circumstance, which no civil or political right can be.

Passage 2

But it is not so much the absurdity as the evil of 45 hereditary succession which concerns mankind. Did it ensure a race of good and wise men it would have the seal of divine authority, but as it opens a door to the FOOLISH, the WICKED, and the IMPROPER, it hath in it the nature of oppression. Men who look upon 50 themselves born to reign, and others to obey, soon grow insolent; selected from the rest of mankind their minds are early poisoned by importance; and the world they act in differs so materially from the world at large, that they have but little opportunity of knowing its true 55 interests, and when they succeed to the government are frequently the most ignorant and unfit of any throughout the dominions. Another evil which attends hereditary succession is, that the throne is subject to be possessed by a minor at any age; all which time the 60 regency, acting under the cover of a king, have every opportunity and inducement to betray their trust. The same national misfortune happens, when a king worn out with age and infirmity, enters the last stage of human weakness. In both these cases the public 65 becomes a prey to every miscreant, who can tamper successfully with the follies either of age or infancy.

The most plausible plea, which hath ever been offered in favour of hereditary succession, is, that it preserves a nation from civil wars; and were this true, 70 it would be weighty; whereas, it is the most barefaced falsity ever imposed upon mankind. The whole history of England disowns the fact. Thirty kings and two minors have reigned in that distracted kingdom since the conquest, in which time there have been 75 (including the Revolution) no less than eight civil wars and nineteen rebellions. Wherefore instead of making for peace, it makes against it, and destroys the very foundation it seems to stand on. ... In short, monarchy and succession have laid (not this or that kingdom 80 only) but the world in blood and ashes.

CONTINUE

33

In Passage 1, Burke indicates that the argument of those who support elected leaders is characterized by its

A) weakness and dishonesty.

B) universality and fanaticism.

C) antiquity and irrelevance.

D) hypocrisy and innovation.

34

As used in line 1, "overload" most nearly means

A) burden excessively.

B) cause to burst.

C) express emotionally.

D) short circuit.

35

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

A) hire.

B) utilize.

C) reimburse.

D) work.

36

Passage 2 most strongly suggests that Paine believes leaderships by right of birth to be

A) illegitimate failures that cause devastating results.

B) useful means by which to avoid dangerously inferior governance.

C) complicated and passionate methods for expressing opinions.

D) valuable despite some historical setbacks.

37

In response to Burke's statement in lines 22–25 ("These . . . crown"), what would Paine most likely say?

A) He would indicate that it is important to address all possible reasons for supporting an unjust cause.

B) He would state that the argument against the divine right to rule is less important than the tendencies of rulers to arbitrarily provide favors to their supporters.

C) He would clarify that the argument against an accepted form of rule is based on results, not redirection.

D) He would deny that the old belief in an inherently granted right to rule a state has completely disappeared.

38

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

A) Lines 49–51 ("Men who . . . insolent")

B) Lines 57–59 ("Another . . . age")

C) Lines 67–69 ("The most . . . wars")

D) Lines 71–72 ("The whole . . . fact")

39

Which of the following types of responses would Burke most likely make to Paine's statements in the final paragraph of Passage 2?

A) One of disagreement, because conflicts do not necessarily indicate an unstable structure

B) One of agreement, because civil wars are a burden on a nation

C) One of acceptance, because excessive violence demonstrates a failure of a system

D) One of doubt, because Paine failed to provide details and dates of the wars and rebellions he cites

CONTINUE

40

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

A) Lines 6–8 ("The people . . . trial")

B) Lines 12–16 ("They . . . Constitution")

C) Lines 31–35 ("These . . . authority")

D) Lines 35–39 ("The old . . . government")

41

Which choice best states the relationship between the two passages?

A) Passage 2 underscores the concerns raised by Passage 1.

B) Passage 2 argues a point dismissed by Passage 1.

C) Passage 2 presents another method for resolving the issues delineated in Passage 1.

D) Passage 2 expands on the main position expressed and advocated in Passage 1.

42

The main purpose of both passages is to

A) evaluate the various benefits of parliamentary forms of government.

B) seek compromise on a passionately debated issue of importance.

C) reject an opposing view and a particular position.

D) prove that history is based on false beliefs.

CONTINUE

Questions 43–52 are based on the following passage.

This passage is adapted from Shouguang Jin, University of Florida, "Explainer: CRISPR technology brings precise genetic editing—and raises ethical questions," originally published by *The Conversation*: https://theconversation.com/.

A group of leading biologists earlier this month called for a halt to the use of a powerful new gene editing technique on humans. Known by the acronym CRISPR, the method allows precise editing of genes for targeted traits, which can be passed down to future generations.

Scientists have long sought after this sort of genome editing tool for living cells. Two other technologies, called zinc-finger nucleases and TALEN (transcription activator-like effector nuclease) are available to achieve the same result. However, the CRISPR technology is much easier to generate and manipulate. This means that most biological research laboratories can carry out the CRISPR experiments. As a result, CRISPR technology has been quickly adopted by scientists all over the world and put into various tests. It has been demonstrated to be effective in genome editing of most experimental organisms, including cells derived from insects, plants, fish, mice, monkeys and humans.

Such broad successes in a short period of time imply we've arrived at a new genome editing era, promising fast-paced development in biomedical research that will bring about new therapeutic treatments for various human diseases. The CRISPR technology offers a novel tool for scientists to address some of the most fundamental questions that were difficult, if not impossible, to address before. For instance, the whole human genomic DNA sequence had been deciphered many years ago, but the majority of information embedded on the DNA fragments are largely unknown. Now, the CRISPR technology is enabling scientists to study those gene functions. By eliminating or replacing specific DNA fragments and observing the consequences in the resulting cells, we can now link particular DNA fragments to their biological functions.

Recently, cells and even whole animals with desired genome alterations have successfully been generated using the CRISPR technology. This has proven highly valuable in various biomedical research studies, such as understanding the cause and effect relationship between specific DNA changes and human diseases. Studying DNA in this way also sheds light on the mechanisms underlying how diseases develop and provides insights for developing new drugs that eliminate specific disease symptoms.

With such profound implications in medical sciences, many biotech and pharmaceutical companies have now licensed the CRISPR technology to develop commercial products. For example, a biotech company, Editas Medicine, was founded in 2013 with the specific goal of creating treatments for hereditary human diseases employing the CRISPR technology. However, products derived from the use of CRISPR technology are yet to hit the market with FDA approval.

With the CRISPR technology, scientists can now alter the genome composition of whole organisms, including humans, through manipulating reproductive cells and fertilized eggs or embryos. Those particular genetic traits are then passed down through generations. This brings hope to cure genetic defects that cause various hereditary human diseases, such as cystic fibrosis, haemophilia, sickle-cell anemia, Down syndrome and so on.

Unlike the current approaches of gene therapy which temporarily fix defective cells or organs through the introduction of corrected or functional genes, the CRISPR technology promises to correct the defect in the reproductive cells, producing progenies that are free of the defective gene. In other words, it can eliminate the root causes of hereditary human diseases.

In theory, then, hereditary features that people consider advantageous, such as higher intelligence, better body appearance and longevity, can be introduced into an individual's genome through CRISPR mediated reproductive cell modifications as well. However, scientists do not yet fully understand all the possible side effects of editing human genomes. It is also the case that there is no clear law to regulate such attempts.

That's why groups of prominent scientists in the field have recently initiated calls for ethical guidelines for doing such modifications of reproductive cells, the fear being that uncontrolled practice might bring about unforeseen disastrous outcomes in the long run. The guidelines call for a strong discouragement of any attempts at genome modification of reproductive cells for clinical application in humans, until the

CONTINUE

social, environmental, and ethical implications of such operations are broadly discussed among scientific and governmental organizations.

There is no doubt that the exciting and revolutionary CRISPR technology, under the guidance of carefully drafted and broadly accepted rules, will serve well for the well-being of humankind.

