

SEPTEMBER 26, 2020  
US

# The SAT®

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# Test Book

## IMPORTANT REMINDERS

**1**

A No. 2 pencil is required for the test.  
Do not use a mechanical pencil or pen.

**2**

Sharing any questions with anyone is a violation of Test Security and Fairness policies and may result in your scores being canceled.

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**Test begins on the next page.**

# 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 Colson Whitehead, *Sag Harbor*. ©2009 by Colson Whitehead. The narrator is remembering a children's race at the annual Labor Day celebration held in his summer community when he was fifteen.

We were all there. It was where we mingled with who we had been and who we would be. Sharing space with our echoes out in the sun. The shy kid we used to be and were growing away from, the confident or hard-luck men we would become in our impending seasons, the elderly survivors we'd grow into if we were lucky, with gray stubble and green sun visors. The generations replacing and replenishing each other. Every summer this shifting-over took place in small degrees as you moved closer to the person who was waiting for you to catch up and some younger version of yourself elbowed you out of the way.

Where was my replacement, then? Which boy was it, standing with the others at the starting line.

Waiting for it to begin. Probably that knock-kneed creature in the green mesh T-shirt, with the scabbed knees and telltale messed-up Afro. Just looking at him, you knew he wasn't going to win. It was the way he carried himself, last place before he'd taken a step. But he'd give it a good try. Like he always did.

And who was I replacing? According to this scheme, he had to be here on this street, chowing down on some of Mr. Baxter's pork ribs. Was he one of Those Who Didn't Come Out Anymore? Had he been happy out here, or was he out in the world

never speaking of this place just as it did not speak of him, the one who did not turn out as expected. Did he find someone? Was he here watching over his kids to keep them safe and reminiscing with the old pals, shaking hands that were cold and wet from dips into coolers, catching the eye of his wife from the other side of the street. She smiles back and they share this moment in the crowd. Maybe he didn't exist and I was the first of my line. The mutant strain. Or I was in his vicinity, but I couldn't recognize him because I didn't believe I could grow into that one day, smiling and assured and at peace. That sleeping part of me finally roused to action. Maybe I saw him every day out here, passing him by, I was looking at him now, and I pitied the very sight of him, too scared to acknowledge how I would turn out.

The pistol sounded. They ran down the street, all the boys 11 to 12, slapping down the pavement in their cheap rubber. The obvious winner, the tallest kid, the most put-together kid, the one who knew how to move through the world, quickly pulled out in front. The kid I put my money on, the one in the green mesh shirt, didn't come in last, but just barely. He hunched over by the finish line, panting. Tough race. The first time we ran it, I remembered, this street was still dirt. They finally put some asphalt down and then people started retiring out here, staying past Labor Day and through the winter. It wasn't their summer place anymore. It was their home.

The winner jumped up and down. Mr. Grady said, "Almost beating Gary Osgood's famous record from 1981, but not quite, is Little Clive of

60 Azurest!” There was a Little Clive? How could there be more than one Clive, it was ridiculous. The recent overlap in Mohammads and Malcolms made sense, times change, but how could there be another Clive?

With the races over, the crowd reclaimed the street after being penned in the sidelines, bumping against the folding tables and old ladies’ chairs. I caught sight of my runner as the people hustled in. He turned from his friends and a darkness churned through his features for a moment before he found his mask again. Yeah, he had to be me. That was me all over. The look of fret when he slips up and for a second other people can see it. Sometimes you recognize yourself in other people right off and sometimes it’s subconscious. When you get older, you gather friends and lovers for reasons other than the accident that your houses are close together. There’s an affinity, stuff you share in common and things you seek out in other people. Something drew you together but you didn’t understand that secret undertow until one day after years and years of talking, it comes, the key story that lays it all out. Who could know at the start of that innocent evening that this was the night to make it plain. They tell you what happened and you think, we’re more alike than I knew, but of course you did know, it’s what brought you together.

1

In relation to the passage as a whole, a main purpose of the first paragraph is to

- A) establish the framework of an extended comparison.
- B) introduce a contrast between competing perspectives of an event.
- C) foreshadow a tragic outcome to a story.
- D) suggest the unreliability of the narrator’s memory.

2

Based on the passage, “We” in the first sentence most likely refers to both the current residents of the community and to their

- A) dead and living relatives.
- B) past and future counterparts.
- C) emotional and rational selves.
- D) near and faraway friends.

3

According to the passage, the narrator’s first impression of the boy in the green shirt is that he reacts to discouraging situations primarily by

- A) befriending his competitors.
- B) avoiding his responsibilities.
- C) refusing help from others.
- D) making a determined effort.

4

Which choice best supports the idea that the narrator sees a link between self-assurance and success?

- A) Lines 43-45 (“They ran . . . rubber”)
- B) Lines 45-48 (“The obvious . . . front”)
- C) Lines 57-60 (“The winner . . . Azurest”)
- D) Lines 71-72 (“The look . . . see it”)

5

The main purpose of the third paragraph (lines 22-42) is to reveal the narrator’s

- A) frustration with the predictability of his elders.
- B) curiosity about the variety of choices open to him.
- C) uncertainty about the type of person he will become.
- D) alarm at the rapid approach of adult obligations.

6

As used in line 35, “line” most nearly means

- A) path.
- B) ridge.
- C) kind.
- D) occupation.

7

The narrator indicates that the passage’s setting had changed from being a place that

- A) had a thriving population to a place whose population had declined.
- B) local children mostly disliked to a place that they mostly enjoyed.
- C) had hosted many athletic competitions to a place that hosted few.
- D) people generally visited for a season to a place where some people lived permanently.

8

A main theme of the passage is that

- A) individuals are connected to each other in ways they may not immediately understand.
- B) people benefit most from activities based on allegiance to a community.
- C) friends begin their relationships as strangers who are often wary of one another.
- D) each person possesses a unique combination of traits that endure throughout a lifetime.

9

Which choice most clearly illustrates the theme in the answer to the previous question?

- A) Lines 25-29 (“Had . . . someone”)
- B) Lines 51-55 (“The first . . . anymore”)
- C) Lines 78-82 (“Something . . . out”)
- D) Lines 82-83 (“Who . . . plain”)

10

In lines 83-86 (“They . . . together”), the narrator makes a distinction between which two types of knowledge?

- A) Detached analysis and biased opinion
- B) Intuitive insight and active awareness
- C) Personal discovery and public information
- D) Overused ideas and original thought

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

This passage is adapted from George Washington’s Farewell Address. Originally published in 1796.

Observe good faith and justice toward all nations. Cultivate peace and harmony with all. Religion and morality enjoin this conduct; and  
 Line can it be that good policy does not equally  
 5 enjoin it? It will be worthy of a free, enlightened, and, at no distant period, a great nation to give to mankind the magnanimous and too novel example of a people always guided by an exalted justice and benevolence. Who can doubt that in the course of  
 10 time and things the fruits of such a plan would richly repay any temporary advantages which might be lost by a steady adherence to it? Can it be that Providence has not connected the permanent felicity of a nation with its virtue? The experiment, at least, is  
 15 recommended by every sentiment which ennobles human nature. Alas! is it rendered impossible by its vices?

In the execution of such a plan nothing is more essential than that permanent, inveterate antipathies  
 20 against particular nations and passionate attachments for others should be excluded and that in place of them just and amicable feelings toward all should be cultivated. The nation, which indulges toward another a habitual hatred, or a habitual  
 25 fondness, is in some degree a slave. It is a slave to its animosity or to its affection, either of which is sufficient to lead it astray from its duty and its interest. Antipathy in one nation against another disposes each more readily to offer insult and injury,  
 30 to lay hold of slight causes of umbrage, and to be haughty and intractable when accidental or trifling occasions of dispute occur. . . .

. . . So likewise, a passionate attachment of one nation for another produces a variety of  
 35 evils. Sympathy for the favorite nation, facilitating the illusion of an imaginary common interest, in cases where no real common interest exists, and infusing into one the enmities of the other, betrays the former into a participation in the quarrels and  
 40 wars of the latter without adequate inducement or justification. . . . And it gives to ambitious, corrupted, or deluded citizens (who devote themselves to the favorite nation) facility to betray or sacrifice the interests of their own country, without odium,  
 45 sometimes even with popularity, gilding with the

appearances of a virtuous sense of obligation, a commendable deference for public opinion, or a laudable zeal for public good, the base or foolish compliances of ambition, corruption, or  
 50 infatuation. . . .

. . . Against the insidious wiles of foreign influence (I conjure you to believe me, fellow-citizens) the jealousy of a free people ought to be constantly awake, since history and experience prove that  
 55 foreign influence is one of the most baneful foes of republican government. But that jealousy to be useful must be impartial, else it becomes the instrument of the very influence to be avoided instead of a defense against it. . . .

60 . . . The great rule of conduct for us, in regard to foreign nations, is in extending our commercial relations to have with them as little political connection as possible. So far as we have already formed engagements, let them be fulfilled with  
 65 perfect good faith. Here let us stop.

11

The main purpose of the passage is to

- A) articulate a set of foreign policy principles.
- B) trace the historical development of a cultural attitude.
- C) respond to a criticism about an interaction with a foreign nation.
- D) urge citizens to become more knowledgeable about international relations.

12

As used in lines 3 and 5, “enjoin” most nearly means

- A) prescribe.
- B) forewarn.
- C) forbid.
- D) defend.

13

In the passage, Washington suggests that the interests of the United States would best be served if its relations with other nations were characterized by

- A) cautious imitation.
- B) amicable competition.
- C) dispassionate congeniality.
- D) diplomatic frankness.

14

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

- A) Lines 9-12 (“Who . . . to it”)
- B) Lines 18-23 (“In the . . . cultivated”)
- C) Lines 51-56 (“Against . . . government”)
- D) Lines 63-65 (“So far . . . faith”)

15

As used in lines 36-37, “common” most nearly means

- A) shared.
- B) sociable.
- C) widespread.
- D) ordinary.

16

Washington implies that if the United States were to cultivate more favorable relationships with some nations than with others, the most likely result would be that the United States would

- A) be unable to maintain commercial relationships that are essential to its economic prosperity.
- B) be fragmented by increasing political divisions among its own citizens.
- C) find that favored nations would attempt to control United States foreign policy decisions.
- D) be drawn into conflicts that were otherwise unnecessary.

17

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

- A) Lines 1-2 (“Observe . . . nations”)
- B) Lines 23-25 (“The nation . . . slave”)
- C) Lines 35-41 (“Sympathy . . . justification”)
- D) Lines 56-59 (“But that . . . it”)



18

In line 52, Washington includes the parenthetical statement most likely to

- A) qualify his original argument.
- B) engage his audience directly.
- C) provide a note of evidence.
- D) suggest a possible outcome.

19

In context, the final sentence of the passage indicates that the United States should

- A) refuse to help other countries if helping them would put the welfare of the United States in jeopardy.
- B) satisfy its obligations to other countries but go no further than what its arrangements with them require.
- C) cease the discussion about the relationship between the United States and other nations and turn its attention to new topics.
- D) value its bonds with other nations and do its best to assist its allies in potential conflicts.

20

The passage implies that the most desirable economic policy for the United States would be one that

- A) allows its national wealth to grow as quickly as possible.
- B) refuses to exchange products with nations that are enemies of its allies.
- C) abstains from trade relations that require political agreements.
- D) maximizes the sale of resources that are plentifully available.

21

As used in line 64, “engagements” most nearly means

- A) agreements.
- B) encounters.
- C) plights.
- D) defenses.

