PSAT/NMSQT®

CollegeBoard / NATIONAL MERIT SCHOLARSHIP CORPORATION

**Wednesday**
**October 10, 2018**

# PSAT/NMSQT®

**Preliminary SAT/National Merit Scholarship Qualifying Test**

# Test Book

## IMPORTANT REMINDERS

**1**

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

**2**

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**Test begins on the next page.**

# Reading Test

## 60 MINUTES, 47 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 1-9 are based on the following passage.**

This passage is adapted from Zia Haider Rahman, *In the Light of What We Know*. ©2014 by Zia Haider Rahman. The narrator, a Bangladeshi immigrant in London, has been describing a job he had as a teenager, working as an assistant to carpenters.

I warmed to Bill and Dave quickly. I remember that both of them always said "thanks" or "cheers, mate," even to each other. Such words did not seem to figure in the vocabulary of Sylheti, a language in which, rather than saying thank you, one balanced the whole sentence on terms of deference to age or class. This had the effect, I had noticed, that those who were senior in age or higher in class weren't required by the language to indicate deference and were therefore saved from stooping for the tools to express gratitude.

My mother had always winced when I said please and thank you. Thank you, I'd say when she gave me a second helping of rice and curry. Or thank you when she handed me a lightbulb as I stood on a chair to change the ceiling light. Thank you was an English phrase that ruptured my spoken Sylheti. My mother would grimace and insist that I stop saying it. Because we never had that kind of relationship, I could never ask her why. I have thought that she couldn't bear to hear me say thank you because it signified how far away I'd moved from the culture and values she had inherited, even then. But over the years that have passed since boyhood, I have come to regard such explanations, where mere cultural difference is invoked at every turn, as facile and unilluminating. I now consider her distaste as having had a quality of depth I had not attributed to it before. I think the woman who had raised me, who had provided a family for me, however flawed that family was, was offended that I had turned the web of duties, which bound a family together, into the mere exchange of favors, thank you and please standing for reciprocation. In her mind, I believe, a network of duty and service, tightened under centuries of evolution, had been reduced by my thank you to the trading culture of the West. It was duty and obligation, not measured gains, that reinforced the bonds within the extended family to make something stronger than there would have been otherwise, strong enough and large enough to endure hardships. My understanding came much later, though. But in the summer before college, when I heard Bill and Dave say please and thank you, occasioned at every turn and gesture, I was charmed.

Above all, I liked Bill and Dave because of the banter between them. The two of them talked incessantly about the work in a language that was new to me. A carpenter's world is steeped in a vocabulary of its own, and Bill and Dave were masters of that vocabulary. It was never just a hammer but a cross pein pin hammer, never just a plane but a rebate plane, never a mere clamp but a three-way edging clamp or a G or an F clamp. Each tool had a specific function, and Bill and Dave would never make do with one tool where another was better suited to the job. I fetched the tools as need arose, and very quickly I came to know each tool's name and function.

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CONTINUE

By the way, Bill said, you may think knowing the names of tools and hardware is about identifying them, but if that's all you think then you'd be wrong. You see, calling things by their proper names is the beginning of wisdom. That's a Chinese proverb and they invented writing. The wisdom, in case you're wondering, is that when you get names right, you narrow the gap between you and the thing. The most important tool is your hand and you'd be in serious trouble if there were a gap between you and your hand. So names are important. Unless you're talking about roses, that is. But only roses.

**1**

Over the course of the passage, the focus of the narrator shifts from

A) reflecting on certain interactions with his mother to describing an insight he gained at work.

B) introducing individuals who influenced his childhood to examining why those individuals had such an impact.

C) determining the source of his mother's discontent to comparing his mother with other people.

D) describing a time in which he sought direction to explaining how a particular profession helped him find that direction.

**2**

In the context of the passage, the use of the word "ruptured" (line 17) serves mainly to

A) foreshadow the permanent breach that will occur between the narrator and his country of birth.

B) indicate the difficulty that the narrator has communicating in his native language.

C) highlight the state of distrust that has developed between the narrator and his family.

D) emphasize the extent to which the narrator's adoption of Western ways is incompatible with the culture he grew up in.

**3**

The passage suggests that working with Bill and Dave had which effect on the narrator?

A) It caused him to view his mother's habits as quaint and unsophisticated.

B) It led him eventually to appreciate the complexity of familial relationships in his native culture.

C) It demonstrated how thoughtless he had always been toward his mother.

D) It helped him to feel more confident about his language skills in unfamiliar settings.

**4**

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

A) Lines 3-11 ("Such . . . gratitude")

B) Lines 34-42 ("In her . . . hardships")

C) Lines 43-45 ("But in . . . charmed")

D) Lines 49-51 ("A carpenter's . . . vocabulary")

**5**

As used in line 36, "reduced" most nearly means

A) converted.

B) conquered.

C) subjugated.

D) degraded.

**6**

The passage suggests that the narrator most enjoyed which aspect of carpentry?

A) The opportunity to practice his spoken English

B) The experience of learning new jargon

C) The chance to impress others with his knowledge

D) The physicality of working with his hands

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CONTINUE

7

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

A) Lines 46-49 ("Above . . . me")
B) Lines 51-54 ("It was . . . F clamp")
C) Lines 55-57 ("Each . . . job")
D) Lines 67-70 ("The most . . . hand")

8

The last paragraph serves primarily to

A) introduce a way of thinking that opposes the point of view of the narrator's mother.
B) question the fundamental relationship between names and the things they designate.
C) allow insight into the narrator's way of thinking.
D) provide a further reflection on the deeper significance of language.

9

In the last paragraph, Bill is characterized primarily as a

A) strict disciplinarian.
B) loyal confidant.
C) thoughtful mentor.
D) lovable fraud.

**Questions 10-19 are based on the following passage and supplementary material.**

This passage is adapted from David Streitfeld, "Why Web Reviewers Make Up Bad Things." ©2013 by The New York Times Company.

It's pretty clear exactly who writes fake positive reviews on the Web: friends or relatives of the author or the shop or restaurant owner, or sometimes the
Line author or shop owner himself. The goal of fake
5 positive reviews is to increase sales, and the reviewers are the ones who benefit, or want their friends to benefit.

But who writes fake negative reviews, denouncing stuff without any obvious reason? The usual
10 assumption is that the perpetrators are competitors of some sort, hoping to get an edge on other novelists or chefs or innkeepers. But are there really so many nasty people in the world who need to get some slight advantage by tearing down the restaurant one
15 block over? The question has been shrouded in mystery.

Until now. A fascinating new academic study sheds light on the fake negative review, finding not only that the source is totally unexpected but also
20 that the problem is much bigger than a few malicious operators.

It turns out that competitors are not necessarily the ones giving one miserable star to products they did not buy or experiences they did not have.
25 Customers do it—in fact, devoted customers.

This is hard to wrap your brain around, so first some background. The study was done by Eric Anderson of Northwestern University and Duncan Simester of the M.I.T. Sloan School of Management,
30 using data from an unnamed apparel company that markets through catalogs, a few stores and a Web site. The company does not use third-party sellers and few of its products turn up on eBay, so it provided a relatively controlled experiment.

35 Registered customers wrote over 325,000 reviews in the study period. But for 16,000 of those reviews, there is no evidence that the customer bought the item. These reviews are on balance much more negative. (Could the items have been gifts, which
40 could explain a higher level of dissatisfaction? No, the reviewers explicitly said they bought the items. The researchers were also able to rule out other possibilities, such as the negative reviews' being attributable to differences among items or among
45 reviewers.)

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The researchers cannot say directly what the comments look like that accompany these reviews, because then it would be possible to do a Web search and identify the company. But Mr. Simester said they are something like this:

- I should have read all of the negative reviews before ordering. Please bring back the old style.
- I ordered this item over your Web site. Why is it that good designs are always changed? Please go back to the original.
- I am on a "Made in the USA" campaign and so am returning this item. Please stop importing.

The cranky customers are acting, the study concludes, as "self-appointed brand managers." To put it another way, they are venting. The review forum gives them a simple and direct means of doing so: I hated this product, so listen to me.

As Mr. Simester put it in an interview: "Your best friends are your worst critics." The study mentions in passing that Harley-Davidson's customers were upset when the company introduced a perfume. They took it personally. The same phenomenon seems to be operating here and, perhaps, all over the Web, distorting the review process in a way never imagined.

The apparel retailer was somewhat alarmed to discover this was going on, Mr. Simester said. One possible solution is to allow customers to write reviews only if they have purchased the product. Or give customers easier ways to let their feelings be known.

For the rest of us, the rule remains the same: read reviews if you have no other source of information, but never place your full trust in them. Mr. Simester, who says he has never written a review himself, follows this philosophy.

The other conclusion is that behavior online is too easily taken as a mirror of reality when it is nothing of the sort. What seems to be the voice of the masses is the voice of a self-appointed few, magnified and distorted.

"For every thousand customers, only about 15 write these reviews—and one of them is writing negative reviews of products he hasn't bought," Mr. Simester said. "How surprised should we be that one out of a thousand people do something we have trouble understanding?"