43

The primary purpose of the passage is to

A) contrast competing theories in a scientific field.

B) detail the findings of a study.

C) outline the history of a scientific discovery.

D) evaluate the prospects of a technological advancement.

44

The author's attitude toward CRISPR technology is best described as

A) unconcerned ambivalence.

B) cautious optimism.

C) restrained fear.

D) unqualified exuberance.

45

As used in line 21, "editing" most nearly means

A) abridging.

B) altering.

C) revising.

D) polishing.

46

According to the passage, which of the following is true of DNA fragments?

A) The majority of the information embedded in them has been discovered.

B) They are a mechanism underlying how diseases develop.

C) Their sequence was deciphered using gene editing technology.

D) Their purposes may be revealed through the use of CRISPR technology.

47

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

A) Lines 27–31 ("For instance . . . unknown")

B) Lines 33–36 ("By eliminating . . . functions")

C) Lines 43–46 ("Studying . . . symptoms")

D) Lines 72–77 ("In theory . . . well")

48

What does the author suggest about current approaches to gene therapy?

A) They do not prevent people from passing on diseases to their offspring.

B) They are obsolete now that CRISPR technology is available.

C) They include introducing corrected genes derived from insects, plants, and fish.

D) They are the only safe alternatives to the use of CRISPR technology.

CONTINUE

49

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

A) Lines 1–3 ("A group . . . humans")

B) Lines 16–19 ("It has . . . humans")

C) Lines 65–70 ("Unlike . . . gene")

D) Lines 70–71 ("In other . . . diseases")

50

The reference to "higher intelligence, better body appearance and longevity" in lines 73–74 most likely serves to

A) support a theory.

B) counter an argument.

C) provide illustrative examples.

D) summarize a key point.

51

Which of the following does the author suggest about the "ethical guidelines" mentioned in line 82?

A) They may discourage scientists from achieving further advances.

B) Scientists hope such guidelines will end human genome modification.

C) They were not in place when CRISPR technology was developed.

D) They are needed despite scientists' deep understanding of human genome modification.

52

The word "revolutionary" (line 93) most directly suggests that

A) CRISPR technology will have a profound effect on human gene therapy.

B) human health has been dramatically improved by CRISPR technology.

C) a significant shift in thinking was required to develop the CRISPR technique.

D) new ethical guidelines have fundamentally changed CRISPR's potential applications.

STOP

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

No Test Material On This Page

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.

The New American Renaissance

Since 1970 or so, the shape of the humanities has changed significantly. Before that time, it was rare to read books, look at paintings, or 1 watch plays by anyone other than white male European-American artists. While a bias still remains, there is no question that the canon, the group of accepted "classic" 2 works; has become much

1

A) NO CHANGE
B) rarer still was watching
C) to watch
D) DELETE the underlined portion.

2

A) NO CHANGE
B) works—
C) works
D) works,

CONTINUE

more diverse. Still, in the United States, some groups have been 3 more vocal than others. There is no better example of such a marginalization than that of Native Americans.

Each century has had its figures—William Apess was a minister and autobiographer in the nineteenth century and Zitkala-Sa was a story writer and memoirist in the early twentieth. Still, these figures were never able to reach audiences as broad as those of their white contemporaries. Today, however, as the reclamation of heritage gains more traction, this public marginalization may be changing.

Literary critic Kenneth Lincoln identifies the change and 4 outlined a kind of historical timeline in his 1983 book *Native American Renaissance*. Throughout the nineteenth century, Native Americans were systematically eradicated throughout all parts of the growing United States. Much of their 5 repartee with white Americans came in the form of military campaigns. When the wars subsided, the American government started a similarly cruel program of assimilation, 6 often this involved the movement of Native American children from their homes to "Indian schools" that sought to remove any trace of tribal inheritance.

3

Which choice most effectively sets up the information that follows?

A) NO CHANGE
B) successful despite the obstacles.
C) forced to stay on the periphery.
D) content to stay out of the public eye.

4

A) NO CHANGE
B) outlining
C) was outlining
D) outlines

5

A) NO CHANGE
B) contact
C) chatting
D) banter

6

A) NO CHANGE
B) it often involved
C) this type of thing often involved
D) often involving

CONTINUE

7 There were lots of anti-war demonstrations in the 1960s and 1970s, an era of cultural reclamation, when the emphasis on "melting-pot"-style assimilation shifted toward an attitude of "multicultural society." 8 At this time, people from all races began to think it possible to live in the United States while at the same time identifying with a particular racial group. Around this time, after many of the "Indian schools" had closed, Native American children could gain English-language education closer to home. 9 However, they could continue to identify with their cultural heritage while gaining an "American" education.

7

Which choice connects the sentence with the previous paragraph?

A) NO CHANGE

B) Kenneth Lincoln was just a young man

C) This practice of assimilation had begun to change

D) Many important things happened

8

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

> This was not always the case as many groups have been marginalized throughout American history.

Should the writer make this addition here?

A) Yes, because it gives an important reminder that the United States is always changing.

B) Yes, because it shows that Native American writers have not always been popular.

C) No, because it makes a historical claim that the passage contradicts.

D) No, because it repeats information from earlier in the passage that is already implied in this paragraph.

9

A) NO CHANGE

B) Nevertheless,

C) Because,

D) Moreover,

CONTINUE

This shift led to more Native Americans attending colleges and universities, and more empathetic attitudes among the literary establishment allowed more **10** of them space for publication of poetry and fiction. **11** The result was an efflorescence of Native American writers, particularly in the 1970s and 1980s. During this period, writers like Leslie Marmon Silko, Gerald Vizenor, and Paula Gunn Allen became popular. These writers are now among the most respected in the country, and they have influenced countless others. While the literary establishment may have been centuries late in acknowledging the significant contributions that Native American culture can make to the world, we should nonetheless be glad that this influence is finally more widely available.

10

A) NO CHANGE
B) Native American writers
C) of these
D) from it

11

Which choice most effectively combines the underlined sentences?

A) Particularly in the 1970s and 1980s, writers like Leslie Marmon Silko, Gerald Vizenor, and Paula Gunn Allen became popular, a resultant efflorescence of Native American writers.
B) The result was an efflorescence of Native American writers, particularly in the 1970s and 1980s; in these decades, popularity was earned for writers including Leslie Marmon Silko, Gerald Vizenor, and Paula Gunn Allen.
C) Leslie Marmon Silko, Gerald Vizenor, and Paula Gunn Allen were three of the writers who became popular in this period of the 1970s and 1980s amid the resulting efflorescence of Native American writers.
D) The result, particularly in the 1970s and 1980s, was an efflorescence of Native American writers including Leslie Marmon Silko, Gerald Vizenor, and Paula Gunn Allen.

CONTINUE

Questions 12–22 are based on the following passage.

Make Like a Tree and Change Leaves

Anyone who lives in the Mid-Atlantic or New England 12 knows the flowering of spring and the lush greens of summer. The four seasons in these areas are most evident in the look of the trees. This is never more true than 13 when people are in the case of fall, when the trees are covered with beautiful swatches of red, yellow, and orange as the leaves change color. For many, this fall foliage represents the Northeast in 14 the state in which it is most pure.

People in this region have taken to the idea. Now, foliage tourism is as much a part of the region as beach season is for those on the coast. Many business 15 owners including, restaurant owners, hoteliers, and farmers, throughout the region depend on a boom in October and November.

12

A) NO CHANGE
B) bodes
C) foretells
D) indicates

13

A) NO CHANGE
B) considering
C) with the consideration
D) DELETE the underlined portion.

14

A) NO CHANGE
B) its purest state.
C) which it is in the purest possible state.
D) the state of purity rather than impurity.

15

A) NO CHANGE
B) owners, including
C) owners, including,
D) owners including:

CONTINUE

However, there is a problem. Except in very odd circumstances, it will *always* be beach season in July and August. Foliage season, however, is a bit more difficult to predict. It is clear, **16** for instance, that the leaves tend to change in the last few months of the year, but when they change and how vivid their colors will be has long remained a mystery. Of course, many people would certainly like to know the cause. **17** Because of it, fall without the foliage is like a whole season of rainy beach days, at least from a tourism perspective.