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

This passage and accompanying figures are adapted from James A. Estes, "Carnivory and Trophic Connectivity in Kelp Forests." ©2005 by Island Press. The author describes the possible role of killer whales in the decline of the Aleutian Islands sea otter population in the 1990s.

Initially, it seemed that an unrealistically large number of killer whales would have been required to eat so many sea otters over such a short time period.

Line However, by combining the loss estimates with  
5 measures of killer whale nutritional requirements and sea otter nutritional content, we calculated that fewer than four killer whales feeding solely on sea otters could have eaten all of the 40,000 sea otters. These various observations and analyses led us to  
10 conclude that killer whale predation was a reasonable and likely explanation for the decline.

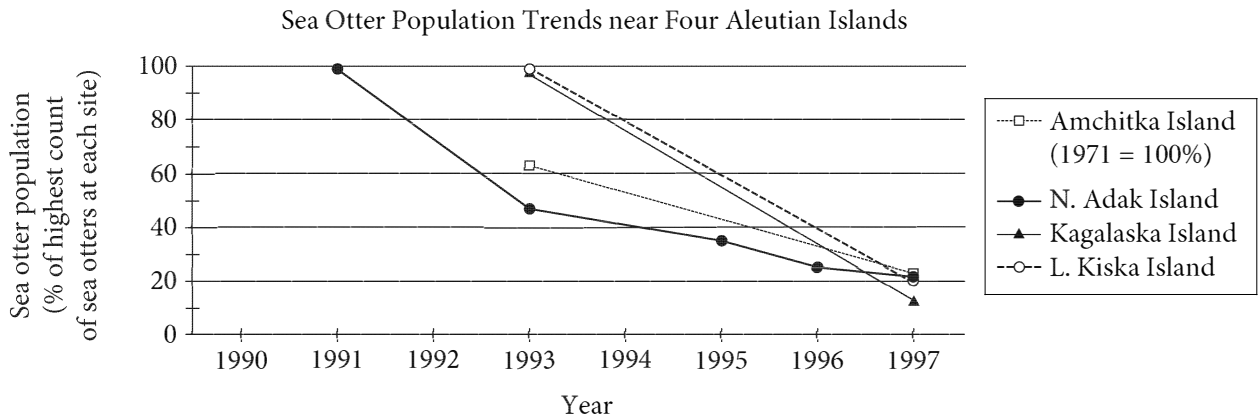
What caused the killer whales to suddenly eat so many sea otters? We began exploring this question by assuming that either increased numbers of killer  
15 whales or a change in their behavior caused it to happen. Since a rapid population increase by killer whales seemed unlikely, we focused on the behavioral ecology of killer whales and the history of their food resources within the area of the sea otter  
20 decline.

Three killer whale ecotypes have been described for the North Pacific Ocean: those that feed mostly on fish (the "residents"), those that feed mostly on marine mammals (the "transients"), and those that  
25 feed in offshore oceanic waters (the diet of these animals is poorly known). A strong potential for cultural evolution created by the species' distinct matrilineal social structure and very long period of association between mothers and their young is  
30 thought to be important in the generation and maintenance of these ecotypes. Two inferences emerged from the preceding view of killer whale behavior. One was that transient killer whales were probably responsible for the sea otter declines. The  
35 other was that the prey base of these transients must have changed in some way to cause this to happen. The well-documented collapse of pinniped populations, including Steller sea lions, northern fur seals, and harbor seals—all of which are eaten by  
40 killer whales—in the western Gulf of Alaska and Aleutian Islands during the 1970s and 1980s provided a reasonable explanation. We hypothesized that some of the pinniped-eating killer whales

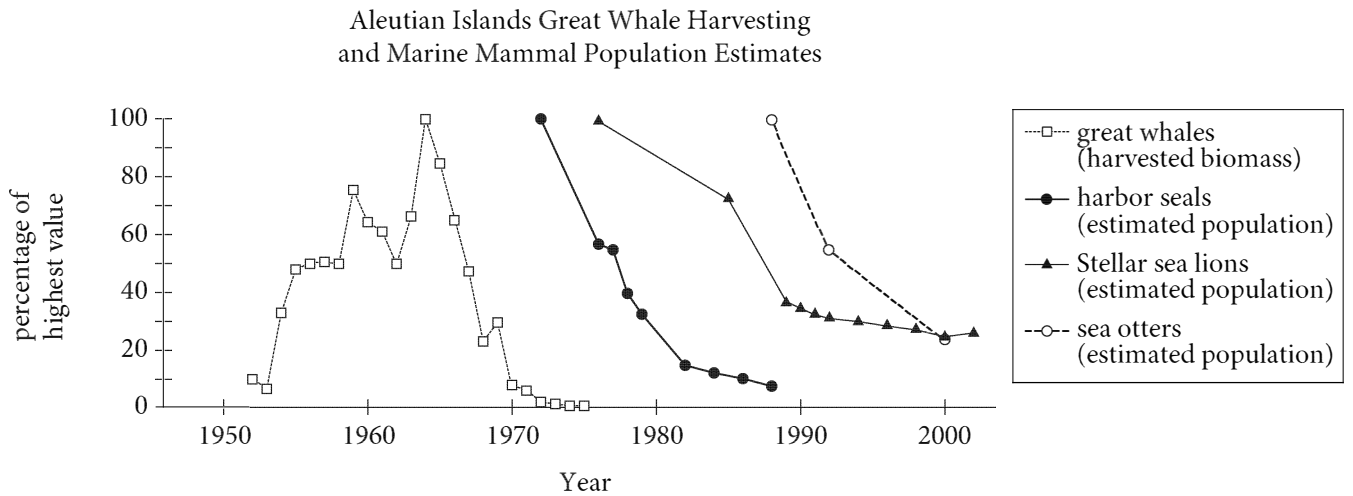
expanded their diets to include sea otters as the  
45 dwindling numbers of pinnipeds were no longer able to sustain them. This hypothesis is supported by the fact that the sea otter decline began as the most precipitous phase of the Steller sea lion decline in the Aleutian Islands was ending.

50 If our hypothesis is true, then a search for the ultimate cause of the sea otter collapse rests squarely on the question of why the pinnipeds declined. Several lines of evidence and reasoning led my colleagues and me to suspect that increased killer  
55 whale predation had also caused the pinniped declines. For one, the sea otter and sea lion declines were similar in pattern and geographical range. If killer whale predation caused the sea otter decline, it seemed reasonable to us that this process might have  
60 figured prominently in the sea lion declines as well. Demographic and energetic analyses have demonstrated that relatively small changes in killer whale behavior here too could have driven the sea lion declines. We estimate that as few as 26 killer  
65 whales could have generated all of the necessary mortality in the Aleutian Islands if these animals fed exclusively on sea lions. Alternatively, a dietary shift of less than 1% (based on source of caloric input) by the region's entire killer whale population (estimated  
70 at about 3800 individuals) also could have driven the decline. These extreme-case scenarios establish the ease with which some intermediate possibility could have caused the sea lion population decline.

**Figure 1**



**Figure 2**



Harvested biomass serves as an indicator for the population of great whales, an important food resource for killer whales.

22

In accounting for the decline of the sea otter population discussed in the passage, the author makes his case by

- A) illustrating that various criticisms of the proposed explanation are unfounded.
- B) re-creating prior studies as a way to develop a more comprehensive understanding.
- C) demonstrating that the proposed explanation is feasible even under fairly unlikely conditions.
- D) pointing out that competing explanations do not take into account all of the available evidence.

23

The main purpose of the second paragraph (lines 12-20) is to

- A) describe the calculations that led to the study's hypothesis.
- B) explain the thinking that informed the researchers' line of inquiry.
- C) indicate the methods by which data were observed and collected.
- D) question how a conclusion about a finding was reached.

24

The third paragraph (lines 21-49) primarily serves to

- A) explain why the research team was forced to revise its hypothesis.
- B) refute a hypothesis advanced by a competing research team.
- C) compare opposing hypotheses about the same phenomenon.
- D) outline the reasoning behind the hypothesis advanced by the author.

25

The research conducted by the author and his team most directly addresses which question about the eating habits of killer whales?

- A) Will transient killer whales feed on fish if marine mammals are unavailable?
- B) Why was there a shift in the diet of transient killer whales?
- C) What are the food resources of killer whales that feed in offshore oceanic waters?
- D) How did the diet of resident killer whales change?

26

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

- A) Lines 21-26 (“Three . . . known”)
- B) Lines 26-31 (“A strong . . . ecotypes”)
- C) Lines 42-46 (“We hypothesized . . . them”)
- D) Lines 56-57 (“For one . . . range”)

27

As used in line 29, “association” most nearly means

- A) interaction.
- B) organization.
- C) agreement.
- D) memory.

28

Which choice provides the best evidence in support of the researchers' hypothesis for why sea lion populations collapsed?

- A) Lines 31-33 (“Two . . . behavior”)
- B) Lines 33-34 (“One . . . declines”)
- C) Lines 50-52 (“If our . . . declined”)
- D) Lines 61-64 (“Demographic . . . declines”)

29

As used in line 60, “figured” most nearly means

- A) played a role.
- B) made sense.
- C) estimated.
- D) believed.

30

According to figure 1, which site had experienced the greatest percent decrease in its sea otter population by 1997?

- A) Amchitka Island
- B) N. Adak Island
- C) Kagalaska Island
- D) L. Kiska Island

31

The data shown in figure 2 are consistent with which inference about the Aleutian Islands great whales?

- A) The great whales’ decline in the late 1960s and early 1970s led killer whales to turn to harbor seals as a food resource.
- B) The great whales’ decline in the late 1960s and early 1970s was mirrored by a decline in the killer whales’ population.
- C) The great whales recovered somewhat after 1970 as new species of prey were introduced into the killer whales’ environment.
- D) The great whales were an insubstantial portion of killer whales’ diets prior to the early 1970s.

32

Taken together, the passage and figure 2 support which generalization about killer whales in the Aleutian Islands?

- A) They have preyed on sea otters to a greater extent than they have on any other marine mammals.
- B) They appear to prefer pinnipeds to either great whales or sea otters as a food resource.
- C) Since 1960, they have suffered serious food shortages as their prey resources have declined.
- D) Over the years, they appear to have specialized in one prey population at a time.

**Questions 33-42 are based on the following passage and supplementary material.**

This passage is adapted from Katharine Viner, “How Technology Disrupted the Truth.” ©2016 by Guardian News and Media Limited.

Emily Bell, the director of the Tow Centre for Digital Journalism at Columbia University, has outlined the seismic impact of social media for journalism. “Our news ecosystem has changed more dramatically in the past five years,” she wrote, “than perhaps at any time in the past 500.” The future of publishing is being put into the “hands of the few, who now control the destiny of the many.” News publishers have lost control over the distribution of their journalism, which for many readers is now “filtered through algorithms and platforms which are opaque and unpredictable.” This means that social media companies have become overwhelmingly powerful in determining what we read—and enormously profitable from the monetisation of other people’s work. As Bell notes: “There is a far greater concentration of power in this respect than there has ever been in the past.”

Publications curated by editors have in many cases been replaced by a stream of information chosen by friends, contacts and family, processed by secret algorithms. The old idea of a wide-open web—where hyperlinks from site to site created a non-hierarchical and decentralised network of information—has been largely supplanted by platforms designed to maximise your time within their walls, some of which (such as Instagram and Snapchat) do not allow outward links at all.