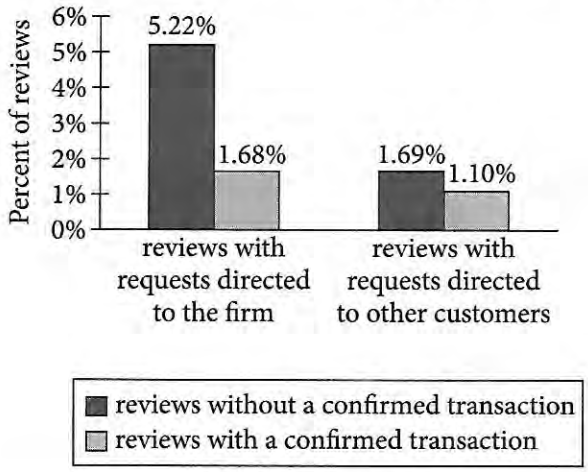
**Figure 1**

Distribution of Product Ratings

| | Without a confirmed transaction | With a confirmed transaction | Difference |
|---|---|---|---|
| Average rating | 4.07 | 4.33 | –.26 |
| Rating = 1 | 10.66% | 5.28% | 5.38% |
| Rating = 2 | 6.99% | 5.40% | 1.59% |
| Rating = 3 | 8.01% | 6.47% | 1.54% |
| Rating = 4 | 13.83% | 16.96% | –3.13% |
| Rating = 5 | 60.51% | 65.89% | –5.38% |

**Figure 2**

Reviews Containing Requests Directed to the Firm versus to Other Customers




Figures adapted from Eric T. Anderson and Duncan I. Simester, "Reviews without a Purchase: Low Ratings, Loyal Customers, and Deception." ©2014 by American Marketing Association.

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CONTINUE

10

Anderson and Simester's study suggests that a common reason that consumers review an item they have not bought is that they

A) own a business that competes with the product's brand.
B) underestimate the economic impact of their actions.
C) have never shopped online.
D) do not want the brand's product line to change.

11

Which choice best supports the idea that Anderson and Simester wish to conceal the identity of the company involved in their study?

A) Lines 8-16 ("But . . . mystery")
B) Lines 17-21 ("A fascinating . . . operators")
C) Lines 22-24 ("It turns . . . have")
D) Lines 46-49 ("The researchers . . . company")

12

As used in line 23, "miserable" most nearly means

A) meager.
B) unhappy.
C) tragic.
D) suffering.

13

What can most reasonably be inferred from the passage about products made by the company used in Anderson and Simester's study?

A) They are more popular among people who shop in stores than among online shoppers.
B) Their quality has improved since the company began manufacturing overseas.
C) They are usually purchased directly from the company itself.
D) Their design is changed frequently based on customer feedback.

14

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

A) Lines 26-27 ("This . . . background")
B) Lines 27-29 ("The study . . . Management")
C) Lines 32-33 ("The company . . . eBay")
D) Lines 33-34 ("so it . . . experiment")

15

The main purposes of the sentences in parentheses in lines 39-45 are to

A) anticipate readers' questions and rule out possible weaknesses in the study's design.
B) mention interesting data and explain how they are related to the study's main finding.
C) explain dissatisfaction with the study's results and encourage critics to reconsider.
D) point out flaws in the researchers' methods and offer alternate theories on the causes of the behavior being studied.

16

As used in line 68, "operating" most nearly means

A) managing.
B) performing.
C) engaging.
D) occurring.

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CONTINUE

17

Which choice best summarizes the two paragraphs in lines 77-86?

A) Shoppers should read reviews carefully to determine whether the reviewer actually purchased the item.

B) Only a small percentage of the people who buy a product review it online, so shoppers should not assume reviews represent how most customers feel about a product.

C) All customers who buy a product should review it online so that online reviews provide shoppers with an accurate reflection of how the product has been received.

D) As more companies require customers to verify the purchase of an item before they are able to review it, online reviews are becoming more trustworthy.

18

Based on figure 1, which statement is true for both reviewers with confirmed transactions and reviewers without confirmed transactions?

A) They are more likely to give a product rating of 2 than of 3.

B) They are most likely to give a product rating of 4 or 5.

C) They are least likely to give a product rating of 1.

D) Their product ratings are concentrated at the center of the rating scale.

19

According to figure 2, the highest percentage of requests made in product reviews were written by

A) reviewers without a confirmed transaction, directed toward the firm selling the product.

B) reviewers with a confirmed transaction, directed toward the firm selling the product.

C) reviewers without a confirmed transaction, directed toward all other reviewers.

D) the firm selling the product, directed toward reviewers with a confirmed transaction.

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**Questions 20-28 are based on the following passage and supplementary material.**

This passage is adapted from Niina Heikkinen and ClimateWire, "Does Agave Hold the Secret to Drought-Resistant Farming?" ©2015 by Scientific American, a Division of Nature America, Inc.

Agave is teaching scientists about how to craft more drought-resistant plants. The hardy succulent, along with species like prickly pear (an edible cactus), pineapple, and vanilla orchids, has evolved over millions of years to perform a different kind of photosynthesis that allows the plants to survive in semiarid environments where water isn't always readily available.

The process is called crassulacean acid metabolism, or CAM, and a small group of scientists have been studying it for several decades because the plants that have it use less water. However, it has only been in the last couple of years that a growing number of researchers have been attempting to fully identify and transfer this photosynthetic pathway to other plant species.

Re-creating an entire metabolic pathway in a plant is far from a simple task. Once scientists figure out all the genes associated with its basic function, as well as its regulation, they then have to find a way to add that genetic material into the target plant, or make existing genes and proteins within the plant work the way they want them to. Altogether, that could involve somewhere around 100 genes, the researchers said, though they don't know the exact number yet.

Xiaohan Yang, a staff scientist in the Biosciences Division at Oak Ridge National Laboratory, is one of the researchers working to figure out how to get CAM to work in other types of plants. He said interest in CAM has increased rapidly in the last few years alone, as concern about the effects of drought has gone up and more funding from the federal government has come in.

What makes photosynthesis in agave and cactus so different? Unlike most plants that take up carbon dioxide through stomata [small openings that allow plants to regulate the intake and release of gases] in their leaves during the day (known as $C_3$ and $C_4$ plants), CAM plants absorb most of their $CO_2$ [carbon dioxide] at night. This timing shift means less water evaporates off of the leaves through transpiration. In fact, CAM plants require between a [sixth] and a [fourth] of the water that $C_3$ and $C_4$ plants need, respectively.

However, CAM plants also need a way of storing carbon overnight, because just like other plants, they cannot use it to build energy reserves like sugars and starches without sunlight. They do this by temporarily fixing carbon in a transient pool of mostly malic acid. When the sun rises, the plants break down the organic acids, releasing the $CO_2$. At this point, the plant is able to perform photosynthesis like a $C_3$ plant, except the stomata don't have to stay open because the carbon is already available in the leaf.

The challenge for researchers like Yang is to find a way to get other plants to create this nocturnal carbon storage. Since the genomes of a number of different CAM plants have been sequenced in the past two years, researchers are beginning to develop a better understanding of how the pathway works.

"We have a very good idea of what genes are important for CAM species," Yang said. "Right now, we are working on how those genes come together, and then we test their efficiency."

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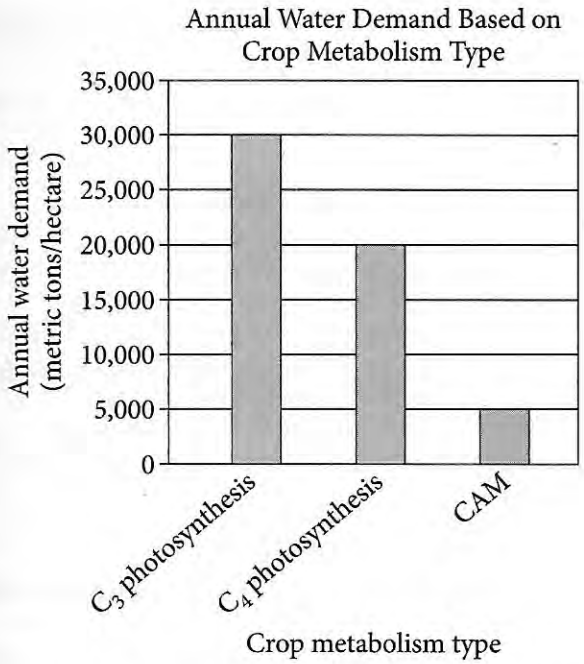


Adapted from Xiaohan Yang et al., "A Roadmap for Research on Crassulacean Acid Metabolism (CAM) to Enhance Sustainable Food and Bioenergy Production in a Hotter, Drier World." ©2015 by ORNL/UT-Battelle and New Phytologist Trust.

**20**

The main purpose of the passage is to

A) describe research that may facilitate the cultivation of plants in conditions of limited water availability.

B) endorse a promising approach to water conservation as appropriate for agricultural contexts.

C) explain how crassulacean acid metabolism disrupts photosynthesis in commonly farmed plant species.