A recent study published in *Proceedings of the National Academy of Sciences* has begun to uncover some of the factors behind the change. Scientists **18** have long known that climate conditions influence the changing of the leaves, but no one has ever been sure which aspect of the weather to privilege—moisture, temperature, frost, etc. **19** No previous explanation has been able to say why in one year the leaves were still a vibrant yellow on the first of November while the next year they had all fallen already.

16

A) NO CHANGE
B) nevertheless,
C) for all that,
D) on the other hand,

17

A) NO CHANGE
B) Subsequently,
C) After all,
D) Additionally,

18

A) NO CHANGE
B) long knows
C) long know
D) are long knowing

19

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

> The Mount Washington Observatory reports that the average rainfall in the New Hampshire region is approximately 6–9 inches, depending on the month.

Should the writer make this addition here?

A) Yes, because it provides support for the passage's main claim that fall foliage can now be accurately predicted.
B) Yes, because it adds an important detail regarding the expected moisture levels in one region.
C) No, because it introduces the work of an organization that is not discussed elsewhere in the passage.
D) No, because it is not relevant to the paragraph's description of the general factors that influence fall foliage.

CONTINUE

The answer, it seems, is that 20 their is different factors in different places. This group of scientists analyzed two different New England ecosystems, one along the coast and one in the highlands. They found that both reacted to frosts in the fall, but only the highlands reacted to frosts in the spring. 21

Combining these findings with climate-change predictions for the next century, 22 having suggested that the changes will come later in the year for the highlands and perhaps a bit earlier for the coasts. Should these predictions turn out to be true, it could be a major boon for the tourism industry in these areas and for the tourists who visit them.

20

A) NO CHANGE
B) their's
C) their are
D) there are

21

At this point, the writer wants to add another detail that adds to the findings described in this paragraph. Which choice most effectively accomplishes this goal?

A) The forests along the coast, perhaps not surprisingly, were particularly sensitive to rain and other types of moisture.
B) The leaves fall from the trees after they have changed, thus giving the name "fall" to the season.
C) Except for the ocean breezes, temperatures along the water tend to be a bit higher than in the mountains.
D) The leaves do not change color in the same way in the spring, but the blossoms of the trees create their own kind of beauty.

22

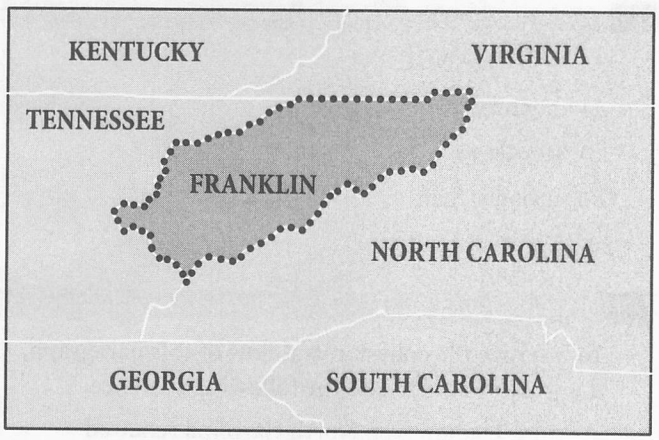
A) NO CHANGE
B) to suggest
C) suggesting
D) the researchers suggest

CONTINUE

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

(Almost) The Fifty-First State

When people refer to the "fifty-first state," they are usually referring to Puerto Rico or one of the contemporary U.S. holdings outside the fifty states. What many don't realize, however, is that the idea of extra states, particularly within U.S. borders, 23 is mainly the concern of academics. One early case is the state of Franklin. On a modern map, the state of Franklin would be bound by Tennessee to the west and south, Virginia to the north, and North Carolina to the southeast. 24



North Carolina, one of the original thirteen colonies, offered a few of its westernmost counties to the federal 25 government as payment for debts; those that had been incurred—for manpower and ammunition—during the Revolutionary War. As Congress decided what to do with the land, the North Carolinian legislature decided that the western counties were too valuable to let go, and the state soon retracted 26 it's offer of its' western counties.

23

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

A) NO CHANGE
B) presents a fun historical challenge.
C) is actually quite an old idea.
D) is rather outdated in this day and age.

24

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 state names be discussed?

A) NO CHANGE
B) Virginia, Tennessee, North Carolina
C) North Carolina, Virginia, Tennessee
D) North Carolina, Tennessee, Virginia

25

A) NO CHANGE
B) government as payment for debts:
C) government as payment for debts
D) government—as payment for debts,

26

A) NO CHANGE
B) it's offer of its
C) its offer of it's
D) its offer of its

CONTINUE

In the meantime, though, the counties in the northwest corner of the state had been developing a kind of regional identity. The three counties now called the State of Franklin 27 having been attempted to secede from North Carolina. Encouraged by the new federal government's quick creation of states from ceded lands, the three counties issued a declaration of 28 independence, yet their independence was rooted in particular in their distance from North Carolina's state capital.

[1] The secession was not recognized by Congress, and John Sevier and the leaders of the Franklin movement eventually took oaths of allegiance to the state of North Carolina. [2] This time, Congress acted quickly and accepted North Carolina's offer, interested as it was in pushing statehood further west from the thirteen colonies along the Atlantic coast. [3] Sevier and others led the administration of the ceded territories. [4] These territories were eventually granted statehood in 1796, though this time as something more recognizable—as the northeastern 29 boarder to the modern-day state of Tennessee. 30

27

A) NO CHANGE
B) was attempting
C) were attempting
D) is attempting

28

A) NO CHANGE
B) independence, which
C) independence. Independence
D) independence, and independence

29

A) NO CHANGE
B) boarder from
C) border to
D) broader than

30

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

> In 1789, however, North Carolina renewed its offer of the western counties to the federal government.

The sentence would most logically be placed after

A) sentence 1.
B) sentence 2.
C) sentence 3.
D) sentence 4.

CONTINUE

Today, Franklin is a distant memory, but its short-lived history provides a unique look into some of the early machinations of the newly formed American government. The contemporary fifty states may seem like they have always existed, but that is certainly not the case—just as national borders are artificial creations, 31 so too are state borders, and as such, they are always subject to change. It may have been nearly 150 years since a state, West Virginia, was carved out of another existing state, Virginia, but that does not mean that the map as it is drawn now will forever be so. The State of Franklin may be a mere historical 32 curiosity to some, but to others, it is a reminder that even a powerful, federally oriented nation is 33 usually made up of 50 or so states.

31

A) NO CHANGE
B) being
C) but also are
D) the same can be said of

32

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) stumper
C) thing
D) mind-blower

33

Which choice most effectively concludes the sentence and paragraph?

A) NO CHANGE
B) very important in the world and in history.
C) a living, breathing thing, ever subject to change.
D) home to many things of historical interest.

CONTINUE

Questions 34–44 are based on the following passage.

What's So Civil About Engineers Anyway?

No matter where you live, you see their work everywhere. Whether you cross a bridge or drive on a highway, you 34 see the work of civil engineers. Civil engineering as a profession is centuries old and has long been necessary for the functioning of modern government. 35 As long as people need to get to school or work, civil engineers will continue to be 36 beginnings of modern societies.

34

A) NO CHANGE
B) saw
C) have been seeing
D) sees

35

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

Few governments in the modern world could function without the work of civil engineers.

Should the writer make this addition here?

A) Yes, because it supports the information contained in the following paragraph.
B) Yes, because it provides an important reminder that governments are not made up of politicians alone.
C) No, because it is a mere restatement of an idea expressed in the previous sentence.
D) No, because it is a digression from the main point of the paragraph.