Many people, in fact, especially teenagers, now spend more and more of their time on closed chat apps, which allow users to create groups to share messages privately. But the closed space of a chat app is an even more restrictive silo than the walled garden of Facebook or other social networks.

As the pioneering Iranian blogger Hossein Derakhshan, who was imprisoned in Tehran for six years for his online activity, wrote, the “diversity that the world wide web had originally envisioned” has given way to “the centralisation of information” inside a select few social networks—and the end result is “making us all less powerful in relation to government and corporations.”

Of course, Facebook does not decide what you read—at least not in the traditional sense of making decisions—and nor does it dictate what news

organisations produce. But when one platform becomes the dominant source for accessing information, news organisations will often tailor their own work to the demands of this new medium. (The most visible evidence of Facebook’s influence on journalism is the panic that accompanies any change in the news feed algorithm that threatens to reduce the page views sent to publishers.)

In the last few years, many news organisations have steered themselves away from public-interest journalism and toward junk-food news, chasing page views in the vain hope of attracting clicks and advertising (or investment). The most extreme manifestation of this phenomenon has been the creation of fake news farms, which attract traffic with false reports that are designed to look like real news, and are therefore widely shared on social networks. But the same principle applies to news that is misleading or sensationally dishonest, even if it wasn’t created to deceive: the new measure of value for too many news organisations is virality rather than truth or quality.

Of course, journalists have got things wrong in the past—either by mistake or prejudice or sometimes by intent. So it would be a mistake to think this is a new phenomenon of the digital age. But what is new and significant is that today, rumours and lies are read just as widely as copper-bottomed facts—and often more widely, because they are wilder than reality and more exciting to share.

Figure 1

Survey Responses to the Question,  
“For each dimension, which of the news sources  
you’ve used in the last week do you value most?”

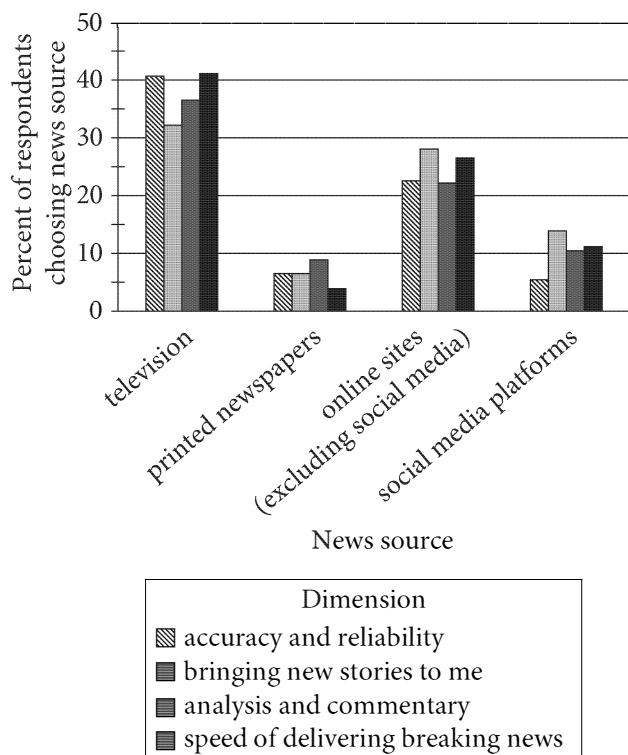
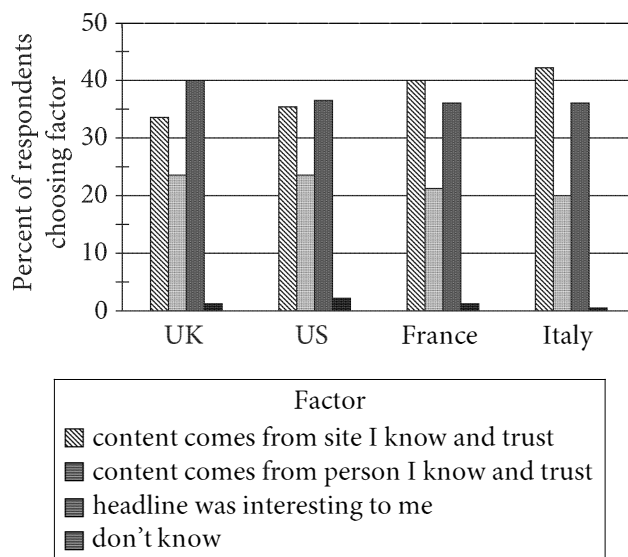


Figure 2

Survey Responses to the Question, “When deciding  
whether to click on a link posted on social media,  
which factor do you consider most important?”



Figures adapted from Nic Newman, David A. L. Levy, and Rasmus Kleis Nielson, “Reuters Institute Digital News Report 2015: Tracking the Future of News.” ©2015 by Reuters Institute for the Study of Journalism.

33

In the passage, the author describes certain social platforms as a “restrictive silo” and “walled garden” (lines 33-34) to

- suggest that younger users want complete control over the information they share with peers.
- underscore how the features of these platforms serve to regulate the distribution of information.
- demonstrate how the design of these platforms shifted from encouraging open dialogue to limiting user interactions.
- assert that the greater security provided by these platforms outweighs their shortcomings.

34

In the first paragraph, the author includes the quotation from Bell about the “news ecosystem” (line 4) to

- A) contend that journalists now write news for an audience they had previously disregarded.
- B) emphasize that the recent transformation of journalism is unprecedented.
- C) assert that news publishers are alarmed by the advent of social media.
- D) challenge the assumption that journalists validate their claims.

35

As used in line 17, “concentration” most nearly means

- A) centralization.
- B) attention.
- C) quantity.
- D) exertion.

36

In the passage, the author suggests that news publishers would most likely respond to the rise in prominence of a social media company with

- A) disapproval, as they recognize that the company will choose to focus exclusively on mainstream news.
- B) anxiety, as they are aware that their profit margins will temporarily fluctuate owing to changes in leadership.
- C) adaptability, as they modify their content according to how that company disseminates news.
- D) enthusiasm, as they have the opportunity to develop new media to target a specific audience.

37

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

- A) Lines 9-12 (“News . . . unpredictable”)
- B) Lines 43-46 (“Of course . . . produce”)
- C) Lines 46-49 (“But . . . medium”)
- D) Lines 50-53 (“The most . . . publishers”)

38

The author suggests that in the news industry, “public-interest journalism” (lines 55-56) is increasingly being replaced by journalism that

- A) attracts readers who rarely engage with the news.
- B) prioritizes the popularity of a topic over its significance.
- C) avoids controversial subjects.
- D) emulates the aesthetic of nonjournalistic media.

39

In the passage, the author anticipates which objection to her critique of the credibility of online journalism?

- A) Online journalism is able to provide relevant and engaging content to readers.
- B) Journalists follow a clear protocol of attributing their sources when reporting on the news.
- C) Social networks foster frank discussions of news that is widely distributed online.
- D) Older forms of journalism exist that contain purposely inaccurate information.



40

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

- A) Lines 58-63 (“The most . . . networks”)
- B) Lines 63-67 (“But the . . . quality”)
- C) Lines 68-70 (“Of course . . . intent”)
- D) Lines 72-75 (“But what . . . share”)

41

Which statement about respondents’ opinions on news sources is best supported by figure 1?

- A) On average, respondents indicated that printed newspapers cover the news more accurately and reliably than do online sites, excluding social media.
- B) On average, respondents indicated that online sites, excluding social media, offer better analysis and commentary on the news than does television.
- C) On average, respondents indicated that printed newspapers introduce them to a wider array of new stories than do social media platforms.
- D) On average, respondents indicated that online sites, excluding social media, provide more accurate and reliable news than do social media platforms.

42

In figure 2, which finding most directly challenges the author’s argument in the last two paragraphs (lines 54-75) about how news is shared online?

- A) On average, respondents from France and Italy valued the perceived trustworthiness of sites over the interest level of headlines.
- B) On average, respondents from all four countries valued content from trusted people less than content from trusted sites or content with interesting headlines.
- C) On average, respondents from the United Kingdom valued the interest level of headlines over all other factors.
- D) On average, respondents from the United Kingdom and the United States were nearly identical in their attitudes on when to click on links posted to social media.

**Questions 43-52 are based on the following passages.**

Passage 1 is adapted from Christopher Crockett, “Experts Don’t Agree on Age of Saturn’s Rings.” ©2016 by Society for Science & the Public. Passage 2 is adapted from Matija Ćuk, “How Old Are Saturn’s Rings?” ©2016 by SETI Institute.

**Passage 1**

Data from the Cassini spacecraft, in orbit since 2004, may help resolve a decades-long debate over the age of Saturn’s rings, wide belts of shiny ice chunks orbiting the planet. They may be primordial, dating back to roughly 4.6 billion years ago, or a recent addition in the last 100 million years or so.

There’s not enough pollution in the rings for them to have been around for a long time, argues planetary scientist Paul Estrada of the SETI Institute in California. Cassini data show that about 25 times as much debris—mostly from the Kuiper belt beyond Neptune—rains down on the rings than previously thought. All that interplanetary rain should not just darken the rings, but each impact should redistribute material as well. Sharp contrasts in composition seen at the inner edge of the main ring can’t have been sustained for more than a few hundred million years, Estrada says.

The trouble with making rings so recently is how to do it. “It’s hard to make rings in the last 100 million years,” says Larry Esposito, a planetary scientist at the University of Colorado Boulder. “This is not an exciting time.” Saturn’s rings were probably created after a moon or some passing icy body got torn apart in a collision or by wandering too close to the planet. But there hasn’t been much stuff flying around Saturn or the solar system in the last several billion years.

Esposito argues that despite some youthful appearances, the rings are ancient and recycle material lurking beneath their top layers, keeping the pollution levels lower than expected. Also, some lightweight rings could have formed quite recently and still look pristine, he says, while the most massive part of the rings endured for billions of years.

Part of the solution to the age question is knowing how massive the rings are. Observations from Cassini suggest that the rings are relatively hefty—possibly comparable to Saturn’s moon Mimas—

though that’s not well known. “It’s a lot easier to make a massive ring if you make it early,” says Glen Stewart, also at Colorado Boulder. Billions of years ago more material was available to make a heavy ring than in recent times.

A lightweight ring could be formed more recently, however. Computer simulations suggest that the orbits of moons around Saturn could have changed a lot in the last several hundred million years or so, Estrada says. Those shifting orbits could lead to several different scenarios in which moons destroy one another, creating icy debris that spreads out and forms rings.

**Passage 2**

Are Saturn’s rings as old as the planet, or are they relatively new and we’re just lucky to be around at the same time as they are?

One clue to the answer could be found in the shifts of the inner moons now orbiting this large world. In 2012, Valery Lainey and his team at the Paris Observatory found that the tides within Saturn’s fluid interior enlarge the inner moons’ orbits so fast that the system could not have stayed so compact since the beginning of the solar system, 4.5 billion years ago.

Additional proof of a young age has been found by computer simulations that model the past orbital evolution of the moons. We’ve determined that when the moons shift their orbits due to Saturn’s internal tides, they sometimes encounter orbital resonances, which are configurations in which one moon’s orbital period is a simple fraction of another’s. When two moons are in orbital resonance, they alter each other’s orbit strongly, making originally flat and round orbits into tilted ellipses.

By simulating past orbital resonances between the largest three inner moons of Saturn—Tethys, Dione and Rhea—we find their orbits could not have evolved as much as previously thought, or they would have encountered more orbital resonances in the past, and their orbits should have been considerably more tilted relative to each other than we observe today.