D) clarify why a particular study of plant genetics has not produced results that can be applied to agriculture.

**21**

Which choice provides the fullest explanation for the recent rise in scientific research on CAM?

A) Lines 1-2 ("Agave . . . plants")

B) Lines 9-12 ("The process . . . water")

C) Lines 30-34 ("He said . . . come in")

D) Lines 59-62 ("Since . . . works")

**22**

In lines 2-8, the references to specific plant species serve primarily to

A) identify plants whose biochemical processes have been artificially altered.

B) specify the plants that the researchers used in the experiment.

C) provide examples of plants that rely on an alternative kind of metabolism.

D) note exceptions to the plant behavior that the scientists observed.

**23**

As used in line 6, "allows" most nearly means

A) enables.

B) authorizes.

C) excuses.

D) acknowledges.

**24**

As used in line 57, "challenge" most nearly means

A) requirement.

B) competition.

C) dispute.

D) difficulty.

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CONTINUE

25

Based on the passage, which choice best identifies the point to which genetic research on CAM has advanced?

A) Scientists believe that once they isolate the genes involved in CAM, they can alter them to perform new functions in CAM plants.

B) Scientists possess an incomplete understanding of how CAM-related genes function because many CAM species' genomes have yet to be sequenced.

C) Scientists feel more confident about which genes are involved in CAM than about the precise interactions among those genes.

D) Scientists know that CAM pathways differ from one species to another but have not yet determined the specific differences.

26

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

A) Lines 18-23 ("Once . . . them to")

B) Lines 23-26 ("Altogether . . . yet")

C) Lines 57-59 ("The challenge . . . storage")

D) Lines 63-66 ("We have . . . efficiency")

27

According to the graph, approximately how much water does a hectare of CAM plants require per year?

A) 5,000 metric tons

B) 10,000 metric tons

C) 15,000 metric tons

D) 20,000 metric tons

28

Which of the following choices is a claim in the passage that is supported by the data in the graph?

A) CAM plants do not leave their stomata open throughout photosynthesis.

B) CAM plants demand less water on average than either $C_3$ or $C_4$ plants do.

C) CAM plants absorb more $CO_2$ during the night than during the day.

D) CAM plants perform a certain phase of photosynthesis in the same manner that $C_3$ plants do.

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**Questions 29-37 are based on the following passage.**

This passage is adapted from George H. W. Bush's inaugural address as president of the United States of America. Delivered in 1989.

America today is a proud, free nation, decent and civil, a place we cannot help but love. We know in our hearts, not loudly and proudly, but as a simple fact, that this country has meaning beyond what we see, and that our strength is a force for good. But have we changed as a nation even in our time? Are we enthralled with material things, less appreciative of the nobility of work and sacrifice?

My friends, we are not the sum of our possessions. They are not the measure of our lives. In our hearts we know what matters. We cannot hope only to leave our children a bigger car, a bigger bank account. We must hope to give them a sense of what it means to be a loyal friend, a loving parent, a citizen who leaves his home, his neighborhood and town better than he found it. What do we want the men and women who work with us to say when we are no longer there? That we were more driven to succeed than anyone around us? Or that we stopped to ask if a sick child had gotten better, and stayed a moment there to trade a word of friendship?

No President, no government, can teach us to remember what is best in what we are. But if the man you have chosen to lead this government can help make a difference; if he can celebrate the quieter, deeper successes that are made not of gold and silk, but of better hearts and finer souls; if he can do these things, then he must.

America is never wholly herself unless she is engaged in high moral principle. We as a people have such a purpose today. It is to make kinder the face of the Nation and gentler the face of the world. My friends, we have work to do. . . .

The old solution, the old way, was to think that public money alone could end these problems. But we have learned that is not so. And in any case, our funds are low. We have a deficit to bring down. We have more will than wallet; but will is what we need. We will make the hard choices, looking at what we have and perhaps allocating it differently, making our decisions based on honest need and prudent safety. And then we will do the wisest thing of all: We will turn to the only resource we have that in times of need always grows—the goodness and the courage of the American people.

I am speaking of a new engagement in the lives of others, a new activism, hands-on and involved, that gets the job done. We must bring in the generations, harnessing the unused talent of the elderly and the unfocused energy of the young. For not only leadership is passed from generation to generation, but so is stewardship. And the generation born after the Second World War has come of age.

I have spoken of a thousand points of light, of all the community organizations that are spread like stars throughout the nation, doing good. We will work hand in hand, encouraging, sometimes leading, sometimes being led, rewarding. We will work on this in the White House, in the Cabinet agencies. I will go to the people and the programs that are the brighter points of light, and I will ask every member of my government to become involved. The old ideas are new again because they are not old, they are timeless: duty, sacrifice, commitment, and a patriotism that finds its expression in taking part and pitching in.

**29**

Bush's central claim in the speech is that

A) when the United States overcomes its love of material things, the country will become a beacon to the rest of the world.

B) even though the United States is economically strong, the country faces many perplexing problems.

C) if each citizen engages in the kind of behavior that is truly valued in the United States, many of the nation's problems will be addressed.

D) because each US citizen is a point of light in his or her neighborhood, the country's future will always be bright.

**30**

Which choice best supports the conclusion that Bush views the president as a moral guide for the nation?

A) Lines 1-2 ("America . . . love")

B) Lines 9-10 ("My . . . lives")

C) Lines 23-28 ("But . . . must")

D) Lines 62-66 ("The old . . . pitching in")

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CONTINUE

31

As used in line 10, "measure" most nearly means

A) course of action.
B) piece of legislation.
C) degree of concern.
D) standard of comparison.

32

In the speech, Bush suggests that, fundamentally, most individuals truly esteem

A) family members more than friends and neighbors.
B) personal character more than material acquisitions.
C) business opportunities more than government programs.
D) civic activism more than political rhetoric.

33

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

A) Lines 2-5 ("We know . . . good")
B) Lines 7-8 ("Are . . . sacrifice")
C) Lines 10-14 ("In our . . . parent")
D) Lines 39-44 ("We will . . . grows")

34

Which choice best describes Bush's view of the "citizen" described in line 14?

A) Heartfelt approval
B) Tempered enthusiasm
C) Reluctant endorsement
D) Quiet concern

35

What main effect do the phrases "high moral principle" and "make kinder the face of the Nation," used in the fourth paragraph (lines 29-33), have on the tone of the speech?

A) They create an optimistic tone that tempers Bush's warnings to listeners about challenges that lie ahead.
B) They create an inspirational tone that contributes to Bush's efforts at rallying listeners.
C) They create an ominous tone that lends gravity to Bush's call for listeners to change their behavior.
D) They create a calming tone that reassures Bush's listeners of the ease with which problems can be overcome.

36

In the speech, Bush indicates that at the time of his inauguration, there is a shortage of

A) financial resources.
B) political will.
C) patriotic sentiment.
D) community organizations.

37

In the speech, Bush characterizes himself as someone who will support

A) government assistance for both the elderly and the very young.
B) increased citizen involvement in community organizations.
C) business leaders who possess and act upon a social conscience.
D) rugged individualism and self-sufficiency for all Americans.

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CONTINUE

**Questions 38-47 are based on the following passages.**

Passage 1 is adapted from Stephen Jay Gould, "Cope's Rule as Psychological Artefact." ©1997 by Nature Publishing Group. Passage 2 is adapted from Joseph Dussault, "When It Comes to Evolution, Bigger Really Is Better." ©2015 by The Christian Science Monitor. Both passages consider Cope's rule, the notion that animal lineages tend to increase in physical size over evolutionary time.

**Passage 1**

We should ask a basic, emperor's-new-clothes question about Cope's rule: is it even true at all? One would think that an issue so fundamental, and so eminently testable, had been conclusively resolved long ago—except for a perverse trait of the human psyche. We tend to pick most "notable" cases out of general pools, often for idiosyncratic reasons that can only distort a proper scientific investigation.

Might not our convictions about the validity of Cope's rule be a psychological artefact of singling out lineages that display size increase because we all know that "bigger is better"? Such a procedure might provide an example of another pervasive and lamentable bias of human reasoning: our tendency to focus on extremes that intrigue us, rather than full ranges of variation. The obvious test requires that we abandon our habit of selective search for the expected and, instead, study all lineages in large clades with excellent data over substantial geological intervals. David Jablonski has followed this admirable procedure in the most comprehensive set of data ever assembled to test Cope's rule—and the rule fails in this case.

In 1997, Jablonski studied all 191 bivalve and gastropod lineages of mollusks with sufficient data (including 1,086 species) during 16 million years of Late Cretaceous time for the rich faunas of the Gulf and Atlantic coastal plain of North America. He consistently concentrated on complete ranges of variations, rather than expansion or contraction of extreme values alone.

Jablonski found, first of all, that lineages showing net increase in size (that is, increase in both the smallest and largest species) are no more common than lineages showing net decrease of both the smallest and largest: 27–30% display net increase; 26–27% display net decrease. Moreover, in the additional 25–28% of lineages that show size increase for the largest species, the smallest species also decrease in size over the same interval—yielding a pattern of expansion in the overall range of variation (at both high and low ends), not a directed trend towards increasing general size. In short, although many individual lineages do show increase in body size, just as many decrease. So a full account of all data provides no support for Cope's rule as a preferential bias for evolution of size.