36

A) NO CHANGE
B) cornerstones
C) basics
D) footings

CONTINUE

The American Society of Civil Engineers defines the profession as "the design and maintenance of public works such as roads, bridges, water, and energy systems as well as public facilities like ports, railways, and airports." 37 In other words, civil engineers design and maintain the components of energy and transportation systems in the modern world. The projects can be 38 large—like the Hoover Dam, the Holland Tunnel, or the interstate system that covers the whole country—or small—like local roads and power stations. Civil engineers see these projects through from start to finish: from the earliest stages of design and analysis to the final stages of completion and beyond.

37

A) NO CHANGE
B) On the other hand,
C) Nonetheless,
D) In the abstract,

38

A) NO CHANGE
B) large; like the Hoover Dam, the Holland Tunnel, or the interstate system that covers the whole country;
C) large: like the Hoover Dam, the Holland Tunnel, or the interstate system that covers the whole country,
D) large: like the Hoover Dam, the Holland Tunnel, or the interstate system that covers the whole country—

CONTINUE

[1] Civil engineers collaborate on large projects. [2] Their backgrounds tend to 39 vary—however, specialties can range from architecture to environmental engineering, from ecology to urban planning. [3] Those who want a greener country draw on the expertise of civil engineers in designing windmills and other sustainable sources of energy. [4] Environmental engineering has been particularly popular of late on both sides of the environmental debate. [5] Those who are less concerned with long-term energy sources have drawn on the help of civil engineers in mining oil and gas and in 40 creating delivery mechanisms that they make to get those resources all over the country. 41

39

A) NO CHANGE
B) vary however specialties
C) vary, however, specialties
D) vary, however. Specialties

40

A) NO CHANGE
B) creating delivery mechanisms
C) creating delivery mechanisms by making them
D) fabricating and making mechanisms for delivery

41

To make this paragraph the most logical, sentence 3 should be

A) placed where it is now.
B) placed after sentence 4.
C) placed after sentence 5.
D) DELETED from the paragraph.

CONTINUE

In either case, civil engineering is a fascinating field, and it is 42 full of interesting people. The Bureau of Labor Statistics predicts that the field will grow by nearly 20% between 2012 and 2022. The field offers incredible job security—regardless of changes in political power, civil engineering will continue to occupy a central place in the world. With every new development in energy or transportation, a civil engineer faces a new set of problems that 43 they have to solve for the country to reap the full benefits of these developments.

44 Should you so choose the work of civil engineering it may not have the glory of political leadership, but it certainly does present opportunities to make a tangible difference in the city, state, or country in which you live. The work of civil engineers is always about the future. After all, it wouldn't make sense to build a bridge if it were only meant to stand for your own lifetime. The work of civil engineers is a gift to future generations in a way that few other types of work can be.

42

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

A) NO CHANGE
B) very complicated.
C) constantly growing.
D) difficult to describe.

43

A) NO CHANGE
B) they must solve
C) all of them really have to solve
D) he or she must solve

44

A) NO CHANGE
B) The career they call civil engineering
C) Civil engineering
D) Opting for a career in civil engineering

STOP

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

Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

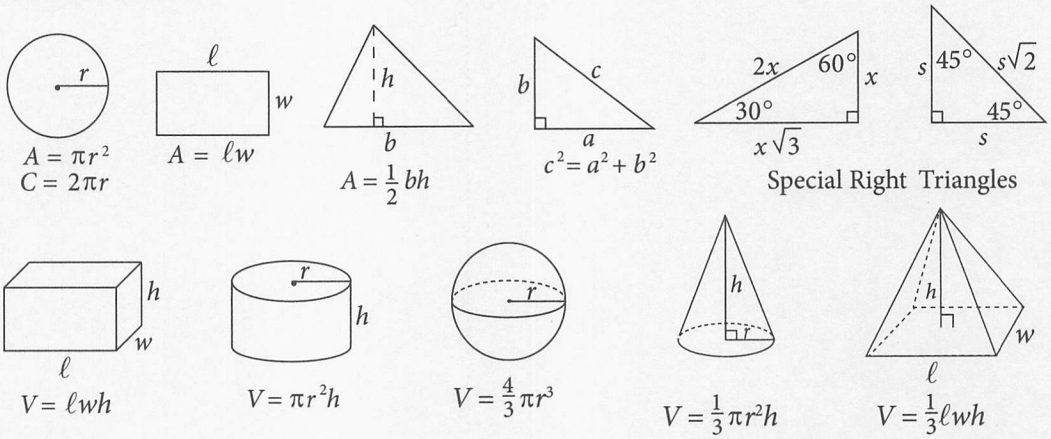
DIRECTIONS

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



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.

CONTINUE

1

In the function $g(x) = \frac{5}{3}x + k$, k is a constant. If $g(9) = 12$, what is the value of $g(-3)$?

A) -12

B) -8

C) -3

D) 2

2

$$3(k + 2) = h$$

$$\frac{h}{k} = 5$$

If the solution set to the system of equations shown above is (h, k), what is the value of k?

A) 1

B) 3

C) 6

D) 15

3

Which of the following expressions is equal to 1 for some value of y?

A) $|2 - y| + 2$

B) $|y - 2| + 2$

C) $|y + 2| + 2$

D) $|2 - y| - 2$

4

If $\frac{x + y}{x}$ is equal to $\frac{6}{5}$, which of the following is true?

A) $\frac{y}{x} = \frac{1}{5}$

B) $\frac{y}{x} = \frac{11}{5}$

C) $\frac{x + y}{x} = \frac{1}{5}$

D) $\frac{x - 2y}{x} = -\frac{1}{5}$

CONTINUE

5

$$g(x) = -4x - 7$$

The function g is shown above. Which of the following is equal to $g(-2x)$?

A) $8x - 7$

B) $8x + 7$

C) $8x^2 - 21x$

D) $-8x - 7$

6

Which of the following expressions is equivalent to $4(3x - 2)(5x - 2)$?

A) $12x$

B) $7x^2 + 15x$

C) $60x^2 + 16x$

D) $60x^2 - 64x + 16$

7

If $k = 1$, which of the following is the solution set for $x - 7 = \sqrt{x - k}$?

A) {1}

B) {5}

C) {10}

D) {5, 10}

8

While preparing for a weightlifting competition, Alexei plans a training program in which his heaviest lift of each day increases by a constant amount. If Alexei's training program requires that his heaviest lift on day 6 is 180 pounds and his heaviest lift on day 24 is 225 pounds, which of the following most accurately describes how the amount Alexei lifts changes from day 6 to day 24 in his training program?

A) Alexei increases the weight of his heaviest lift by 2 pounds every 5 days.

B) Alexei increases the weight of his heaviest lift by 2 pounds per day.

C) Alexei increases the weight of his heaviest lift by 2.5 pounds per day.

D) Alexei increases the weight of his heaviest lift by 5 pounds per day.

CONTINUE

9

$$y = -4x - 6$$

Which of the following is the equation of a line that is parallel to the line with the equation shown above?

A) $4x - y = 9$

B) $4x + 2y = 8$

C) $6x + 3y = 12$

D) $12x + 3y = 10$

10

$$y = (x - 7)(3x + 4)$$

$$x = 3y - 1$$

The solution set for the system of equations shown above contains how many ordered pairs?

A) Infinitely many

B) 2

C) 1

D) 0

11

Peggie and Joan each purchased a bouquet of flowers from a florist. The price of Peggie's bouquet was d dollars, and the price of Joan's bouquet was \$4 less than the price of Peggie's bouquet. If Peggie and Joan split the cost of the bouquets equally, and each paid 15% sales tax on her share, which of the following expressions gives the amount, in dollars, that each of them paid?

A) $1.15d - 2.3$

B) $2d - 1.15$

C) $2.15d - 2$

D) $2.3d - 4.6$

12

$$\frac{z - 3}{z + 3} = 8$$

What is the value of z in the equation above?