While our simulations tell us how much the orbits shifted, they don’t indicate how old the system is in 55 years. To help with this problem, we turn to the geysers on the icy moon Enceladus, whose energy output should be tied to the strength of tides within Saturn.

Using measurements of the hydrothermal power  
90 of Enceladus from the Cassini spacecraft, we arrive at  
an age of 100 million years for the icy moons of  
Saturn (i.e., those interior to Titan), which we believe  
is also likely to be the age of the rings.

This would date the formation of Saturn's rings  
95 and inner moons to the Cretaceous period, which  
was during the age of the dinosaurs.

43

As used in line 2, “resolve” most nearly means

- A) focus.
- B) settle.
- C) dilute.
- D) change.

44

Paul Estrada's argument in Passage 1 suggests that a  
relatively old ring would

- A) appear to be more uniform in its makeup than a younger ring.
- B) tend to have a greater proportion of ice than a younger ring.
- C) be more resistant to damage from pollution than a younger ring.
- D) be more likely to shift its orbit over time than a younger ring.

45

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

- A) Lines 7-10 (“There’s . . . California”)
- B) Lines 10-13 (“Cassini . . . thought”)
- C) Lines 13-15 (“All . . . well”)
- D) Lines 15-18 (“Sharp . . . says”)

46

The reference to dinosaurs in the last paragraph of  
Passage 2 primarily serves to

- A) suggest that conditions on Earth and Saturn were somewhat similar during the period in which Saturn's rings were formed.
- B) demonstrate how measurements of hydrothermal power can be used to date events on Earth as well as on Saturn.
- C) emphasize the fundamental differences between two developments taking place within the same solar system 100 million years ago.
- D) highlight the young age of Saturn's rings by relating the time of their formation to a familiar and relatively recent phenomenon in Earth's history.

47

According to the author of Passage 2, alterations in  
the orbits of Saturn's inner moons occur partly as a  
result of

- A) an increase in the hydrothermal output of individual moons.
- B) periodic changes in Saturn's orbital path.
- C) forces generated by tidal activity within Saturn.
- D) interplanetary debris moving too close to Saturn.

48

As used in line 79, “encountered” most nearly means

- A) approached.
- B) faced.
- C) exposed.
- D) resisted.

49

Which choice best states the relationship between the two passages?

- A) Passage 1 presents evidence supporting contrasting points of view on an issue, while Passage 2 presents evidence supporting a single point of view on that issue.
- B) Passage 1 elaborates on the details of a particular scientific problem, while Passage 2 focuses on the methods employed to solve that problem.
- C) Passage 1 provides an overview of a new theoretical model, while Passage 2 presents the results of empirical research based on that model.
- D) Passage 1 considers several approaches to testing a particular hypothesis, while Passage 2 argues that only one of those approaches is valid.

50

Both passages make reference to which type of evidence?

- A) Simulations of the tidal movements in Saturn's fluid interior
- B) Simulations of the past orbits of Saturn's moons
- C) Measurements of energy output from the interior of one of Saturn's moons
- D) Measurements of interplanetary debris originating in the Kuiper belt

51

Esposito, cited in Passage 1, would most likely respond to the claim about the age of Saturn's rings presented in lines 89-93 ("Using . . . rings") by

- A) agreeing, given the mass of the materials that compose Saturn's moons.
- B) agreeing, given the shift in orbits of Saturn's moons predicted by the simulations.
- C) disagreeing, given the relatively recent formation of lightweight rings.
- D) disagreeing, given the lack of available debris in the past 100 million years.

52

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

- A) Lines 19-22 ("The trouble . . . Boulder")
- B) Lines 23-26 ("Saturn's . . . planet")
- C) Lines 26-28 ("But there . . . years")
- D) Lines 29-32 ("Esposito . . . expected")

## 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**

# 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.

### Making Space for Creation

In recent years, the increasing emergence of independent inventors, **1** designers and, craftspeople has become known as the maker movement. With this

1

- A) NO CHANGE
- B) designers, and
- C) designers; and
- D) designers, and,

growing number of makers has arisen new demand for

**2** “makerspaces.” Public libraries, as community centers that promote access to knowledge and resources, are **3** top-notch spots for such spaces. **4** Empowering patrons to become makers offers public libraries a way to fulfill their central mission.

2

The writer is considering revising the underlined portion to the following.

“makerspaces”—physical locations where creators can gather to share equipment and work on projects.

Should the writer make this revision here?

- A) Yes, because it defines a term that is central to the passage’s argument.
- B) Yes, because it helps explain why such spaces are in high demand.
- C) No, because it repeats information that is provided in the previous sentence.
- D) No, because it does not specify the kinds of projects typically undertaken in these spaces.

3

Which choice best maintains the style and tone of the passage?

- A) NO CHANGE
- B) second to none
- C) the ideal sites
- D) unsurpassed in their suitability

4

Which choice most effectively states the main argument of the passage?

- A) NO CHANGE
- B) Libraries need to adapt their facilities and services to remain relevant.
- C) Many librarians support the creation of makerspaces in their communities.
- D) The creation of makerspaces is one of many ways libraries can attract more patrons.

Makerspaces provide a valuable service to a library's users by making available costly equipment that would be difficult for individuals to procure. The FabLab in Exeter Library, Devon, England, offers an array of tools, including 3-D printers and photo scanners, as well as materials for arts, crafts, and **5** materials for building and repairing machines. One patron, artist Rivka Jacobs, who designs hats and headpieces, uses the FabLab's vinyl cutter and laser engraver to experiment with unusual materials and innovative techniques. **6** The first makerspace to open in a United Kingdom public library, the FabLab offers workshops and events that expose community members to technologies they might not have encountered otherwise.

5

- A) NO CHANGE
- B) to build and repair
- C) also for building and for repairing
- D) building and repairing

6

Which choice provides the most expected transition from the previous sentence?

- A) NO CHANGE
- B) With funding provided by several local nonprofits,
- C) As well as updating its website regularly,
- D) In addition to providing resources,



7 As these spaces are versatile, the contents and configuration of makerspaces can be tailored to the needs of individual communities. In 2011, the Allen County Public Library in Fort Wayne, Indiana, installed a 50-foot trailer in its parking lot that served as a makerspace until the library could 8 remedy the main building to accommodate such a space indoors. The trailer, owned by the nonprofit educational organization TekVenture, provided equipment such as an electronics workbench, an injection molding machine, and a 3-D printer, along with educational programming that 9 integrate these technologies. Jeff Krull, the library’s director at the time, saw this effort as vital to his organization’s broader mission: “The library is in the learning business, not just the book business,” he said.

7

Which choice provides the most logical transition to the information that follows in the sentence?

- A) NO CHANGE
- B) While they involve some expense,
- C) Since these spaces are becoming popular,
- D) Though some patrons might not use these spaces,

8

- A) NO CHANGE
- B) modify
- C) revise
- D) correct

9

- A) NO CHANGE
- B) integrated
- C) had integrated
- D) are integrating

Because the primary benefit of libraries is that they are free to the **10** public, so libraries that desire to build and maintain makerspaces must rely on grants and other external sources of funding rather than put the burden solely on patrons—though many makerspaces, like the FabLab, may still necessitate the payment of a fee. While some caution that even small fees will likely pose a barrier to some patrons—and libraries with limited resources face the impediment of not being able to afford the initial expenditure for machines—an investment in makerspaces is a worthwhile one. By inspiring the creators of the future and furnishing **11** one with needed resources, makerspaces offer a new way for libraries to enrich their communities.

10

- A) NO CHANGE
- B) public, therefore, libraries
- C) public. Libraries
- D) public, libraries

11

- A) NO CHANGE
- B) them
- C) us
- D) you

Questions 12-22 are based on the following passage.

### Preserving the Music of New Orleans

Since 1961, Preservation Hall, a modest 31-by-20-foot space in New Orleans, has been **12** an important venue for the revival and conservation of traditional jazz. It has no air conditioning, **13** and having no stage, and

12

Which choice most effectively conveys the main idea of the passage?

- A) NO CHANGE
- B) one of the most significant tourist attractions in the city.
- C) a vital part of the history of the Jaffe family.
- D) shaped by non-New Orleans natives even though its goal has been the preservation of New Orleans-style music.

13

- A) NO CHANGE
- B) and there is no stage,
- C) no stage,
- D) And no stage;

no food or drink, and the audience sits on hard wooden benches or on the floor. **14** Indeed, in the last 50 years, over two million eager listeners have passed through **15** it's doors. “There is no question that Preservation Hall saved New Orleans jazz,” **16** says the founder of the New Orleans Jazz & Heritage Festival. He is George Wein.

In the mid-1950s, art dealer Larry Borenstein started a local jazz resurgence in New Orleans. He opened a small gallery, Associated Artists Studio, in the French Quarter and invited jazz musicians to hold informal jam sessions to bring in customers. At the time, traditional jazz—a style of music that originated in New Orleans at the turn of the twentieth century and that combines marching band rhythms with group improvisation—was overshadowed by new types of music such as rock and roll. There were few venues dedicated to jazz concerts, and **17** lots of elderly folks who played jazz were out of work.

14

- A) NO CHANGE
- B) So
- C) Besides,
- D) Yet

15

- A) NO CHANGE
- B) there
- C) its
- D) their

16

Which choice most effectively combines the underlying sentences?

- A) says George Wein, and he is the founder of the New Orleans Jazz & Heritage Festival.
- B) says the New Orleans Jazz & Heritage Festival's founder, who is George Wein.
- C) George Wein, who founded the New Orleans Jazz & Heritage Festival, says.
- D) says George Wein, founder of the New Orleans Jazz & Heritage Festival.

17

- A) NO CHANGE
- B) a plethora of maturing jazz musicians
- C) many aging jazz musicians
- D) tons of older jazz musicians

The informal sessions at Associated Artists allowed these musicians to make music again and to earn a small income. The sessions steadily grew **18** in popularity, and eventually Borenstein moved his gallery next door, keeping the original space exclusively for the music. On June 10, 1961, the hall started holding nightly jazz concerts for **19** donations. It being the official start of Preservation Hall. In September of that year, Borenstein asked a young couple from Philadelphia, Allan and Sandra Jaffe, to take over the day-to-day operations of Preservation Hall.

18

- A) NO CHANGE
- B) for
- C) of
- D) by

19

- A) NO CHANGE
- B) donations; this being
- C) donations; it was
- D) donations it was

[1] The Jaffes had a vision for the hall as the home of traditional jazz and the musicians who made it. [2] Allan rode around New Orleans on his scooter, looking for out-of-work musicians and offering them jobs at Preservation Hall. [3] In 1963, the Jaffes started the Preservation Hall Jazz Band, the house band of the hall, with Allan on tuba. [4] Over the years, older musicians in the band **20** are passing on their seats to a younger generation of musicians who continue to keep traditional jazz alive. [5] Ben Jaffe, who in 1993 took over the management of the hall from his parents and the role of tuba player, explains, “We have a lot of responsibility to protect the traditions that we all grew up with, and the people whose chairs we now sit in.” **21**

Preservation Hall has not changed much over the years—it is still a single room with worn floorboards and **22** now with an entrance fee of \$15 to \$20—but this adds to its authenticity. Ben Jaffe has no plans to renovate it. “You don’t change something that’s already perfect!” he explains.

20

- A) NO CHANGE
- B) have passed
- C) will pass
- D) would have passed

21

To make this paragraph most logical, sentence 5 should be placed

- A) where it is now.
- B) before sentence 1.
- C) after sentence 1.
- D) after sentence 3.