**Passage 2**

After conducting an extensive study on size, a Stanford research team found that, over time, marine animal lineages generally evolve to be larger.

The team amassed mountains of data under Stanford paleobiologist Jonathan Payne. The hulking dataset they compiled spans 542 million years, and includes five of the major phyla and over 17,000 genera—about 75 percent of all marine genera in the fossil record, and nearly 60 percent of all animal genera to have ever lived.

Payne says his research seems to support Cope's rule.

"The average animal in the oceans today is 150 times larger in biovolume than the average animal in the oceans during the Cambrian, 540 million years ago," Payne says. "Prior to our study, it was unknown whether there had been size change and, if so, in what direction or by how much."

"We [also] found that size did not result from universal selection toward larger size," Payne adds. "Rather, the classes that were already larger early in the evolution of animal life have diversified differentially across evolutionary time. In other words, our data suggest that larger size favors diversification, rather than that larger sizes are favored in all populations."

While the overall increase in marine animal size is pretty much indisputable, some scientists argue that size is not a matter of "active selection," but a result of random, non-selective mutations—a concept known as neutral drift. In other words, neutral drift could cause some lineages to grow in size, but only by chance—that doesn't necessarily mean evolution "favors" size. The neutral drift argument is supported by evidence from bird and insect populations, who have not grown in size as Cope's rule postulates.

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CONTINUE

"It is possible that Cope's rule applies mainly to marine animals," Payne admits. "Understanding the underlying causes better will be critical to determining whether or not we should expect animals in other environments to exhibit the same patterns."

But Payne says that, at least in this case, neutral drift isn't his culprit.

**38**

The main purpose of the first paragraph of Passage 1 is to

A) cast doubt on the reliability of certain research methods.

B) present a human tendency for which there is no reasonable explanation.

C) call into question a scientific concept.

D) offer new evidence for a traditional theory.

**39**

As used in line 6, "cases" most nearly means

A) arguments.

B) explanations.

C) circumstances.

D) examples.

**40**

As used in line 8, "proper" most nearly means

A) distinctive.

B) relevant.

C) lawful.

D) legitimate.

**41**

The author of Passage 1 implies that confidence in Cope's rule is the result of

A) a common tendency that inhibits scientific inquiry.

B) a reluctance to contradict scientific authorities.

C) an arbitrary preference for scientific data that are quantitative rather than observational.

D) an unwillingness to alter established practices of scientific research.

**42**

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

A) Lines 1-2 ("We should . . . all")

B) Lines 9-12 ("Might . . . better")

C) Lines 28-31 ("He consistently . . . alone")

D) Lines 45-47 ("So a . . . size")

**43**

According to Passage 2, scientists who support the neutral drift argument believe that the overall increase in the size of marine animal life is due to the

A) random survival of mutations that affect size within particular lineages.

B) direct influence of evolutionary selection on animal populations.

C) cumulative effect of long-term shifts in environmental conditions.

D) psychological biases that often affect researchers' observations.

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CONTINUE

44

Which choice best states the relationship between the two passages?

A) Passage 2 disputes the scientific foundation of the work reported in Passage 1.

B) Passage 2 describes evidence in support of a concept that Passage 1 challenges.

C) Passage 2 discusses an experiment that Passage 1 rejects as inconclusive.

D) Passage 2 expands upon the preliminary results of a study outlined in Passage 1.

45

Which statement best identifies the overall structures of the two passages?

A) Passage 1 explores a sequence of contrasting arguments, while Passage 2 explores a single argument throughout.

B) Passage 1 supports a position with a series of generalizations, while Passage 2 supports a position through a detailed analysis of scientific data.

C) Passage 1 considers a topic solely from a historical perspective, while Passage 2 alternates between historical and contemporary perspectives.

D) Passage 1 shifts from a theoretical discussion to an analysis of specific results, while Passage 2 presents concrete results and then concedes the limitations of a theory that may explain them.

46

The author of Passage 1 would most likely have considered the data set used for Payne's study in Passage 2 to be

A) exemplary, because Payne excluded data that had been identified as statistically problematic.

B) promising, because Payne's analysis was wide-ranging and encompassing.

C) acceptable, because Payne considered differences between marine and terrestrial species.

D) deficient, because Payne analyzed only 75 percent of all marine animals.

47

Which choice from Passage 1 provides the best evidence for the answer to the previous question?

A) Lines 6-8 ("We tend . . . investigation")

B) Lines 12-16 ("Such . . . variation")

C) Lines 16-20 ("The obvious . . . intervals")

D) Lines 32-37 ("Jablonski . . . decrease")

# STOP

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

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# 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.**

### Embroidering History

Kate Russell, an American who lives on the small island of Alderney just off the coast of France, became 1 wild about the Bayeux Tapestry the moment she first saw it. She loved the beautifully embroidered series of pictures that tell the story of William the Conqueror's victory at the Battle of Hastings in 1066. She was overwhelmed by the sheer magnitude of the tapestry, wondering how artists working in the late eleventh century could have 2 created a piece 230 feet long. She was further intrigued by the mystery surrounding the missing ending of the tapestry.

1

A) NO CHANGE
B) eager about
C) fired up by
D) fascinated by

2

A) NO CHANGE
B) used yarns dyed with such vivid colors.
C) studied other depictions so closely to produce the masterpiece.
D) devoted so much time to creating this masterpiece.

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CONTINUE

Though nobody is sure exactly when or how the final panels of the Bayeux Tapestry were lost, scholars believe the original piece most likely ended with William the Conqueror's coronation as king of England. 3 The piece begins with an image of King Edward the Confessor sitting on the throne of England. In the middle of the tapestry there is an image of Harold, Edward's successor, taking the throne at his coronation. Ending the tapestry with an image of William finally enthroned would make for what 4 Professor, Robert Bartlett a leading expert on the Middle Ages, calls a "neat symmetry."

3

Which choice provides the most logical transition from the previous sentence to the sentence that follows?

A) The story of the Battle of Hastings is a familiar one to many.

B) The intact tapestry shows the coronations of two kings.

C) Evidence for this theory can be found earlier in the tapestry.

D) With his victory, William would become the first Norman king of England.

4

A) NO CHANGE

B) Professor, Robert Bartlett,

C) Professor Robert Bartlett—

D) Professor Robert Bartlett,

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CONTINUE

5 A friend challenged Russell to show what the original ending of the tapestry might have looked like. This spurred Russell on to start working with a local artist, Pauline Black, in 2012. On paper, they designed a series of four scenes depicting the events leading from the Battle of Hastings to William's coronation. 6 By working carefully to use colors and other design elements that matched the original, Russell and Black wondered 7 if their vision could be brought to life on fabric?

5

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

A) Russell was challenged by a friend to show what the original ending of the tapestry might have looked like, and this challenge spurred her on to start

B) Challenged by a friend to show what the original ending of the tapestry might have looked like, Russell was spurred on by this challenge to start

C) Spurred on by a friend who challenged her to show what the original ending of the tapestry might have looked like, Russell started

D) A friend's challenge to Russell was for her to show what the original ending of the tapestry might have looked like; this spurred Russell on and she started

6

A) NO CHANGE

B) Having worked

C) They have worked

D) While having worked

7

A) NO CHANGE

B) could their vision be brought to life on fabric.

C) if their vision could be brought to life on fabric.

D) whether their vision could be brought to life on fabric?

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CONTINUE

Setting themselves up in the local library, Russell and Black recruited the residents of Alderney to help embroider 8 the Alderney Bayeux Tapestry Finale. 9 On the other hand, 416 volunteers spent more than a year completing the work. Using the same embroidery techniques employed by the original artists, 10 the look and feel of the original tapestry were able to be re-created by them. Participants commented that they also were able to share an experience with artists from 900 years ago, down to the very aches in their shoulders.

The culmination of the group's efforts came when the Alderney Finale was displayed alongside the original Bayeux Tapestry in the Bayeux Museum. "I couldn't stop grinning," Russell said, thinking of the day the Finale was brought to the museum. The positive response from the more than 140,000 people who saw the Finale in Bayeux 11 have made one thing clear—the embroiderers of Alderney had succeeded in creating a work that seemed an authentic fit alongside its famous inspiration.

**8**

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

the eight-foot-long piece of linen they called

Should the writer make this addition here?

A) Yes, because it provides a detail that makes clear the scope of the project discussed in the paragraph.
B) Yes, because it reinforces a point made earlier in the sentence.
C) No, because it introduces a term that needs to be defined.
D) No, because it repeats information given earlier in the passage.

**9**

A) NO CHANGE
B) However,
C) After all,
D) In the end,

**10**

A) NO CHANGE
B) the original tapestry's look and feel were able to be re-created by them.
C) they were able to re-create the look and feel of the original tapestry.
D) it was possible for them to re-create the original tapestry's look and feel.