A) $-\frac{27}{7}$

B) $-\frac{7}{2}$

C) -3

D) $-\frac{21}{9}$

CONTINUE

13

In the quadratic equation $x^2 - 3t = \frac{v}{3}x$, t and v are constants. What are the solutions for x?

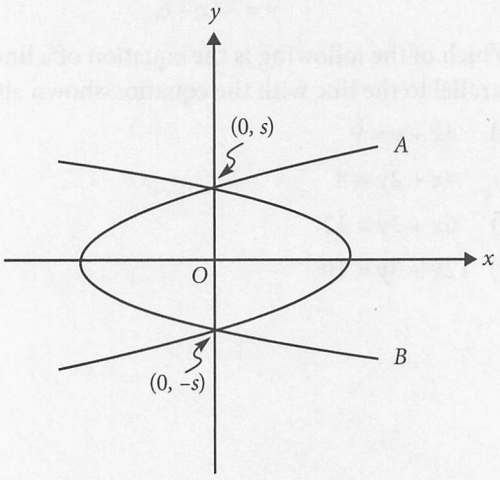
A) $x = \frac{v}{3} \pm \frac{\sqrt{v^2 + 4t}}{3}$

B) $x = \frac{v}{3} \pm \frac{\sqrt{v^2 + 36t}}{6}$

C) $x = \frac{v}{6} \pm \frac{\sqrt{v^2 + 108t}}{6}$

D) $x = \frac{v}{6} \pm \frac{\sqrt{v^2 + 4t}}{6}$

14



Two equations, A and B, defined by $x = 18y^2 - 2$ and $x = -18y^2 + 2$, respectively, are graphed in the xy-plane above. The graphs of A and B intersect at the points $(0, s)$ and $(0, -s)$. What is the value of s?

A) 3

B) 1

C) $\frac{1}{3}$

D) $\frac{1}{9}$

CONTINUE

15

In the equation $\frac{18 + i}{4 + 3i} = a + bi$, where a and b are real numbers, what is the value of a?

(Note: $i = \sqrt{-1}$)

A) 2

B) 3

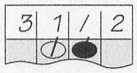
C) $\frac{18}{4}$

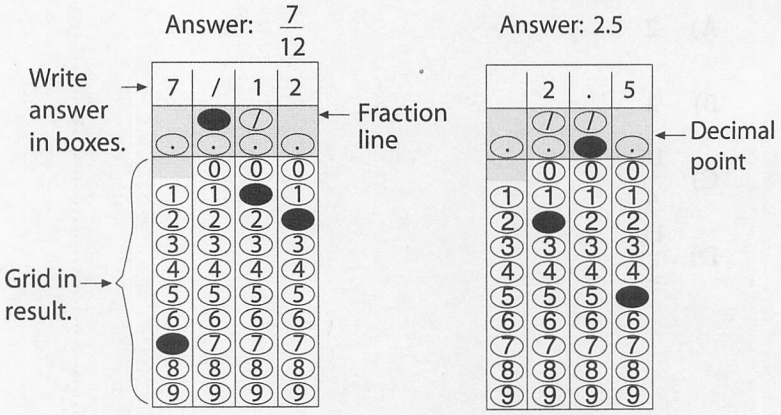
D) $\frac{11}{2}$

CONTINUE

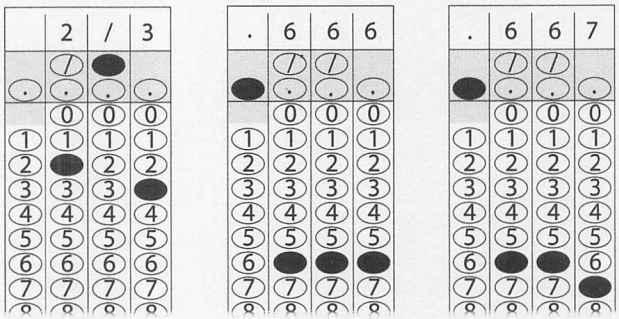
DIRECTIONS

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

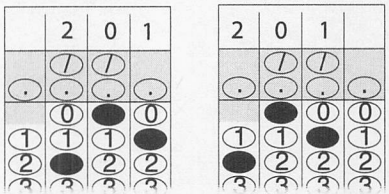
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
4. Some problems may have more than one correct answer. In such cases, grid only one answer.
5. **Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or 7/2. (If  is entered into the grid, it will be interpreted as $\frac{31}{2}$, not as $3\frac{1}{2}$.)
6. **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.



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



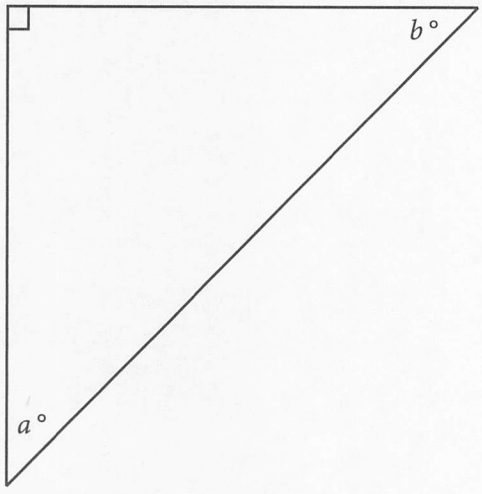
Answer: 201 – either position is correct



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

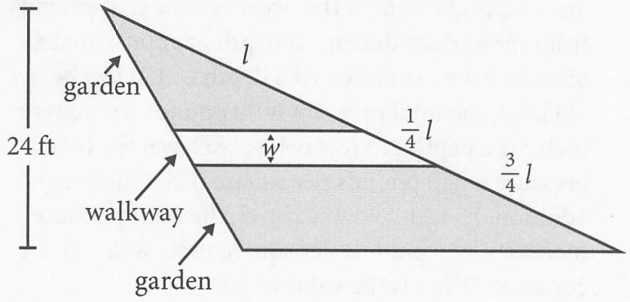
CONTINUE

16



In the triangle above, the cosine of $a°$ is 0.625. What is the sine of $b°$?

17



Bridget owns a triangular patch of land. She decides to convert it into a garden with a paved walkway, as shown above. The long sides of the walkway are parallel to each other and to the base of the triangular patch of land. What is the width, w, in feet, of the walkway?

18

$$8x - 5y = 27$$

$$5x + 10y = 30$$

The solution set of the system of equations above is (x, y). What is the value of y ?

CONTINUE

19

The epipelagic zone is the oceanic zone that extends from the surface down to a depth of approximately 650 feet below sea level. At a depth of 170 feet below sea level, the total pressure is 90 pounds per square inch. At a depth 215 feet below sea level, the total pressure is 110 pounds per square inch. For every additional 5 feet below sea level, the total pressure increases by p pounds per square inch, where p is a constant. What is the value of p ?

20

If $x^3 - 4x^2 + 3x - 12 = 0$, what real value is a solution for x ?

STOP

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

3

No Test Material On This Page

Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

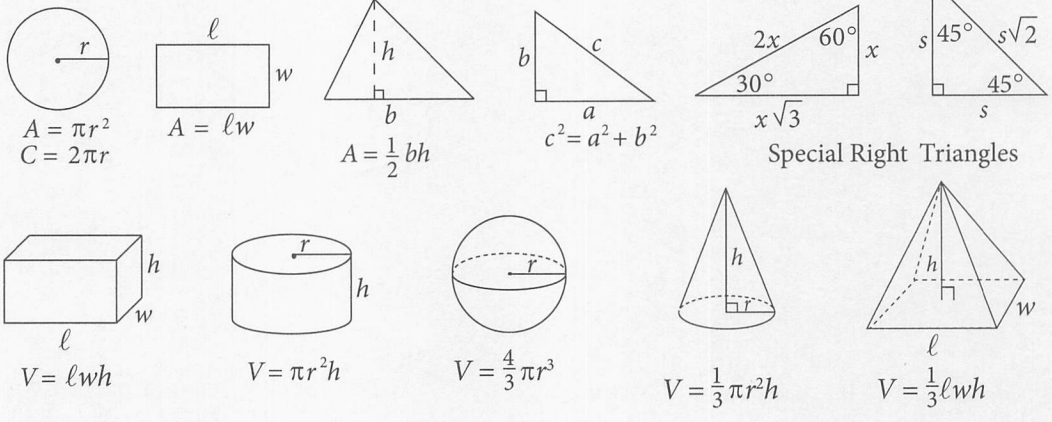
DIRECTIONS

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



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.