22

Which choice provides a second supporting example that is most similar to the first example in the sentence?

- A) NO CHANGE
- B) walls covered in pictures of musicians long gone—
- C) bands that are more diverse in terms of their membership and musical selections—
- D) larger crowds than it has ever seen—

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

### In Defense of Job-Hoppers

In the twentieth century, one hallmark of a successful career **23** has been longevity of service with a single employer. When hiring new staff, employers looked unfavorably on résumés of applicants—referred to as job-hoppers—**24** who changed jobs and positions repeatedly after a few months or a couple of years. Many employers were unwilling to hire and train such applicants because their work history suggested they would soon leave again. But should a history of job-hopping be considered an impediment to employment in today’s job market? Not necessarily.

23

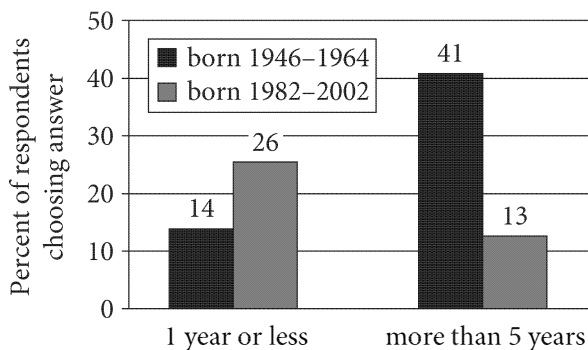
- A) NO CHANGE
- B) will be
- C) was
- D) is

24

- A) NO CHANGE
- B) who, over a relatively brief time, repeatedly changed jobs
- C) who repeatedly changed jobs
- D) DELETE the underlying portion.

The results of a 2014 survey **25** suggests that attitudes toward job-hopping are evolving. Whereas 41 percent of respondents born in the years 1946 to 1964 indicated that they believe workers should stay in a job for at least five years before looking for a new role, **26** almost half of the respondents born in the years 1982 to 2002 thought workers should move within a year. Job-hopping simply doesn't carry the stigma it once did: for example, **27** 13 percent of respondents in the younger demographic indicated that workers should only be expected to stay in a job for a year or less before looking for a new position.

Survey Responses to the Question  
“How long do you think someone should stay in a role before they find a new job?”



Source: Data from Millennial Branding, “Gen Y on the Job.” ©2016 by PayScale, Inc.

25

- A) NO CHANGE
- B) has suggested
- C) are suggesting
- D) suggest

26

The writer wants to support the claim made in the preceding sentence using accurate, relevant information from the graph. Which choice best accomplishes this goal?

- A) NO CHANGE
- B) 26 percent of these respondents answered that workers shouldn't stay in a job for more than five years.
- C) only 13 percent of respondents born in the years 1982 to 2002 agreed with that statement.
- D) 14 percent of respondents born in the years 1946 to 1964 answered that workers should stay in a job for a year or less before looking for a new role.

27

Which choice offers an accurate interpretation of the data in the graph?

- A) NO CHANGE
- B) 14 percent of younger-demographic respondents
- C) 26 percent of respondents in the younger demographic
- D) of respondents in the older demographic, 41 percent



Employers would do well to recognize that job-hoppers most likely have acquired broad—and potentially valuable—sets of skills. From mastering a range of software and technology to **28** different learned approaches to certain tasks, job-hoppers have, in each of their jobs, most likely learned unique skills. **29** First, being able to adapt to different work environments signals prospective employees' flexibility and ability to acquire new skills as needed. A job **30** candidates' experiences in multiple corporate environments should thus be regarded as an asset, not a risk.

28

- A) NO CHANGE
- B) the fact that they have learned different
- C) the learning of different
- D) learning different

29

- A) NO CHANGE
- B) Otherwise,
- C) Regardless,
- D) Moreover,

30

- A) NO CHANGE
- B) candidates experiences
- C) candidate's experience's
- D) candidate's experiences

31 Nevertheless, job-hoppers vary in the average length of time they stay at one place. Writing for the *Harvard Business Review*, Professor Monika Hamori warns that job-hopping isn't necessarily a fast track to career 32 success, suggests that certain employees are more likely to find success by demonstrating their value to their employer, something that is generally accomplished over time and can lead to advancement. Hamori's analysis of non-CEO executive careers reveals that "inside moves produced a considerably higher percentage and faster pace of promotions." Job-hopping is more accepted now, but too many employment changes can still be a red 33 flag. This red flag could be a sign of poor performance or trouble getting along with colleagues.

However, if a candidate's job-hopping has facilitated the development of useful knowledge and skills, it shouldn't be regarded as a detriment. Rather, the varied experiences of job-hoppers should be valued.

31

Which choice best introduces the paragraph's main focus?

- A) NO CHANGE
- B) That's not to say there aren't real benefits to remaining at the same company for an extended time.
- C) Even though adapting to different work environments can be difficult, knowing how to adapt can be a tremendous asset.
- D) Some careers, however, do require that a person stay in one kind of corporate environment.

32

- A) NO CHANGE
- B) success; she suggests
- C) success, she suggests
- D) success; suggesting

33

Which choice most effectively combines the sentences at the underlying portion?

- A) flag—a sign of
- B) flag, and that flag could be a sign of
- C) flag: a red flag that could signify
- D) flag,

Questions 34-44 are based on the following passage.

### A Voyage to Interstellar Space

On August 25, 2012, NASA’s *Voyager 1* space probe became the first spacecraft in history to exit the heliosphere, the magnetic “bubble” filled with charged particles emitted by the Sun. Scientists had been anticipating this event since 1998, when *Voyager 1*, which had completed flybys of Jupiter and Saturn years before, overtook the *Pioneer 10* spacecraft to earn the title of most distant human-made object. Unfortunately, scientists did not get to celebrate *Voyager 1*’s **34** unplanned accomplishment until one year later—when they found out about it.

34

Which choice is most consistent with the paragraph’s earlier characterization of the accomplishment?

- A) NO CHANGE
- B) unexpected
- C) unprecedented
- D) undetected

How did the project's leaders **35** miss such a long-awaited development? *Voyager 1*'s progress to the edge of the heliosphere was tracked by space physicists, scientists who study magnetic fields and gases of electrically charged **36** particle's called plasma's. They had initially planned to use *Voyager 1*'s plasma density data to determine the moment of the crossing into interstellar space, but the instrument designed to collect this information failed, and they were left looking in vain for a shift in the magnetic field. **37** Therefore, after a second instrument detected oscillations in the plasma surrounding the probe, the space physicists realized they could use **38** it to infer the plasma's density. Scouring old data for similar oscillations, **39** they concluded in 2013 that *Voyager 1* had exited the heliosphere a full year earlier.

35

Which choice provides the most effective introduction to the paragraph?

- A) NO CHANGE
- B) justify such a delayed celebration?
- C) excuse such an embarrassing mistake?
- D) react to such an exciting event?

36

- A) NO CHANGE
- B) particle's called plasmas.
- C) particles called plasma's.
- D) particles called plasmas.

37

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

38

- A) NO CHANGE
- B) that
- C) the latter
- D) those oscillations

39

- A) NO CHANGE
- B) their conclusion in 2013 was
- C) it was concluded by them in 2013
- D) the conclusion they developed in 2013 was

Although the excited space physicists contended that *Voyager 1* had entered interstellar space, astronomers countered that the probe had not yet left the solar system. Astronomers generally consider the region where the Sun’s gravitational influence becomes weaker than that of neighboring stars to mark the end of the solar system and the beginning of interstellar space. NASA defines that boundary as the outer edge of the Oort cloud, an enormous shell of small icy **40** objects, that is named for the Dutch astronomer, Jan Hendrik Oort. **41** At its current speed, *Voyager 1* will not reach the inner edge of the Oort cloud for another 300 years—**42** and will approach the star Gliese 445 in about 40,000 years.

40

- A) NO CHANGE
- B) objects, that is named for the Dutch astronomer
- C) objects that is named for the Dutch astronomer,
- D) objects that is named for the Dutch astronomer

41

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

Oort also contributed, with Bertil Lindblad of Sweden, to the Lindblad-Oort theory of galactic rotation.

Should the writer make this addition here?

- A) Yes, because it establishes Oort as an expert in the field.
- B) Yes, because it provides support for an earlier claim about astronomers.
- C) No, because it interrupts the discussion of the Oort cloud.
- D) No, because it undermines the paragraph’s main claim about *Voyager 1*.

42

Which choice provides the most effective supporting example to show that *Voyager 1* is still a long way from the boundary of the solar system?

- A) NO CHANGE
- B) even though it has traveled a great distance since its launch in 1977.
- C) and will take 30,000 years to pass through it.
- D) although that time will be less if the space probe speeds up.

In other words, astronomers are not likely to be able to celebrate *Voyager 1*'s crossing into interstellar space until many years from now. Moreover, like the space physicists, they will probably not know when it happens: *Voyager 1* should be able to collect and transmit data only until 2025, when its batteries are projected to fail. Nevertheless, the intrepid spacecraft will sail boldly onward, perhaps forever, bearing salutations from its **43** home planet from whence it came. Onboard is a gold record containing 116 images, **44** speaking greetings in 55 ancient and modern languages, and a variety of natural sounds highlighting the diversity of life on faraway Earth.

43

- A) NO CHANGE
- B) planetary home on Earth.
- C) planet, Earth, which it calls home.
- D) home planet.

44

- A) NO CHANGE
- B) spoken
- C) speaks
- D) has spoken

**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**



# Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

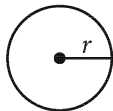
## DIRECTIONS

For questions 1-15, solve each problem, choose the best answer from the choices provided, and fill in the corresponding bubble 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

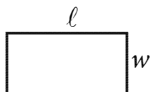
- The use of a calculator **is not permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated,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

## REFERENCE

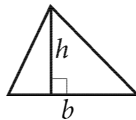


$$A = \pi r^2$$

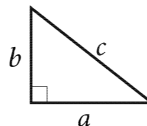
$$C = 2\pi r$$



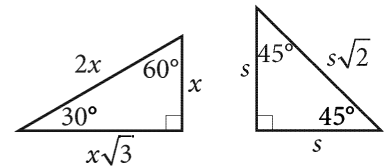
$$A = \ell w$$



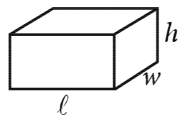
$$A = \frac{1}{2}bh$$



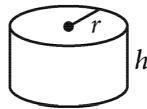
$$c^2 = a^2 + b^2$$



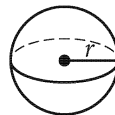
Special Right Triangles



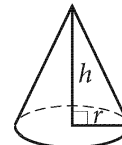
$$V = \ell wh$$



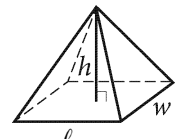
$$V = \pi r^2 h$$



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



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



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

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

The number of radians of arc in a circle is  $2\pi$ .

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





1

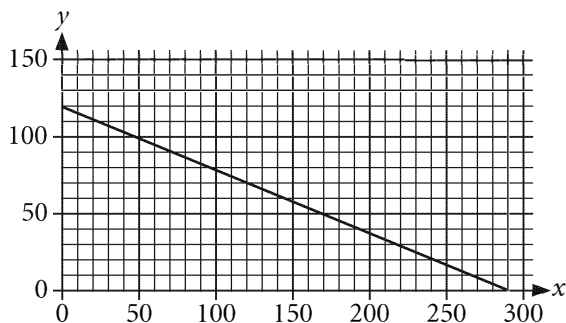
$$y = x^2 + 4x + 5$$

$$y = x + 5$$

What is a solution  $(x, y)$  to the given system of equations?