**11**

A) NO CHANGE
B) are making
C) were making
D) made

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CONTINUE

**Questions 12-22 are based on the following passage.**

**Tips for Better Service**

At most restaurants in the United States with table service—where waitstaff take patrons' orders and serve them at their tables—patrons are expected to tip the servers at the end of the meal. 12 The number of food-service establishments in the United States has almost doubled in the last three decades. Critics of tipping claim that the practice should be abolished because it benefits restaurant owners at their employees' expense. On the contrary, tipping benefits not just restaurant owners but also the patrons and the members of the waitstaff themselves.

13 It is certainly true, as critics contend, that the practice of tipping benefits restaurant owners. This is because it allows owners to pay servers a relatively low hourly wage without violating federal minimum wage laws. The Fair Minimum Wage Act of 2007 established the minimum wage at $5.85 per 14 hour, it has been raised a number of times in subsequent years. Under federal law, restaurant 15 owners' whose server's earn

12

The writer is considering deleting the underlined sentence. Should the sentence be kept or deleted?

A) Kept, because it addresses an important counterpoint to the main argument of the passage.

B) Kept, because it contributes to the paragraph's discussion of the importance of tipping.

C) Deleted, because it blurs the focus of the paragraph by introducing an irrelevant detail.

D) Deleted, because it contradicts the point about tipping made in the next sentence.

13

Which choice most effectively introduces the main topic of the paragraph?

A) NO CHANGE

B) It is actually false, despite what critics believe, that tipping rewards restaurant owners.

C) It is always true, as critics say, that patrons should consider tipping their servers after a meal.

D) It is obviously true, as critics point out, that the minimum wage has been raised several times in recent years.

14

A) NO CHANGE

B) hour, and

C) hour also

D) hour, meanwhile

15

A) NO CHANGE

B) owners whose servers

C) owners whose servers'

D) owners who's servers

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CONTINUE

part of their wages from tips need only pay a fraction of this minimum wage, with the balance to be paid by the patrons who provide tips 16 making up the difference.

If tipping were abolished, the increase 17 for owners' labor costs could be quite significant, and this could have a negative impact on patrons. 18 Therefore, a restaurant manager at one restaurant in Miami Beach, where waitstaff often earn as much as $200 to $300 in tips on a Friday or Saturday night, recently noted that without tipping, server wages would need to average around $30 an hour to offset the money lost in tips. In comparison, according to a 2013 US Department of Labor report, the average hourly wage of an executive administrative assistant is only $24.14 per hour. Restaurant owners would have no choice but to increase menu prices to defray at least part of that increase, and that would come directly out of patrons' pockets.

16

A) NO CHANGE
B) filling in the rest.
C) giving them the other money.
D) DELETE the underlined portion and end the sentence with a period.

17

A) NO CHANGE
B) with
C) in
D) from

18

A) NO CHANGE
B) Ultimately,
C) However,
D) For example,

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CONTINUE

The practice of tipping does not just benefit patrons 19 economically, though, it also ensures that patrons receive better service by providing an incentive to the tip-dependent restaurant employees who wait on them. Simply put, servers 20 want to earn a good tip. These servers are motivated to provide high-quality service to their customers. 21 This motivation might disappear if servers were to receive a fixed hourly wage no matter how they perform on the job.

19

A) NO CHANGE
B) economically though,
C) economically, though;
D) economically—though;

20

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

A) who want to earn a good tip are motivated
B) are motivated by wanting to earn a good tip and trying
C) motivated by wanting to earn a good tip have an incentive
D) who are motivated by the desire to earn a good tip have an incentive

21

Which choice best contributes to the main point made in the paragraph?

A) NO CHANGE
B) Although some restaurant patrons vary the tips they leave based on the quality of service, others simply leave a 15 or 20 percent tip every time.
C) Restaurant patrons should keep their servers' low base wages in mind when calculating the tip they will leave.
D) According to San Diego restaurant owner Jay Porter, replacing tips with a flat service charge led to fewer disputes among his restaurant staff.

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CONTINUE

Finally, far from exploiting them, the practice of tipping actually benefits servers by allowing them to have some control over how much money they make. Instead of being tied to a fixed wage, waiters and waitresses who are motivated can usually make much more by earning tips (on top of a comparatively low hourly wage) than they could from a higher hourly wage without tips. Everyone wins from the practice of tipping; abolishing 22 them, however well intentioned, would help no one.

22

A) NO CHANGE
B) those,
C) it,
D) one,

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CONTINUE

**Questions 23-33 are based on the following passage.**

**What's in a Name?**

Bottlenose dolphins communicate, as do many marine mammals, using specialized whistles—high-pitched vocalizations that carry well in an aquatic environment. What distinguishes bottlenose dolphins from 23 the calls of other marine mammals is how they use their whistles. 24 Specifically, individual bottlenose dolphins develop unique whistle patterns that function much like human names do. Scientists at the University of Saint Andrews have conducted two major experiments on the 25 subject. They think that this ability to identify other individuals by "name" helps dolphin pods stay together in the wild.

23

A) NO CHANGE
B) those of other marine mammals
C) other marine mammals' calls
D) other marine mammals

24

A) NO CHANGE
B) In contrast,
C) Besides,
D) Overall,

25

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

A) subject; they also think
B) subject to think
C) subject and think
D) subject by thinking

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CONTINUE

Other animals, such as parrots, bats, and elephants, are able to maintain group cohesion by recognizing the voices of other individuals, but bottlenose dolphins do more than this. They exhibit what scientists call vocal 26 learning; and this is the ability to refer to an object or individual using a learned sound. Scientists have long known that dolphins develop "signature whistles" that are unique to each individual, but studies published in 2006 and 2013 provide evidence that dolphins learn an individual's signature whistle and use it to call out to that specific dolphin.

26

A) NO CHANGE
B) learning, this
C) learning; which
D) learning. This

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CONTINUE

27 Animal calls can convey a great deal of information, including species, family line, and, in some cases, individual identity. When they are separated, a pair of bottlenose dolphins from the same pod will not simply call out their own signature whistles, hoping to be 28 recognized, instead, each will call out the other's signature whistle—just as two humans would call out each other's names if they were separated in a crowd. 29 When one dolphin hears its own signature whistle, it

**27**

Which choice best sets up the point made in the next sentence?

A) NO CHANGE
B) Scientists have not yet been able to determine how many signature whistles bottlenose dolphins can recall.
C) The dolphins' use of these sounds is thus more complex than the mere recognition of each other's unique whistles.
D) Bottlenose dolphins often form close bonds with other dolphins from the same pod, and these relationships can endure over years.

**28**

A) NO CHANGE
B) recognized; instead,
C) recognized instead;
D) recognized instead

**29**

The writer is considering adding the following sentence.

> Scientists have also distinguished dolphins' signature whistles from birdsongs, which are usually shared between birds rather than being specific to individuals.

Should the writer make this addition here?

A) Yes, because it develops a point made in the previous paragraph about the vocalizations of various kinds of animals.
B) Yes, because it presents an example that supports the paragraph's point about the uniqueness of dolphin whistles.
C) No, because it makes a point about birdsongs that was discussed earlier in the passage.
D) No, because it distracts from the discussion of dolphin whistles by focusing on another kind of animal.

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CONTINUE

will respond with the same call, thus establishing the 30 dolphins' relative locations. The Saint Andrews team theorizes that this behavior allows the dolphins to coordinate movements and keep track of one another.

It is not known how many of these signature whistles a dolphin can 31 remember and use, but research has shown that individuals do 32 hang on to signature whistles in long-term memory. Jason Bruck, a researcher at the University of Chicago, has confirmed captive dolphins' ability to recognize the signature whistles, or "names," of familiar dolphins. Bruck performed a controlled experiment that involved playing other dolphins' signature whistles over a speaker in a target dolphin's enclosure. He found that the dolphins responded to the signature calls of known individuals—even former pod mates last seen twenty years earlier—and largely ignored those of unknown individuals. 33 Bruck's study provides an illuminating means of comparing the function of long-term memory in humans and dolphins.

30

A) NO CHANGE
B) dolphin's relative locations.
C) dolphins' relative location's.
D) dolphins relative location's.

31

A) NO CHANGE
B) remember and use, but,
C) remember and use but,
D) remember, and use but,

32

A) NO CHANGE
B) retain
C) stash away
D) put away

33

The writer wants to describe the results of the research discussed in this paragraph in a way that reflects the main idea of the passage. Which choice best accomplishes this goal?

A) NO CHANGE
B) Bottlenose dolphins thus join the wide range of animals that use vocalizations to communicate with one another.
C) Although these abilities are impressive, researchers recognize that the whistles of bottlenose dolphins cannot perform many of the functions of human language.
D) This result suggests that bottlenose dolphins can distinguish and remember the "names" of acquaintances for long periods of time.

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CONTINUE

**Questions 34-44 are based on the following passage and supplementary material.**

**Cultural Diplomacy Programs Put Friendship First**

Thanks to the Internet, we are more 34 interconnected now; than at any point in our history. As connected as most people are, though, wide divisions 35 survive throughout the world, with many groups struggling to resolve long-standing conflicts. Technology alone does not seem capable of bridging these gaps. If 36 we want to foster peace and empathy in our global society, it is crucial to bring people together face-to-face.