CONTINUE

1

To make the high school football team, Walter must be able to run a 40-yard dash in under 6 seconds. Walter currently runs the 40-yard dash in 7.2 seconds, and believes that with training he can reduce his time by 0.2 seconds per week. Which of the following represents the number of seconds in which Walter believes he will be able to run the 40-yard dash w weeks from now?

A) $0.2 - 7.2w$

B) $6.0 - 0.2w$

C) $7.2 + 0.2w$

D) $7.2 - 0.2w$

2

A piece of yarn 4 yards long is cut in half, and each half is cut into fourths. What is the length, in inches, of each of the pieces of yarn? (1 yard = 36 inches)

A) 8

B) 18

C) 24

D) 36

3

A ride-sharing service charges a base fee of $2.40 per ride. The cost of gas is included in the base fee, but there is an additional charge of $0.30 per mile. For one ride, Edward paid $3.60. How many miles long was Edward's ride?

A) 2

B) 3

C) 4

D) 5

4

Yesterday, Tiki cycled 13 fewer miles than Irina. If the two of them cycled a total of 51 miles yesterday, how many miles did Irina cycle?

A) 19

B) 32

C) 38

D) 64

CONTINUE

5

The resistance of a circuit is equal to the voltage applied to the circuit divided by the number of amps flowing through the circuit. How many amps are flowing through a circuit with a resistance of 9 ohms if 54 volts are applied to the circuit?

A) 486

B) 45

C) 6

D) 0.167

6

Florence interviewed a random sample of her first-year classmates in medical school to determine the statistical distribution of blood types among the students. Of the 75 students she interviewed, 38.7% had O-positive blood type. Based on this result, about how many of the 265 students in Florence's first-year class would be expected to have O-positive blood type?

A) 40

B) 80

C) 100

D) 110

CONTINUE

7

Number of Viewers by Favorite Television Network

	Age (years)					
Network	18–24	25–34	35–44	45–64	65 and older	Total
A	3,729	11,471	12,758	4,164	3,284	35,406
B	5,731	19,879	23,480	7,999	5,466	62,555
C	3,798	12,360	15,252	4,643	3,685	39,738
D	2,984	8,975	12,084	3,676	3,053	30,772
Total	16,242	52,685	63,574	20,482	15,488	168,471

A survey asked television viewers to name their one favorite network: *A*, *B*, *C*, or *D*. The table above displays the number of surveyed viewers, categorized by age group and favorite network. According to the table, if a viewer who was 35-to-64 years old at the time of the survey is chosen at random, which of the following is nearest to the probability that the viewer preferred network *D* ?

A) 0.20

B) 0.35

C) 0.50

D) 0.75

CONTINUE

8

Custom Furniture Made in 2015

Wood species	Furniture type				
	Beds	Chairs	Desks	Tables	Total
Cherry	9	7	0	15	31
Maple	12	6	9	0	27
Walnut	3	1	11	2	17
Total	24	14	20	17	75

The table above shows the 75 pieces of furniture that a custom furniture maker made in 2015, categorized by furniture type and wood species. What proportion of the furniture pieces are desks made of maple?

A) $\frac{2}{25}$

B) $\frac{3}{25}$

C) $\frac{4}{15}$

D) $\frac{9}{25}$

9

The graph of line m in the xy-plane passes through Quadrants I, II, and III, but not Quadrant IV. Which of the following must be true about the slope of line m?

A) It is positive.

B) It is negative.

C) It is undefined.

D) It is zero.

10

The graph of the function g in the xy-plane has x-intercepts at -2, 2, and 5. Which of the following could be the function g?

A) $g(x) = (x - 2)^2(x - 5)$

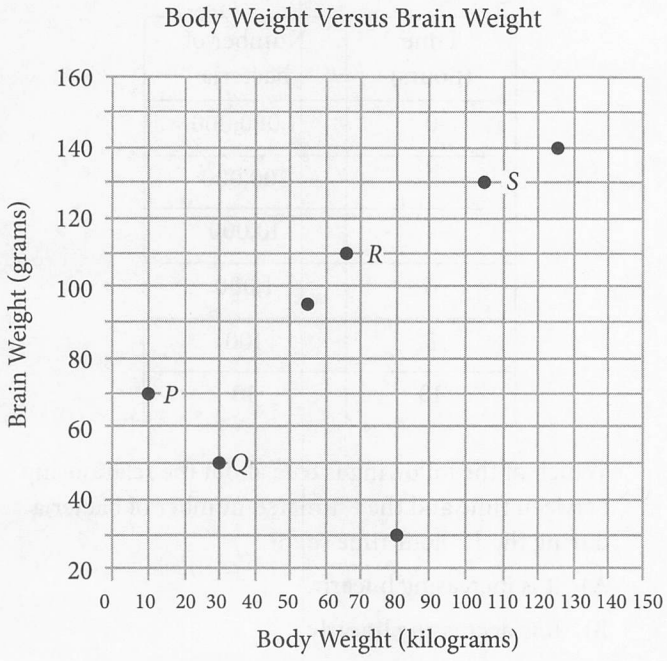
B) $g(x) = (x - 2)(x + 2)(x + 5)$

C) $g(x) = (x + 2)^2(x + 5)$

D) $g(x) = (x - 5)(x - 2)(x + 2)$

CONTINUE

Questions 11 and 12 refer to the following information.



A researcher at a university made the scatterplot above to illustrate the relationship between the body weight and brain weight of 9 species of animals.

11

What is the brain weight, in grams, of the animal that has the greatest body weight?

A) 70

B) 125

C) 140

D) 160

12

Of the points labeled *P*, *Q*, *R*, and *S*, which point represents the species whose ratio of brain weight to body weight is the least?

A) *P*

B) *Q*

C) *R*

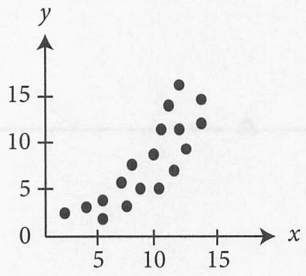
D) *S*

CONTINUE

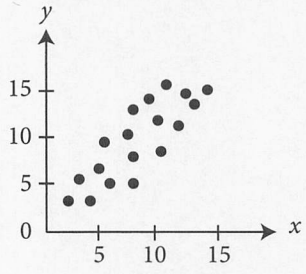
13

Which of the scatterplots below illustrates a relationship that is best modeled by the function $f(x) = \left(\frac{j}{x}\right)^k$, where j is a positive constant and k is a constant less than -1 ?

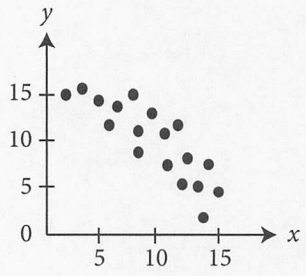
A)



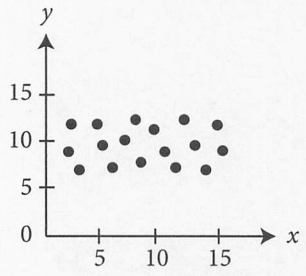
B)



C)



D)



14

The estimated number of bacteria in a laboratory culture over a span of 10 hours is shown in the table below.

Time (hours)	Number of bacteria
0	1,000,000
2	100,000
4	10,000
6	1,000
8	100
10	10

Which of the following is true about the relationship between time and the estimated number of bacteria during the 10-hour time span?

A) It is increasing linearly.