- A)  $(0, -3)$
- B)  $(0, 5)$
- C)  $(-3, 0)$
- D)  $(5, 0)$

2



A dairy case in a grocery store holds only half-gallon and one-gallon bottles of milk. The line in the  $xy$ -plane above represents the relationship between the number of half-gallon bottles,  $x$ , and the number of one-gallon bottles,  $y$ , that the case can hold when completely full. Based on the graph, if the case is completely filled with only one-gallon bottles, how many bottles does it contain?

- A) 120
- B) 144
- C) 240
- D) 288

3

One liter of antifreeze has a mass of 1.1 kilograms, and one liter of water has a mass of 1 kilogram. The radiator of a car contains a mixture of  $x$  liters of antifreeze and  $y$  liters of water. If the mass of the mixture in the radiator is 6 kilograms, which of the following represents the relationship between the number of liters of antifreeze and the number of liters of water used in the mixture in the radiator?

- A)  $1.1(x + y) = 6$
- B)  $1.1x + y = 6$
- C)  $x + y = (1.1)(6)$
- D)  $x + y = 6$



4

A store sells new and pre-owned video games. On Monday the store sold a total of 212 video games: 180 new video games and  $p$  pre-owned video games. Which of the following equations can be used to determine the number of pre-owned video games sold on Monday?

- A)  $p + 180 = 212$
- B)  $p - 180 = 212$
- C)  $180p = 212$
- D)  $\frac{p}{180} = 212$

5

$$y = |x| + a$$

In the function above,  $a$  is a positive constant. Which of the following could be the graph of the function in the  $xy$ -plane?

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



6

$$f(x) = (2x + 9)^2$$

$$g(x) = 6(6x + 10)$$

The functions  $f$  and  $g$  are defined above. Which of the following is equivalent to  $f(x) - g(x)$  ?

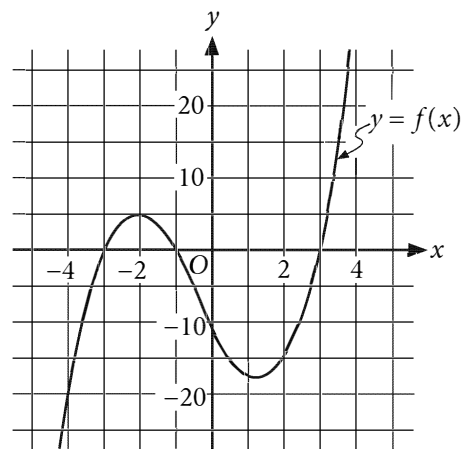
- A)  $4x^2 + 21$
- B)  $4x^2 + 141$
- C)  $4x^2 - 18x + 21$
- D)  $4x^2 + 72x + 141$

7

What is the  $x$ -intercept of the graph of the function  $f(x) = -5x - 10$  in the  $xy$ -plane, where  $y = f(x)$  ?

- A)  $(-10, 0)$
- B)  $(-5, 0)$
- C)  $(-2, 0)$
- D)  $(10, 0)$

8



The graph of the function  $f$  is shown in the  $xy$ -plane. Which of the following could define  $f$  ?

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



9

A submarine that is at a depth of 100 meters begins to descend. The equation  $250 = 100 + 2.5t$  relates the number of seconds,  $t$ , it takes for the submarine to reach a depth of 250 meters after it starts its descent. What is the meaning of 2.5 in the context of the problem?

- A) The depth of the submarine after  $t$  seconds
- B) The depth of the submarine before it begins to descend
- C) The number of meters the submarine descends in  $t$  seconds
- D) The number of meters the submarine descends per second

10

$$3x + By = 12$$

$$2x + By = 10$$

In the system of equations above,  $B$  is a nonzero constant. If  $(x, y)$  is the solution to the system of equations, which of the following is  $(x, y)$ , in terms of  $B$ ?

- A)  $(2, 6B)$
- B)  $(6B, 2)$
- C)  $\left(2, \frac{6}{B}\right)$
- D)  $\left(\frac{6}{B}, 2\right)$

11

In the  $xy$ -plane, an equation of circle  $A$  is  $x^2 + (y - 1)^2 = 1$ . Circle  $B$  is obtained by shifting circle  $A$  one unit down. Which of the following is an equation of circle  $B$ ?

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



12

$$3(2x-1)^2 + k = 4$$

If  $k$  is a constant, for what value of  $k$  will the quadratic equation above have exactly one solution?

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

13

| Time, $t$<br>(minutes) | Number of bacteria, $b(t)$<br>(in millions) |
|------------------------|---|
| 0                      | 150   |
| 25                     | 300   |
| 50                     | 600   |
| 100                    | 2,400                                       |

The table shows the time  $t$ , in minutes, after the initial observation of a bacteria culture and the corresponding values of  $b(t)$ , the number of bacteria, in millions, in the culture. Which of the following functions best models  $b(t)$  ?

- A)  $b(t) = 25(2)^{150t}$
- B)  $b(t) = 25(2)^{\frac{t}{150}}$
- C)  $b(t) = 150(2)^{25t}$
- D)  $b(t) = 150(2)^{\frac{t}{25}}$



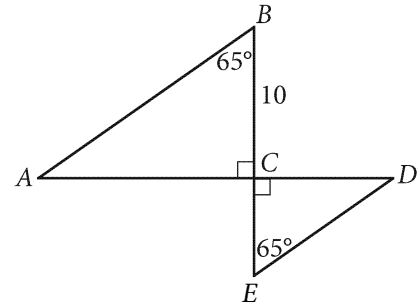
14

$$\frac{x^2(x-2) - 4(x-2)}{x^2 - 4x + 4}$$

If  $x > 2$ , which of the following expressions is equivalent to the given expression?

- A)  $x + 2$
- B)  $(x + 2)(x - 2)$
- C)  $(x - 2)^2$
- D)  $\frac{1}{(x - 2)}$

15



Note: Figure not drawn to scale.

In the figure shown, triangles  $ABC$  and  $ECD$  are right triangles. Which of the following can be determined from the given information?

- I. The length of  $\overline{AB}$
  - II. The length of  $\overline{DE}$
- A) I only
  - B) II only
  - C) I and II
  - D) Neither I nor II


**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 bubbles accurately. You will receive credit only if the bubbles are filled in correctly.
- Mark no more than one bubble 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 

|                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|
| 3                        | 1                        | /                        | 2                        |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

 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.

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

Write answer in boxes. →

|                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|
| 7                        | /                        | 1                        | 2                        |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 0                        | 0                        | 0                        | 0                        |
| 1                        | 1                        | <input type="checkbox"/> | 1                        |
| 2                        | 2                        | 2                        | <input type="checkbox"/> |
| 3                        | 3                        | 3                        | 3                        |
| 4                        | 4                        | 4                        | 4                        |
| 5                        | 5                        | 5                        | 5                        |
| 6                        | 6                        | 6                        | 6                        |
| <input type="checkbox"/> | 7                        | 7                        | 7                        |
| 8                        | 8                        | 8                        | 8                        |
| 9                        | 9                        | 9                        | 9                        |

← Fraction line

Grid in result.

Answer: 2.5

|                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|
|                          | 2                        | .                        | 5                        |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 0                        | 0                        | 0                        | 0                        |
| 1                        | 1                        | 1                        | 1                        |
| 2                        | <input type="checkbox"/> | 2                        | 2                        |
| 3                        | 3                        | 3                        | 3                        |
| 4                        | 4                        | 4                        | 4                        |
| 5                        | 5                        | 5                        | <input type="checkbox"/> |
| 6                        | 6                        | 6                        | 6                        |
| 7                        | 7                        | 7                        | 7                        |
| 8                        | 8                        | 8                        | 8                        |
| 9                        | 9                        | 9                        | 9                        |

← Decimal point

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

|                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|
|                          | 2                        | /                        | 3                        |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 0                        | 0                        | 0                        | 0                        |
| 1                        | 1                        | 1                        | 1                        |
| 2                        | <input type="checkbox"/> | 2                        | 2                        |
| 3                        | 3                        | 3                        | <input type="checkbox"/> |
| 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                        | 6                        |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 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                        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7                        | 7                        | 7                        | 7                        |
| 8                        | 8                        | 8                        | 8                        |
| 9                        | 9                        | 9                        | 9                        |

|                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|
| .                        | 6                        | 6                        | 7                        |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 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                        | <input type="checkbox"/> | <input type="checkbox"/> | 6                        |
| 7                        | 7                        | 7                        | <input type="checkbox"/> |
| 8                        | 8                        | 8                        | 8                        |
| 9                        | 9                        | 9                        | 9                        |

Answer: 201 – either position is correct

|                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|
|                          | 2                        | 0                        | 1                        |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 0                        | <input type="checkbox"/> | 0                        | 0                        |
| 1                        | 1                        | 1                        | <input type="checkbox"/> |
| 2                        | <input type="checkbox"/> | 2                        | 2                        |
| 3                        | 3                        | 3                        | 3                        |

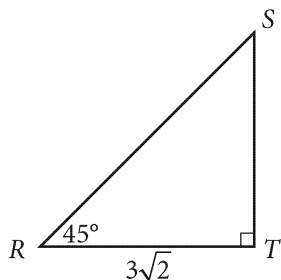
|                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|
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| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 0                        | 0                        | 0                        | 0                        |
| 1                        | 1                        | <input type="checkbox"/> | 1                        |
| <input type="checkbox"/> | 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



Right triangle  $RST$  is shown. What is the length of side  $RS$ ?

17

$$\begin{aligned}x + y &= 11 \\x - y &= 5\end{aligned}$$

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

18

$$3(t - 10) + 2t = 50$$

What value of  $t$  satisfies the equation above?

19

$$h(t) = -\frac{1}{2}gt^2 + v_0t + h_0$$

The function  $h$  above can be used to model the height above the ground, in meters, of an object  $t$  seconds after the object is launched straight up. In the function,  $v_0$  represents the initial velocity of the object in meters per second,  $h_0$  represents the initial height of the object in meters, and  $g$  represents the gravitational acceleration in meters per second per second.

An object with an initial height of 8 meters is launched straight up with an initial velocity of 18 meters per second. If 10 meters per second per second is used to approximate  $g$ , according to the function  $h$ , how many seconds will it take the object to reach the ground?

20

$$2x^2 - 3x - 4 = 0$$

What is the sum of the two solutions to the equation above?

## 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**



# Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

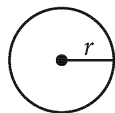
## DIRECTIONS

For questions 1-30, solve each problem, choose the best answer from the choices provided, and fill in the corresponding bubble 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

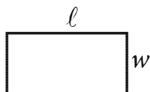
1. The use of a calculator **is permitted**.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated,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

## REFERENCE

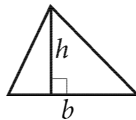


$$A = \pi r^2$$

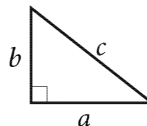
$$C = 2\pi r$$



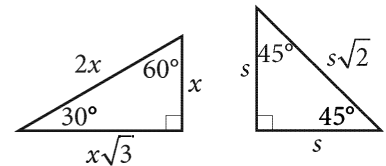
$$A = \ell w$$



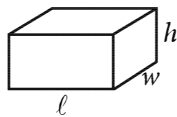
$$A = \frac{1}{2}bh$$



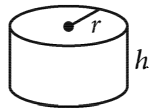
$$c^2 = a^2 + b^2$$



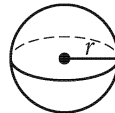
Special Right Triangles



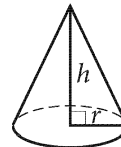
$$V = \ell wh$$



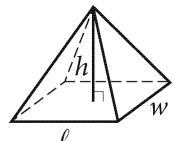
$$V = \pi r^2 h$$



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



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



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

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

The number of radians of arc in a circle is  $2\pi$ .