Cultural diplomacy programs specialize in 37 solving similar problems. One example is Friends Forever, a New Hampshire–based nonprofit organization that assists teenagers from regions with notable cultural, ethnic, or religious divides, such as Northern Ireland or

34

A) NO CHANGE
B) interconnected, now
C) interconnected, now,
D) interconnected now

35

A) NO CHANGE
B) persist
C) persevere
D) maintain

36

A) NO CHANGE
B) he or she wants
C) you want
D) they want

37

Which choice most effectively links this sentence with the information in the previous paragraph?

A) NO CHANGE
B) overcoming technological obstacles.
C) facilitating such interactions.
D) bringing these people together.

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CONTINUE

the Middle East. Young people from different cultures are invited to spend two weeks together in the United States in an intense session known as a "Life Raft." Giving up their cell phones and their privacy, participants cohabitate 38 together in surroundings foreign to all and engage in trust-building activities. Another 39 organization, the International Writing Program at the University of Iowa offers writers from around the world a three-month residency in which to share not only stories and poems 40 as well as the experience of navigating a new environment. By 41 getting to know their peers in an unfamiliar setting, participants in both programs have the rare opportunity to reevaluate—and perhaps even modify—their cultural perceptions.

38

A) NO CHANGE
B) together in surroundings that are unfamiliar and
C) in surroundings that are unfamiliar and
D) in surroundings

39

A) NO CHANGE
B) organization, the International Writing Program at the University of Iowa,
C) organization: the International Writing Program at the University of Iowa,
D) organization, the International Writing Program (at the University of Iowa)

40

A) NO CHANGE
B) but also
C) in addition to
D) but also share

41

Which choice most effectively links the information in the previous sentence with the information that follows?

A) NO CHANGE
B) living with their adversaries for three months,
C) freeing people from a dependence on technology,
D) reading each other's work,

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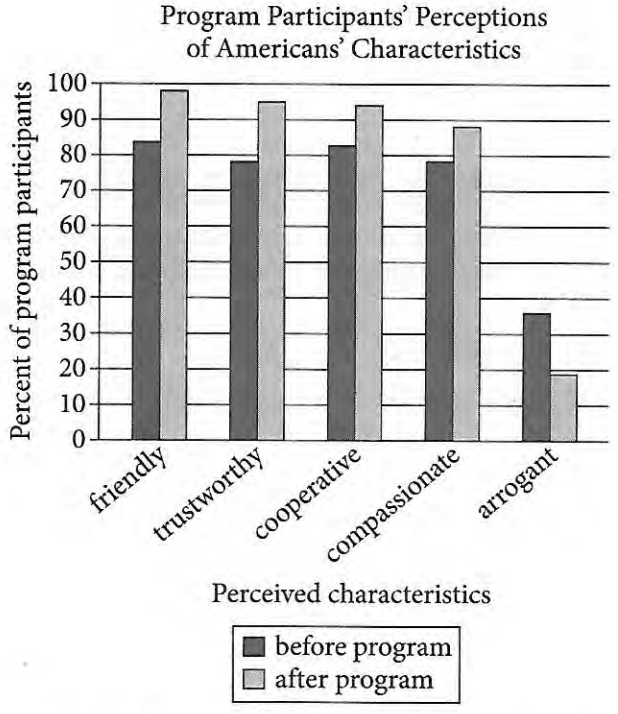
CONTINUE

Skeptics might argue that a person's perception of others cannot change in just a few weeks. Evidence from another cultural diplomacy program suggests that 42 change is hard. Between 1996 and 2001, the US State Department brought to the United States professionals from various countries in the International Visitor Leadership Program. Comparing and averaging data gathered before and after each visitor's several-week stay, State Department researchers found that the visitors' opinions of Americans' positive characteristics (that is, the percentage of visitors who perceived Americans to be friendly, trustworthy, and the like) increased across the board. Meanwhile, the percentage of visitors who saw Americans as arrogant decreased 43 by about double.




Source: Data from "International Visitor Leadership Program Outcome Assessment." US Department of State. Published in 2006.

42

Which choice is best supported by the information in the passage and the graph?

A) NO CHANGE
B) it can.
C) it is possible, but unlikely.
D) perceptions are unpredictable.

43

Which choice supports the writer's point with an accurate interpretation of data in the graph?

A) NO CHANGE
B) an equivalent amount.
C) from around 35 percent to less than 20 percent.
D) to between 30 and 40 percent.

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CONTINUE

What these numbers reveal 44 <u>are</u> perhaps only common sense—new experiences change old perceptions—but even so, it is an important lesson we cannot afford to forget when considering solutions to international issues. The "soft power" of cultural diplomacy is a peaceful and effective approach to strengthening relations between nations. By dissolving stereotypes and broadening understanding of other perspectives, cultural diplomacy programs can help create a world as connected by empathy as it is by the Internet.

44

A) NO CHANGE
B) were
C) is
D) to be

# STOP

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

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# Math Test – No Calculator

## 25 MINUTES, 17 QUESTIONS

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

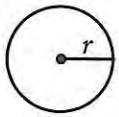
**DIRECTIONS**

**For questions 1-13**, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. **For questions 14-17**, solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 14 on how to enter your answers in the grid. You may use any available space in your test booklet for scratch work.

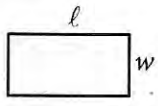
**NOTES**

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

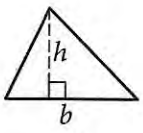
**REFERENCE**



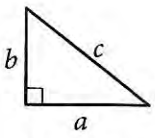

$A = \pi r^2$
$C = 2\pi r$



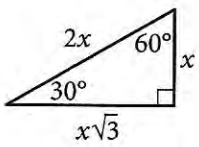

$A = \ell w$

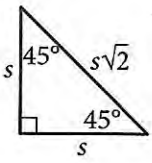



$A = \frac{1}{2}bh$

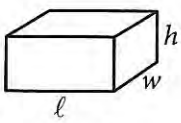



$c^2 = a^2 + b^2$

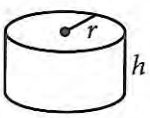


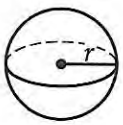

Special Right Triangles



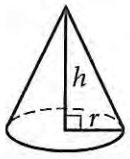

$V = \ell wh$



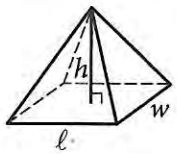

$V = \pi r^2 h$




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




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




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

The number of degrees of arc in a circle is 360.
The number of radians of arc in a circle is $2\pi$.
The sum of the measures in degrees of the angles of a triangle is 180.

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CONTINUE

1

$$51 = 7 + 2x$$

What value of $x$ satisfies the equation above?

A) 58
B) 44
C) 29
D) 22

2

$$3a + 4b = 25$$

A shipping company charged a customer \$25 to ship some small boxes and some large boxes. The equation above represents the relationship between $a$, the number of small boxes, and $b$, the number of large boxes, the customer had shipped. If the customer had 3 small boxes shipped, how many large boxes were shipped?

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

3

On January 1, 2015, a city's minimum hourly wage was \$9.25. It will increase by \$0.50 on the first day of the year for the next 5 years. Which of the following functions best models the minimum hourly wage, in dollars, $x$ years after January 1, 2015, where $x = 1, 2, 3, 4, 5$ ?

A) $f(x) = 9.25 - 0.50x$
B) $f(x) = 9.25x - 0.50$
C) $f(x) = 9.25 + 0.50x$
D) $f(x) = 9.25x + 0.50$

4

$$F = 2.50x + 7.00y$$

In the equation above, $F$ represents the total amount of money, in dollars, a food truck charges for $x$ drinks and $y$ salads. The price, in dollars, of each drink is the same, and the price, in dollars, of each salad is the same. Which of the following is the best interpretation for the number 7.00 in this context?

A) The price, in dollars, of one drink
B) The price, in dollars, of one salad
C) The number of drinks bought during the day
D) The number of salads bought during the day

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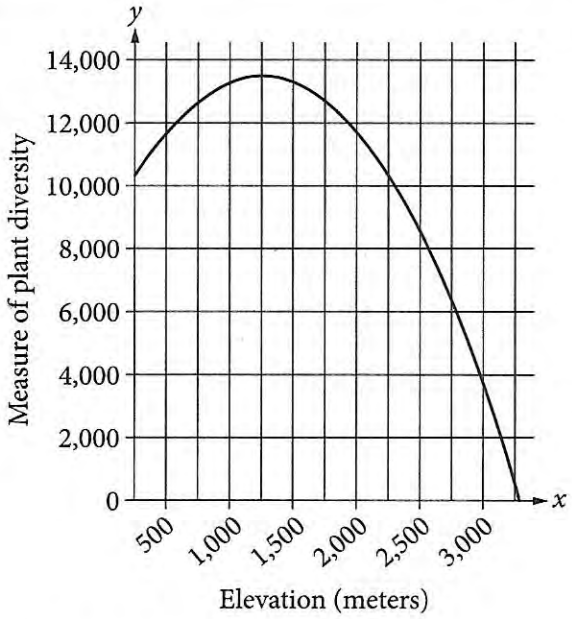
CONTINUE

5




The quadratic function graphed above models a particular measure of plant diversity as a function of the elevation in a region of Switzerland. According to the model, which of the following is closest to the elevation, in meters, at which plant diversity is greatest?