B) It is decreasing linearly.

C) It is increasing exponentially.

D) It is decreasing exponentially.

CONTINUE

15

The expression $20{,}000\left(1+\frac{p}{400}\right)^4$ shows the value, in dollars, one year after purchase, of a savings bond that has an initial value of \$20,000 and that pays an interest rate of p percent, compounded quarterly. If Roger purchased a bond that pays an interest rate of 4 percent and Pete purchased a bond that pays an interest rate of 6 percent, which of the following expressions represents how much more Pete earned than Roger earned, after one year?

A) $20{,}000\left(1+\frac{6-4}{400}\right)^4$

B) $20{,}000\left(1+\frac{\frac{6}{4}}{400}\right)^4$

C) $20{,}000\left(1+\frac{6}{400}\right)^4-20{,}000\left(1+\frac{4}{400}\right)^4$

D) $\frac{20{,}000\left(1+\frac{6}{400}\right)^4}{20{,}000\left(1+\frac{4}{400}\right)^4}$

Questions 16 and 17 refer to the following information.

Stella is planning a vacation and deciding which travel package to purchase. The table below shows the cost of airfare, hotel, and car rental for three different travel packages.

Travel package	Cost of airfare, A (in dollars)	Cost of hotel, H (in dollars per day)	Cost of car rental, R (in dollars per day)
P	400	85	60
Q	550	75	50
R	500	80	70

The total cost, $f(x)$, of a travel package for x days is given by the function $f(x) = A + H(x - 1) + Rx$, where $x \geq 2$.

16

If the relationship between the total cost, $f(x)$, of airfare, hotel, and car rental with travel package R and the number of days, x, for the package is graphed in the xy-plane, the slope of the graph represents which of the following?

A) The combined daily cost of the hotel and car rental

B) The daily cost of the hotel

C) The daily cost of the car rental

D) The total cost of airfare

CONTINUE

17

For how many days, x, will the total cost of travel package Q be less than or equal to the total cost of travel package P?

A) $x \leq 8$

B) $x \geq 8$

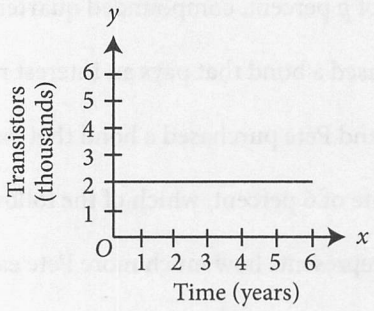
C) $x \leq 9.4$

D) $x \geq 9.4$

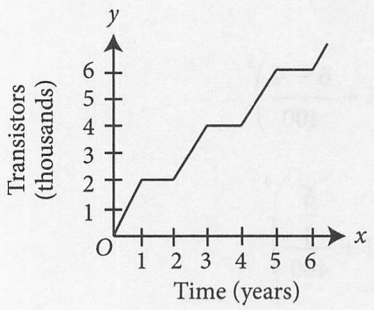
18

A well-known projection known as Moore's law states that the maximum number of transistors that can be placed on an integrated circuit doubles every two years. Which of the following graphs is an accurate representation of Moore's law? (Note: In each graph below, O represents (0, 0).)

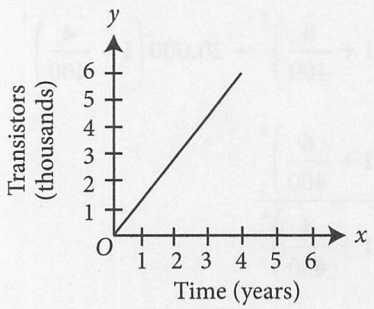
A)



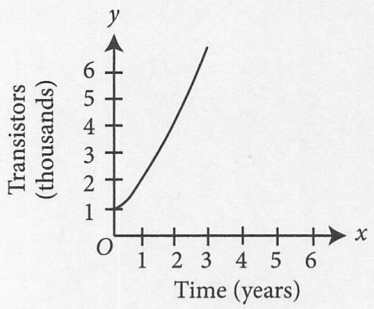
B)



C)



D)



CONTINUE

19

Bob has a number of identical right circular cylindrical buckets, each with an inside diameter of 1 foot. He pours oil from a 55-gallon drum into each bucket until it is full. If the height of the oil in each bucket is approximately 1.5 feet, what is the greatest number of full buckets Bob can pour from one 55-gallon drum of oil? (Note: There are 0.133 cubic feet in 1 gallon.)

A) 6

B) 7

C) 9

D) 10

20

If $2x + 5 \leq 9$, what is the greatest possible value of $2x - 5$?

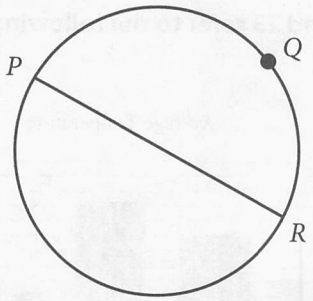
A) -3

B) -1

C) 0

D) 2

21



In the figure above, $\overline{PR}$ is a diameter. If the length of arc $\overset{\frown}{PQR}$ is 18π, what is the length of $\overline{PR}$?

A) 6

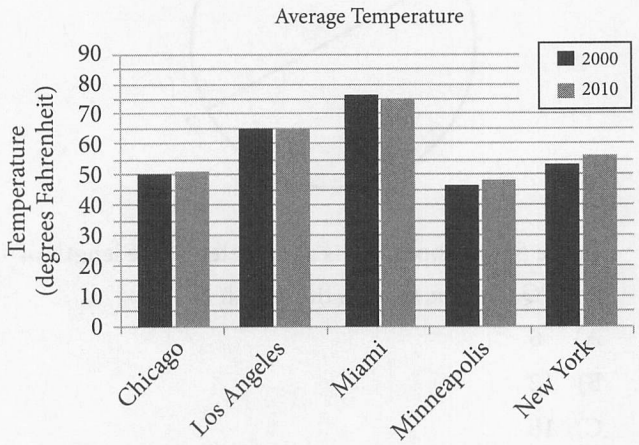
B) 12

C) 18

D) 36

CONTINUE

Questions 22 and 23 refer to the following information.



The bar graph above shows the average temperature in degrees Fahrenheit for five select cities in 2000 and 2010.

22

In a scatterplot of this data where the average temperature of each city in the year 2000 is plotted along the x-axis and the average in the year 2010 is plotted along the y-axis, how many data points would be below the line $y = x$?

A) 1

B) 2

C) 3

D) 4

23

Of the following, which best approximates the percent increase in the average temperature of New York from 2000 to 2010 ?

A) 0.5%

B) 1%

C) 6%

D) 12%

CONTINUE

24

The tables below show the distribution of scores of recent quizzes in English and Physics given to the same 33 students of a particular class.

English Quiz

Score	Frequency
1	5
2	7
3	8
4	7
5	6

Physics Quiz

Score	Frequency
1	1
2	2
3	3
4	22
5	5

Which of the following is true about the data provided for the 33 students?

A) The standard deviation of the scores on the English quiz is larger.

B) The standard deviation of scores on the Physics quiz is larger.

C) The standard deviation of the scores on the English quiz is the same as that of the Physics quiz.

D) The standard deviation for the scores on the two quizzes cannot be calculated from the data provided.

25

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

I. $a < 0$

II. $b < 0$

III. $a < |b|$

A) I only

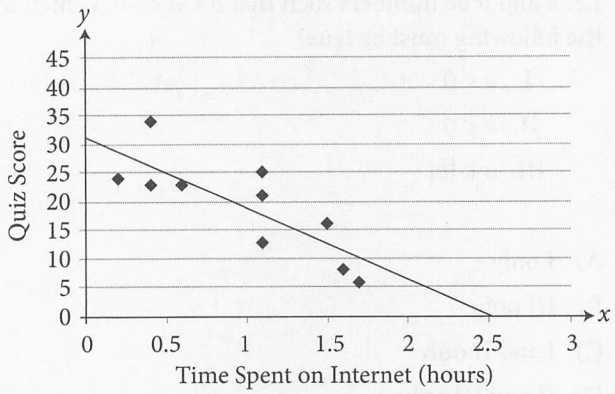
B) III only

C) I and II only

D) II and III only

CONTINUE

26



The scatterplot above shows scores on a recent quiz in a particular class and the number of hours the student spent on the Internet the day before. The line of best fit is also shown and can be described as $y = -12.408x + 31$. Which of the following best describes how the number 31 in the equation relates to the scatterplot?