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

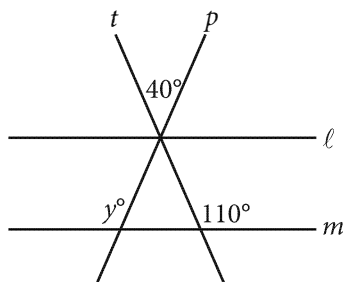


1

An electrical circuit contained a battery and a small light bulb and had a total resistance of 5 ohms. Resistors were added to the circuit. For each resistor added, the circuit's total resistance increased by 3 ohms. If the electrical circuit now has a total resistance of 23 ohms, how many resistors were added to the circuit?

- A) 6
- B) 5
- C) 4
- D) 3

2



In the figure shown, line  $\ell$  is parallel to line  $m$ . What is the value of  $y$ ?

- A) 100
- B) 110
- C) 120
- D) 150

3

A map of the area around Lake Ouachita in Arkansas is drawn to the scale of 3 centimeters = 1 mile. The distance on the map between two campgrounds next to the lake is 9 centimeters. What is the actual distance between these two campgrounds?

- A) 3 miles
- B) 6 miles
- C) 12 miles
- D) 27 miles

4

A fair number cube with faces numbered 2, 4, 6, 8, 10, and 12 is to be rolled once. What is the probability of rolling a 10?

- A)  $\frac{10}{42}$
- B)  $\frac{10}{12}$
- C)  $\frac{1}{10}$
- D)  $\frac{1}{6}$



5

What is 70% of 2,000 ?

- A) 286
- B) 600
- C) 1,400
- D) 2,857

6

A line in the  $xy$ -plane passes through the points  $(0, 3)$  and  $(1, -4)$ . Which of the following is an equation of this line?

- A)  $y = -7x + 3$
- B)  $y = 7x + 3$
- C)  $y = -x + 3$
- D)  $y = x + 3$

7

The function  $h$  is linear, where  $h(0) = 0$  and  $h(3) = 2$ . Which equation defines  $h$  ?

- A)  $h(x) = \frac{2}{3}x$
- B)  $h(x) = \frac{2}{3}x + 2$
- C)  $h(x) = \frac{3}{2}x$
- D)  $h(x) = \frac{3}{2}x + 3$

8

The ratio of  $a$  to  $b$  is  $x$  to 2. If the value of  $b$  is 60, which expression gives the value of  $a$  in terms of  $x$  ?

- A)  $3x$
- B)  $30x$
- C)  $300x$
- D)  $3,000x$



9

According to one theory of vocabulary development, children add to their total vocabulary by about 2 words per day from the time they are 13 months old to the time they are 20 months old. Which of the following types of function best models the size of a child's vocabulary, from 13 months old to 20 months old, as a function of time?

- A) Increasing linear
- B) Decreasing linear
- C) Increasing exponential
- D) Decreasing exponential

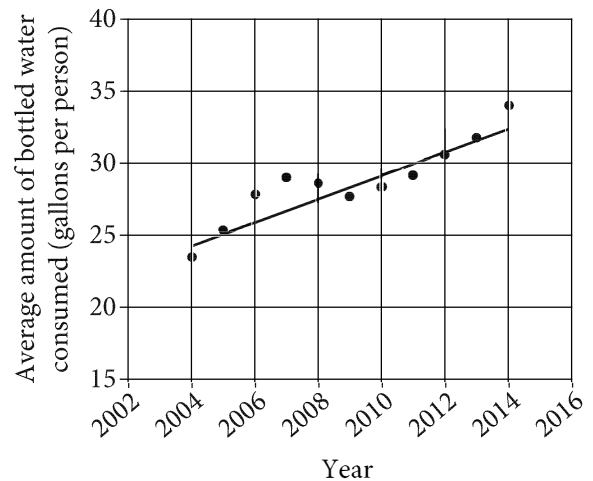
10

An integer is to be selected at random from all positive even integers that are less than or equal to 20. What is the probability that the integer is less than or equal to 10?

- A)  $\frac{1}{4}$
- B)  $\frac{1}{2}$
- C)  $\frac{3}{4}$
- D) 1

11

The scatterplot shows the average amount of bottled water consumed, in gallons per person, in the United States for each year from 2004 through 2014. A line of best fit is also shown.



In which of the following years does the line of best fit underpredict the actual average amount of bottled water consumption?

- A) 2004
- B) 2007
- C) 2009
- D) 2011



12

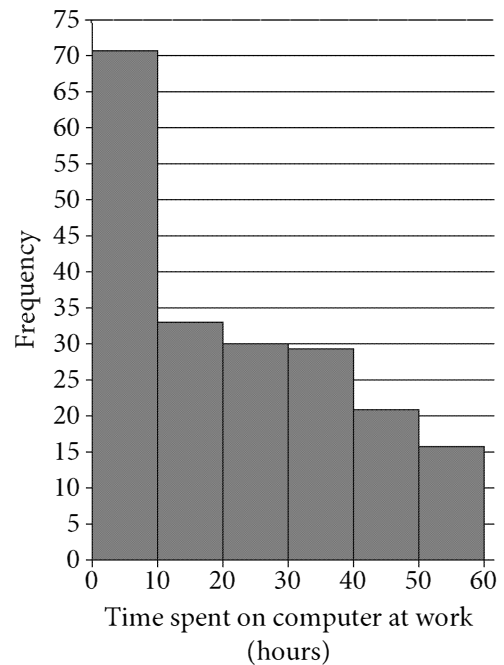
$$ax + 3 = 5x - b$$

In the equation above,  $a$  and  $b$  are constants. If the equation has infinitely many solutions, what are the values of  $a$  and  $b$ ?

- A)  $a = 5, b = 3$
- B)  $a = 5, b = -3$
- C)  $a = -5, b = 3$
- D)  $a = -5, b = -3$

13

A researcher selected 200 workers at a certain company and asked each of them to estimate the time, in hours, they spend on the computer at work each week. The results are summarized in the histogram shown. The first bar represents the number of workers who spend less than 10 hours on a computer at work each week. The second bar represents the number of workers who spend at least 10 hours but less than 20 hours on a computer at work each week, and so on.



Based on the histogram, how many of the 200 workers estimated that they spend less than 30 hours on the computer at work each week?

- A) 30
- B) 66
- C) 104
- D) 134



14

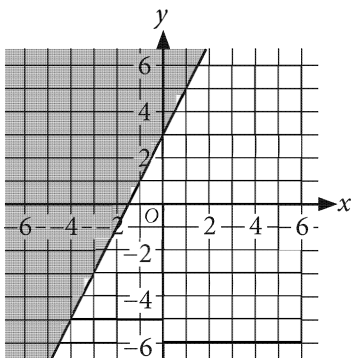
A ball is dropped from an initial height of 10 feet and bounces repeatedly. The maximum height reached after each bounce is 90% of the previous maximum height. Which of the following functions models the maximum height  $h(n)$ , in feet, of the ball after it bounces  $n$  times, where  $n$  is an integer?

- A)  $h(n) = 90(0.1)^n$
- B)  $h(n) = 10(0.1)^n$
- C)  $h(n) = 90(0.9)^n$
- D)  $h(n) = 10(0.9)^n$

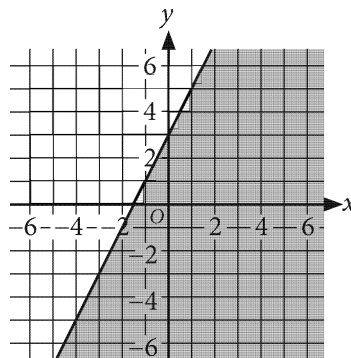
15

In which of the following graphs does the shaded region consist of the solutions to  $y \geq 2x + 3$  ?

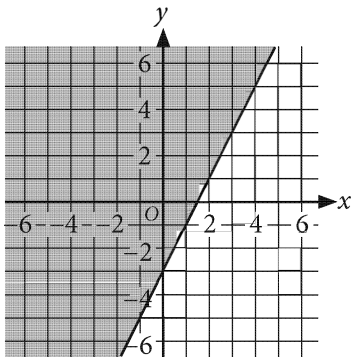
A)



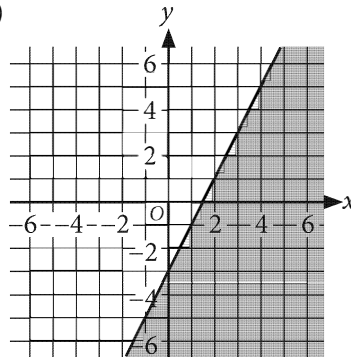
B)



C)



D)





Questions 16-18 refer to the following information.

$$P = 35t + 5,500, \text{ where } 0 \leq t \leq 8$$

A model predicting the fish production in the United States is shown above, where  $t$  is the number of years since 2016 and  $P$  is the total yearly fish production, in thousands of tonnes, in the United States.

16

In what year does the model predict the total yearly fish production in the United States to be 5,710 thousand tonnes?

- A) 2020
- B) 2022
- C) 2115
- D) 2337

17

According to the model, which of the following is the best interpretation of 5,500 in this context?

- A) The total yearly fish production in the United States in 2016 was 5,500 thousand tonnes.
- B) The total yearly fish production in the United States in 5500 is predicted to be 2,016 thousand tonnes.
- C) The total yearly fish production in the United States is predicted to increase 5,500 thousand tonnes each year after 2016.
- D) The total yearly fish production in the United States is predicted to increase 2,016 thousand tonnes each year after 5500.

18

A model predicts that the total yearly fish production in Peru in 2016 will be 3,700 thousand tonnes and will increase by 485 thousand tonnes per year  $t$  years after 2016. In what year do the models for Peru and the United States predict that the total yearly fish production for the two countries will be the same?

- A) 2019
- B) 2020
- C) 2024
- D) 2067





19

The density of water at a certain temperature is 1.0 gram per cubic centimeter ( $\text{g}/\text{cm}^3$ ). What is this density in grams per cubic millimeter ( $\text{g}/\text{mm}^3$ )? ( $1 \text{ g}/\text{mm}^3 = 1,000 \text{ g}/\text{cm}^3$ )

- A) 1,000
- B) 10
- C) 0.1
- D) 0.001

20

Jessica began an experiment with 196 milliliters (mL) of a liquid and ended the experiment one hour later when 41 mL had evaporated. Which of the following is closest to the percent of the original amount of liquid that remained at the end of the experiment?

- A) 20.9%
- B) 59.0%
- C) 79.1%
- D) 88.3%

21

$$m = 12 \left( \frac{d}{93} \right)^{\frac{3}{2}}$$

The number of months  $m$  required for a planet to complete an orbit about the Sun can be modeled by the equation above, where  $d$  is the planet's average distance from the Sun, in millions of miles. Which of the following expresses the distance in terms of the number of months?