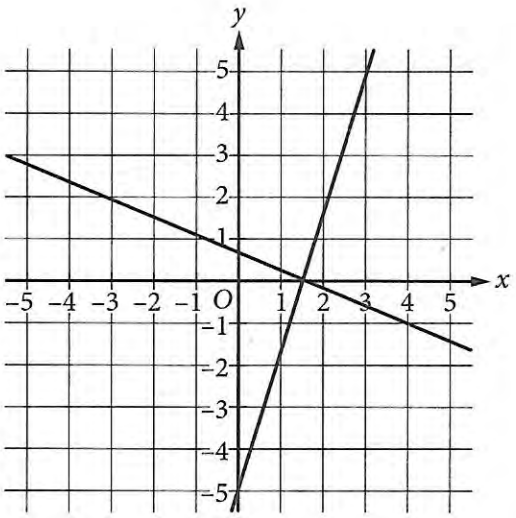
A) 13,500

B) 3,000

C) 1,250

D) 250

6




Which of the following systems of equations has the same solution as the system of equations graphed above?

A) $y = 0$
$x = \frac{3}{2}$

B) $y = \frac{3}{2}$
$x = 0$

C) $y = 0$
$x = 1$

D) $y = 1$
$x = 0$

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CONTINUE

7

The function $f$ defined by $f(x) = x^2$ is graphed in the $xy$-plane. The graph of the function $g$ in the $xy$-plane is the graph of $f$ shifted 4 units upward. Which of the following defines $g(x)$ ?

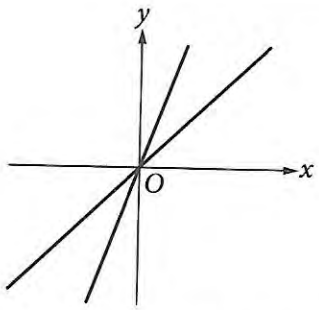
A) $g(x) = f(x + 4)$

B) $g(x) = f(x - 4)$

C) $g(x) = f(x) + 4$

D) $g(x) = f(x) - 4$

8




In the $xy$-plane above, two lines intersect at the origin. Which of the following pairs of equations could represent these lines, where $a$ and $b$ are positive constants?

A) $y = ax$
$y = bx$

B) $y = ax$
$y = -bx$

C) $y = -ax$
$y = -bx$

D) $y = ax$
$y = ax + b$

9

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

Which of the following is equivalent to the expression above?

A) $2x^2 + 2x - 1$

B) $2x^2 + 6x - 3$

C) $4x^2 + 2x - 1$

D) $4x^2 + 6x - 3$

10

Which of the following expressions is equivalent to the sum of $(r^3 + 5r^2 + 7)$ and $(r^2 + 8r + 12)$ ?

A) $r^5 + 13r^3 + 19$

B) $2r^3 + 13r^2 + 19$

C) $r^3 + 5r^2 + 7r + 12$

D) $r^3 + 6r^2 + 8r + 19$

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CONTINUE

11

According to Moore's law, the number of transistors included on microprocessors doubles every 2 years. In 1985, a microprocessor was introduced that had 275,000 transistors. Based on this information, in which of the following years does Moore's law estimate the number of transistors to reach 1.1 million?

A) 1987

B) 1989

C) 1991

D) 1994

12

| $x$ | $f(x)$ |
|---|---|
| 2 | 7 |
| 3 | 5 |
| 4 | 7 |

For the quadratic function $f$, the table above gives some values of $x$ and their corresponding values of $f(x)$. Which of the following could define $f$?

A) $f(x) = (x-3)^2 + 5$

B) $f(x) = (x-3)^2 + 9$

C) $f(x) = 2(x-2)^2 + 7$

D) $f(x) = 2(x-3)^2 + 5$

13

$$3(x-5)^2 + 11 = 59$$

What is the smallest value of $x$ that satisfies the equation above?

A) 9

B) 7

C) 5

D) 1

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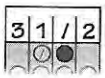
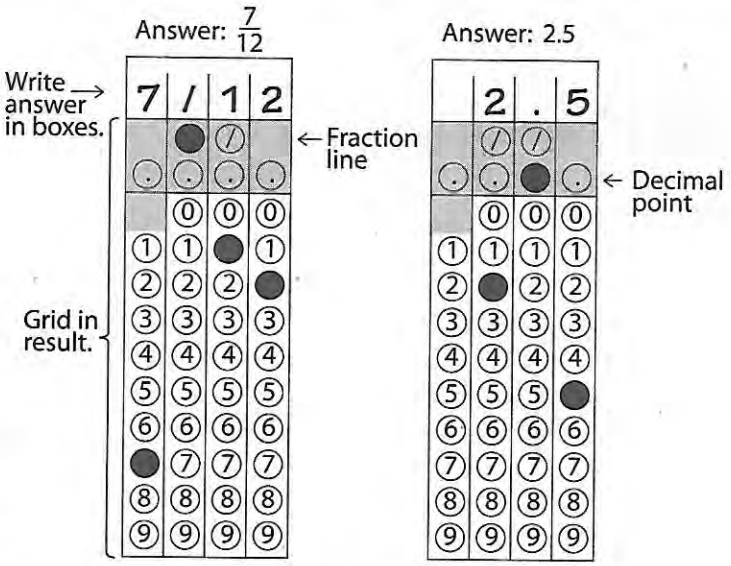
CONTINUE

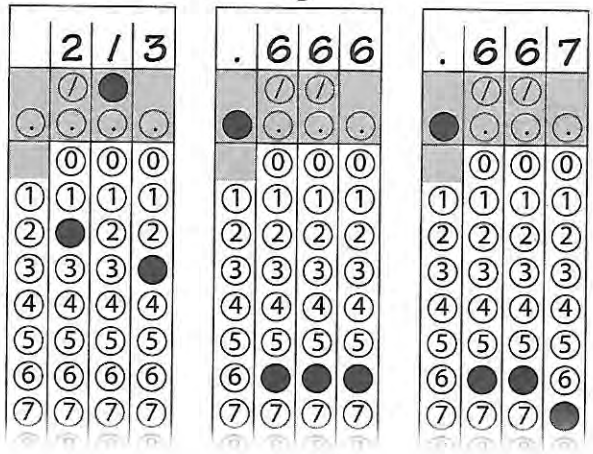
**DIRECTIONS**

**For questions 14-17**, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

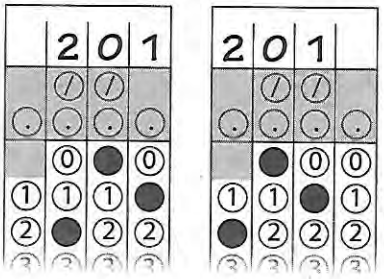
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.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




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




Answer: 201 – either position is correct




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

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CONTINUE

14

$$x + y = 17$$
$$xy = 72$$

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

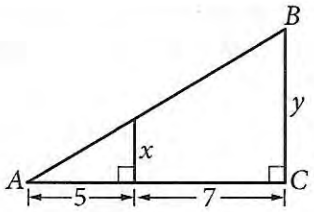
15

If $\frac{3x + 3x}{6} = 24$, what is the value of $6x$ ?

16

According to a model, the head width, in millimeters, of a worker bumblebee can be estimated by adding 0.6 to four times the body weight of the bee, in grams. According to the model, what would be the head width, in millimeters, of a worker bumblebee that has a body weight of 0.5 grams?

17




Note: Figure not drawn to scale.

The area of triangle $ABC$ above is at least 48 but no more than 60. If $y$ is an integer, what is one possible value of $x$ ?

# STOP

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

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No Test Material On This Page

# Math Test – Calculator

## 45 MINUTES, 31 QUESTIONS

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

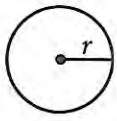
**DIRECTIONS**

**For questions 1-27**, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. **For questions 28-31**, solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 28 on how to enter your answers in the grid. You may use any available space in your test booklet for scratch work.

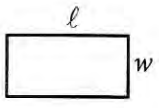
**NOTES**

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.

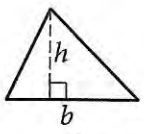
**REFERENCE**



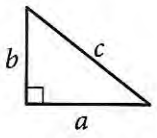

$A = \pi r^2$
$C = 2\pi r$



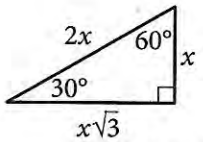

$A = \ell w$

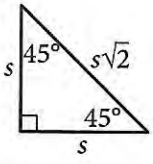



$A = \frac{1}{2}bh$

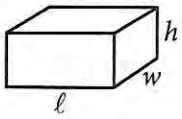



$c^2 = a^2 + b^2$

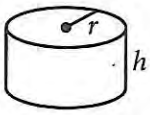


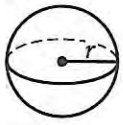

Special Right Triangles



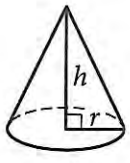

$V = \ell wh$



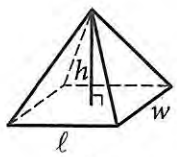

$V = \pi r^2 h$




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




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




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

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.