A) On the quiz, even students who spend very little time on the Internet are unlikely to score above 31 on the quiz.

B) On the quiz, even students who spend very little time on the Internet never score above 31 on the quiz.

C) On the quiz, the lowest score was about 31% of the highest score.

D) On the quiz, the highest score on the test was 31.

27

$$r(x) = 3x^3 + 24x^2 + 21x$$

$$s(x) = x^2 + 8x + 7$$

The polynomials $r(x)$ and $s(x)$ are defined above. Which of the following polynomials is divisible by $3x + 4$?

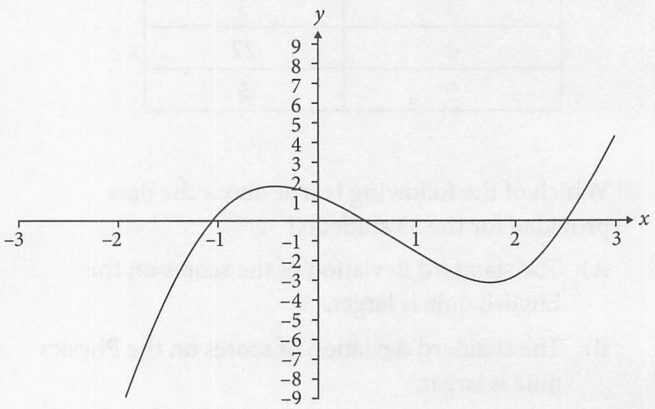
A) $a(x) = r(x) + s(x)$

B) $b(x) = r(x) + 2s(x)$

C) $c(x) = r(x) + 4s(x)$

D) $d(x) = 2r(x) + 4s(x)$

28



The function $g(x) = x^3 - 2x^2 - 2x + \frac{4}{3}$ is graphed in the xy-plane above. If c is a constant such that $g(x) = c$ has one real solution, which of the following could be the value of c?

A) 3

B) 1

C) 0

D) –1

CONTINUE

29

$g(x) = (x - 10)(x + 4)$

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

A) $g(x) = (x + 3)^2 - 31$

B) $g(x) = (x - 3)^2 - 49$

C) $g(x) = x^2 - 6x - 40$

D) $g(x) = x^2 - 40$

30

If a is the average (arithmetic mean) of $4x$ and 7, b is the average of $5x$ and 6, and c is the average of $3x$ and 11, what is the average of a, b, and c, in terms of x ?

A) $x + 4$

B) $x + 8$

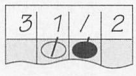
C) $2x + 4$

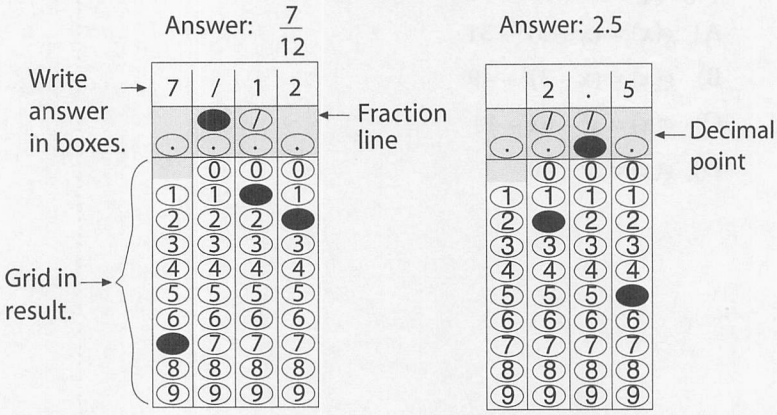
D) $4x + 8$

CONTINUE

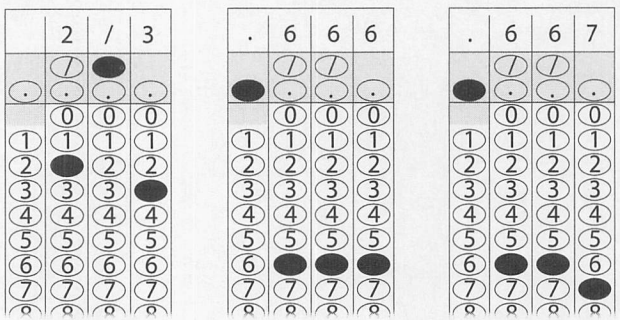
DIRECTIONS

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

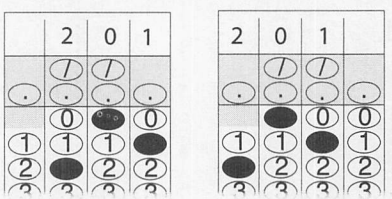
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
4. Some problems may have more than one correct answer. In such cases, grid only one answer.
5. **Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or 7/2. (If  is entered into the grid, it will be interpreted as $\frac{31}{2}$, not as $3\frac{1}{2}$.)
6. **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.



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



Answer: 201 – either position is correct



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

CONTINUE

31

The target heart rate during moderate activity R, in beats per minute, for an adult who is y years old can be estimated using the equation $R = \frac{3(220 - y)}{5}$. According to this estimate, for every increase of 2 years in age, by how many beats per minute will the target heart rate for adults engaged in moderate activity decrease?

32

At 1:00 P.M., a truck driver is 200 miles into a long journey to make a delivery. The driver continues on the journey and travels at an average speed of 60 miles per hour. How many total miles into the journey will the driver be at 8:00 P.M. ?

33

$$d = \frac{1}{2}at^2$$

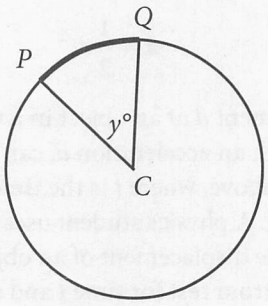
The displacement d of an object in a vacuum, starting from rest with an acceleration a, can be found using the formula above, where t is the time the object has been moving. A physics student uses the formula to determine the displacement of an object in a vacuum accelerating from rest for time t and an object with the same acceleration from rest for time $2.5t$. What is the ratio of the displacement of the object that accelerated for more time to the displacement of the object that accelerated for less time?

34

The *deben*, an ancient Egyptian unit of weight, is approximately equal to 3.21 ounces. It is also equivalent to 12 smaller Egyptian units called *shematies*. Based on these relationships, 488 shematies is equal to how many pounds, to the nearest hundredth? (16 ounces = 1 pound)

CONTINUE

35



Note: Figure not drawn to scale.

The circle above has center C and has a radius of 20. If the length of arc $\overset{\frown}{PQ}$ (shown in bold) is between 15 and 16, what is one possible integer value of y?

36

A toy store keeps marbles in the closet of its stock room. In the closet, 230 marbles are blue and 370 marbles are red. If 110 red marbles are added, how many blue marbles must be added to the closet so that $\frac{2}{5}$ of the marbles in the closet are blue?

Questions 37 and 38 refer to the following information.

A CD account contains $5,400 today. The account earns an annual interest of 7% for each of the next four years. The bank uses the equation $A = 5{,}400(r)^y$ to determine the amount of money in the account, A, after y years if no other deposits or withdrawals are made.

37

What numerical value should the bank use for r?

38

To the nearest dollar, how much money will be in the CD account at the end of the four years? (Note: Disregard the $ sign when gridding your answer.)

END OF TEST

DO NOT RETURN TO A PREVIOUS SECTION.