- A)  $d = \frac{93}{12} (m)^{\frac{2}{3}}$
- B)  $d = \frac{93}{12} (m)^{\frac{3}{2}}$
- C)  $d = 93 \left( \frac{m}{12} \right)^{\frac{3}{2}}$
- D)  $d = 93 \left( \frac{m}{12} \right)^{\frac{2}{3}}$



22

In the  $xy$ -plane, line  $k$  has slope  $\frac{4}{3}$ , and line  $j$  has slope  $\frac{3}{4}$ . Both lines contain the point  $(0, 0)$ .

For which of these lines is  $y > x$  for all positive values of  $x$ ?

- I. Line  $k$
- II. Line  $j$

- A) I only
- B) II only
- C) I and II
- D) Neither I nor II

23

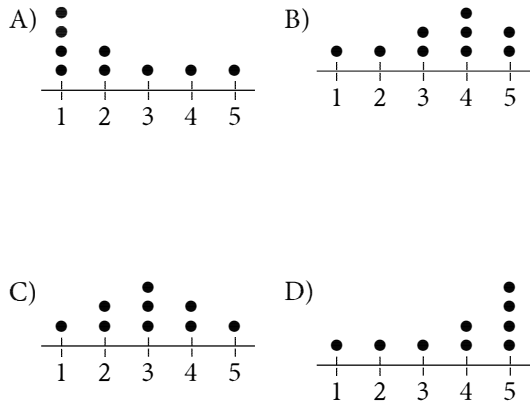
The graph of the equation  $x^2 + 10x + y^2 - 14y = 0$  is a circle in the  $xy$ -plane. What are the coordinates  $(x, y)$  of the center of the circle?

- A)  $(-5, 7)$
- B)  $(-5, -7)$
- C)  $(-10, 14)$
- D)  $(-10, -14)$



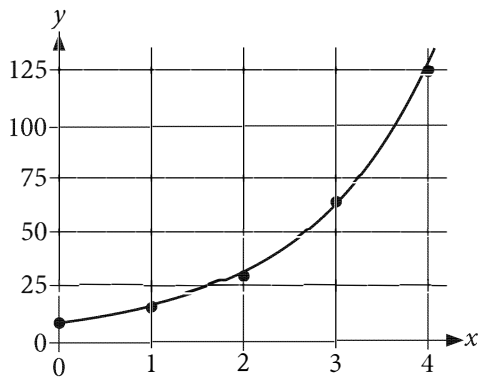
24

For which of the following sets of 9 data points is the median less than the mean?



25

The scatterplot shows the relationship between two variables,  $x$  and  $y$ . An exponential model is also shown.



What is an equation of the exponential model shown?

- A)  $y = -2(8)^x$   
 B)  $y = -8(2)^x$   
 C)  $y = 2(8)^x$   
 D)  $y = 8(2)^x$



26

$$(x + a)(x + b) = x^2 + cx + 11$$

In the equation above,  $a$ ,  $b$ , and  $c$  are positive integer constants. What is the value of  $c$ ?

- A) 6
- B) 9
- C) 11
- D) 12

27

$$f(x) = 42.609(1.067)^x$$

The world crude oil production, in millions of barrels, from the years 1880 to 1980 can be modeled by the function  $f$ , where  $x$  is the number of years after 1880. Which of the following is the best interpretation of the number 1.067 in this context?

- A) On average, the production increased by approximately 0.067 million barrels per year.
- B) On average, the production increased by approximately 1.067 million barrels per year.
- C) On average, the production increased by approximately 6.7% per year.
- D) On average, the production increased by approximately 106.7% per year.

28

The value  $y$  is equal to the value  $x$  increased by 36%. If  $x > 0$ , which of the following expresses  $y$  in terms of  $x$ ?

- A)  $y = 0.36x$
- B)  $y = 0.64x$
- C)  $y = 1.036x$
- D)  $y = 1.36x$



29

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

The function  $f$  is defined by the given equation. What is the product of  $f(a-2)$  and  $f(a)$ , where  $a > 2$ ?

- A)  $\frac{a+2}{a-2}$
- B)  $\frac{2}{a+2}$
- C)  $\frac{a-2}{a}$
- D)  $\frac{a-2}{a+2}$

30

$$\begin{aligned} ax - y &= -4 \\ 3x + 3y &= 12 \end{aligned}$$

In the system of equations above,  $a$  is a constant. If the system has infinitely many solutions, what is the value of  $a$ ?

- A)  $-3$
- B)  $-1$
- C)  $0$
- D)  $1$


**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 bubbles accurately. You will receive credit only if the bubbles are filled in correctly.
- Mark no more than one bubble 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 

|                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|
| 3                        | 1                        | /                        | 2                        |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

 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.

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

Write answer in boxes. →

|                                     |                          |                          |                          |
|-------------------------------------|--------------------------|--------------------------|--------------------------|
| 7                                   | /                        | 1                        | 2                        |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 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                        |
| <input checked="" type="checkbox"/> | 7                        | 7                        | 7                        |
| 8                                   | 8                        | 8                        | 8                        |
| 9                                   | 9                        | 9                        | 9                        |

← Fraction line

Grid in result.

Answer: 2.5

|                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|
|                          | 2                        | .                        | 5                        |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 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                        |

← Decimal point

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

|                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|
|                          | 2                        | /                        | 3                        |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 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                        | 6                        |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 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                        |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 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                        |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 0                        | 0                        | 0                        | 0                        |
| 1                        | 1                        | 1                        | 1                        |
| 2                        | 2                        | 2                        | 2                        |
| 3                        | 3                        | 3                        | 3                        |

|                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|
| 2                        | 0                        | 1                        |                          |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 0                        | 0                        | 0                        | 0                        |
| 1                        | 1                        | 1                        | 1                        |
| 2                        | 2                        | 2                        | 2                        |
| 3                        | 3                        | 3                        | 3                        |

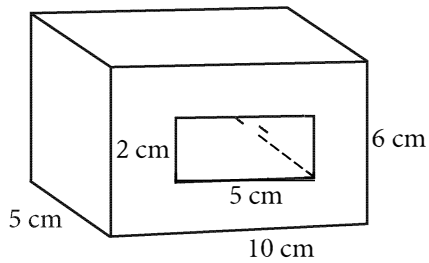
**NOTE:**

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

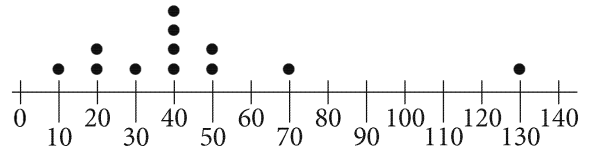


31

A concrete block had a portion removed from its center. Both the block and the portion removed are in the shape of a right rectangular prism, as shown in the figure. The dimensions of the portion of concrete removed are 2 centimeters (cm) by 5 cm by 5 cm. What is the volume, in cubic centimeters, of the concrete remaining in the block after the portion was removed?



32



The dot plot above shows the weights, in pounds, of all 12 dogs in a dog park. When one dog leaves the park, the mean weight of the remaining dogs becomes less than the mean weight of the initial 12 dogs in the park. Of the weights of dogs in the dot plot above, what is a possible weight, in pounds, for the dog that left the park?

33

A sample of clay has a mass of 6 pounds and a volume of 0.05 cubic feet. What is the density, in pounds per cubic foot, of this clay?



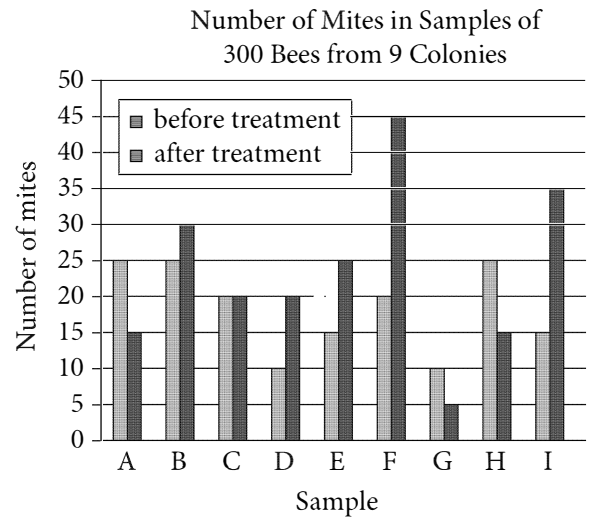
34

If  $5x + 12 = 60$ , what is the value of  $25x + 60$  ?

35

What is the value of the expression  $x^2 + 2x - 2xy - 2y + y^2$  when  $x - y = 50$  ?

Questions 36 and 37 refer to the following information.



The effectiveness of a treatment to reduce the number of mites in nine colonies of bees was examined. Samples of 300 bees were selected from each of the nine colonies immediately before and three days after the treatment was applied. The graph shows the number of mites in each of the samples before and after the treatment.

36

The number of mites after the treatment minus the number of mites before the treatment was determined for each sample. What is the mean of these 9 values?





37

Of the samples with an increase in the number of mites after the treatment, what fraction showed an increase of at least 10 mites?



38

| $x$ | $f(x)$ |
|-----|--------|
| 0   | 1.6    |
| 1   | 0.8    |
| 2   | 0.4    |

The given table shows several values of  $x$  and the corresponding values of  $f(x)$ . If  $f(x) = a(b)^x$ , where  $a$  and  $b$  are constants, what is the value of  $a$ ?

**STOP**

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

# September 26, 2020 US

## Answer Key

### Reading Test Answers

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

READING TEST  
RAW SCORE  
(NUMBER OF  
CORRECT ANSWERS)

### Writing and Language Test Answers

|      |      |      |      |
|------|------|------|------|
| 1 B  | 12 A | 23 C | 34 C |
| 2 A  | 13 C | 24 C | 35 A |
| 3 C  | 14 D | 25 D | 36 D |
| 4 A  | 15 C | 26 C | 37 B |
| 5 D  | 16 D | 27 C | 38 D |
| 6 D  | 17 C | 28 D | 39 A |
| 7 A  | 18 A | 29 D | 40 D |
| 8 B  | 19 C | 30 D | 41 C |
| 9 B  | 20 B | 31 B | 42 C |
| 10 D | 21 A | 32 B | 43 D |
| 11 B | 22 B | 33 A | 44 B |

WRITING AND  
LANGUAGE TEST  
RAW SCORE  
(NUMBER OF  
CORRECT ANSWERS)

### Math Test – No Calculator Answers

|      |               |
|------|---------------|
| 1 B  | 11 A          |
| 2 A  | 12 D          |
| 3 B  | 13 D          |
| 4 A  | 14 A          |
| 5 B  | 15 A          |
| 6 A  | 16 6          |
| 7 C  | 17 3          |
| 8 C  | 18 16         |
| 9 D  | 19 4          |
| 10 C | 20 $3/2, 1.5$ |

MATH TEST –  
NO CALCULATOR  
RAW SCORE  
(NUMBER OF  
CORRECT ANSWERS)

### Math Test – Calculator Answers

|      |      |      |                |
|------|------|------|----------------|
| 1 A  | 11 B | 21 D | 31 250         |
| 2 B  | 12 B | 22 A | 32 50, 70, 130 |
| 3 A  | 13 D | 23 A | 33 120         |
| 4 D  | 14 D | 24 A | 34 300         |
| 5 C  | 15 A | 25 D | 35 2600        |
| 6 A  | 16 B | 26 D | 36 5           |
| 7 A  | 17 A | 27 C | 37 $4/5$       |
| 8 B  | 18 B | 28 D | 38 1.6         |
| 9 A  | 19 D | 29 D |                |
| 10 B | 20 C | 30 B |                |

MATH TEST –  
CALCULATOR  
RAW SCORE  
(NUMBER OF  
CORRECT ANSWERS)