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CONTINUE

**1**

A group of monarch butterflies migrated from Chicago, Illinois, to Michoacán, Mexico, flying a total of 2,100 miles. It took a single butterfly in the group 120 days to travel this route one way. On average, how many miles did the butterfly travel per day?

A) 0.057
B) 0.729
C) 17.5
D) 24

**2**

A chemistry experiment requires three beakers containing different amounts, in milliliters (mL), of a saline solution. The three beakers contain 120 mL, 340 mL, and 275 mL of solution, respectively. What is the approximate total number of ounces of saline solution contained in the three beakers? (Use 1 ounce = 29.5735 milliliters.)

A) 15.55
B) 20.80
C) 21.74
D) 24.85

**3**

$$\frac{3}{4}x + ax = 10$$

In the equation above, $a$ is a constant. If $x = 24$ is the solution to the equation, what is the value of $a$ ?

A) $-\frac{4}{3}$
B) $-\frac{1}{3}$
C) $\frac{40}{99}$
D) $\frac{7}{6}$

**4**

$$C = 1.6(30w + 70)$$

The formula above can be used to approximate the daily energy requirement $C$, in calories, of an adult dog in terms of the dog's weight $w$, in kilograms. Based on the formula, if a dog has a daily energy requirement of at least 1,120 calories and at most 1,216 calories, which of the following inequalities represents the range of all possible values of the dog's body weight, to the nearest tenth of a kilogram?

A) $21.0 \leq w \leq 23.0$
B) $21.9 \leq w \leq 23.9$
C) $24.8 \leq w \leq 26.8$
D) $25.7 \leq w \leq 27.7$

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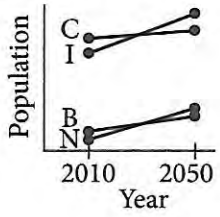
CONTINUE

5

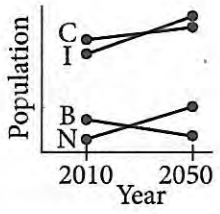
| | 2010 | 2050 (projected) |
|---|---|---|
| China (C) | 1,371 | 1,437 |
| India (I) | 1,150 | 1,628 |
| Brazil (B) | 193 | 260 |
| Nigeria (N) | 160 | 299 |

The table above shows the population, in millions, of four countries in 2010 and the projected population of each country in 2050. If the population of each country were to increase at a constant rate from 2010 to 2050, which of the following graphs could model the populations from 2010 to 2050?

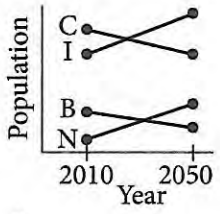
A)



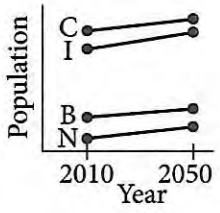

B)



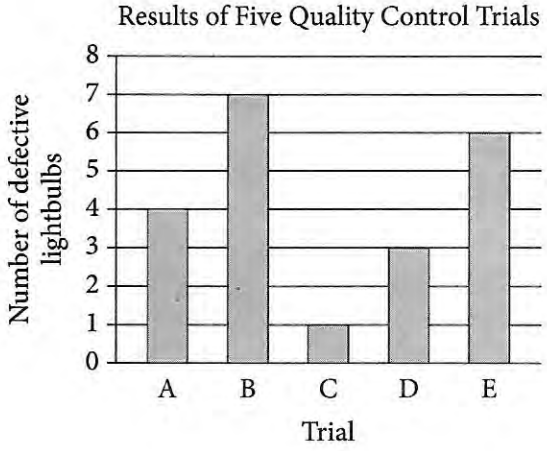

C)




D)




**Questions 6-8 refer to the following information.**




For quality control, a company that manufactures lightbulbs conducted five different trials. In each trial, 500 different lightbulbs were tested. The bar graph above shows the number of defective lightbulbs found in each trial.

6

What is the mean number of defective lightbulbs for the five trials?

A) 4.0

B) 4.2

C) 4.6

D) 5.0

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CONTINUE

7

What is the ratio of the number of defective lightbulbs in Trial D to the median number of defective lightbulbs for the five trials?

A) 1:7

B) 1:6

C) 3:5

D) 3:4

8

In Trial B, what percent of the lightbulbs were defective?

A) 0.70%

B) 0.84%

C) 1.40%

D) 7.00%

9

On a certain day, an air traffic controller determined the number of airplanes that took off from runway M was 3 times the number that took off from runway Q. And on that day, a total of 120 airplanes took off from the two runways. If $m$ and $q$ represent the number of airplanes that took off from runways M and Q, respectively, which of the following systems of equations models the situation?

A) $m = 3q$
$m + q = 120$

B) $3m = q$
$m + q = 120$

C) $m = q$
$m + q = 120$

D) $3m = q$
$m + 3q = 120$

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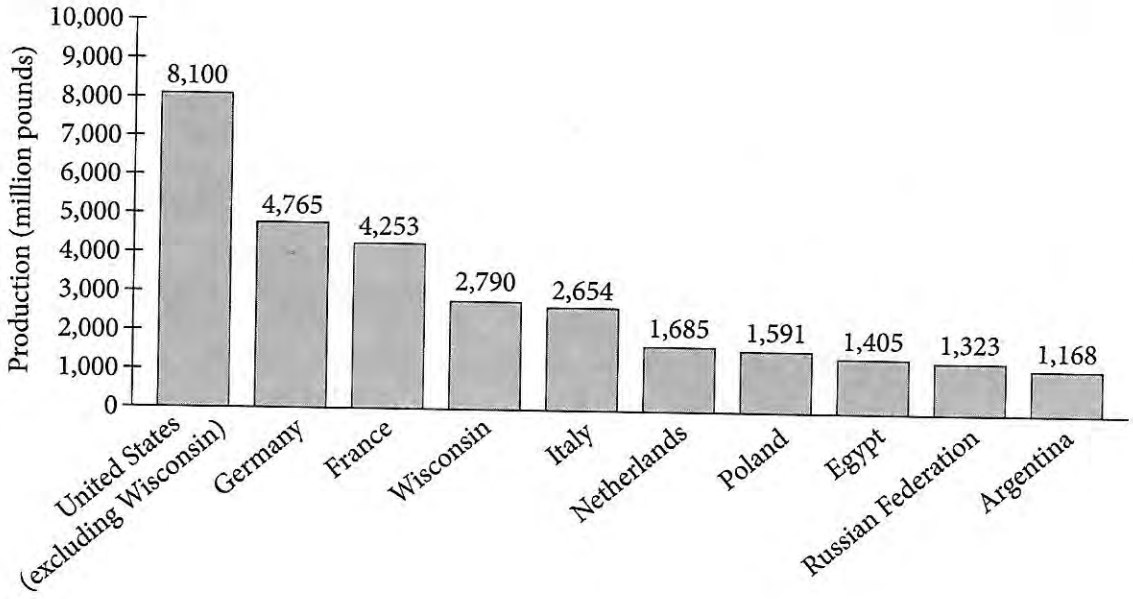
CONTINUE

**Questions 10 and 11 refer to the following information.**




The bar graph above shows information from 2012 on the production of cheese in Wisconsin and comparative production figures for the nine top cheese-producing countries.

10

In 2012, Wisconsin produced 951,571,000 pounds of mozzarella cheese. Which of the following is closest to the percent of Wisconsin cheese production that was mozzarella? (1 million = 1,000,000)

A) 15%
B) 22%
C) 34%
D) 42%

11

Of the following, which best approximates the ratio of the cheese production in the United States (excluding Wisconsin) to that in Wisconsin in 2012?

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

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CONTINUE

12

The table below shows the number of state parks in a certain state that contain camping facilities and bicycle paths.

| | Has bicycle paths | Does not have bicycle paths |
|---|---|---|
| Has camping facilities | 20 | 5 |
| Does not have camping facilities | 8 | 4 |

If one of these state parks is selected at random, what is the probability that it has camping facilities but does not have bicycle paths?

A) $\frac{5}{37}$

B) $\frac{5}{25}$

C) $\frac{8}{28}$

D) $\frac{5}{9}$

13

The results of two independent surveys are shown in the table below.

Men's Height

| Group | Sample size | Mean (centimeters) | Standard deviation (centimeters) |
|---|---|---|---|
| A | 2,500 | 186 | 12.5 |
| B | 2,500 | 186 | 19.1 |

Which statement is true based on the table?

A) The Group A data set was identical to the Group B data set.

B) Group B contained the tallest participant.

C) The heights of the men in Group B had a larger spread than the heights of the men in Group A.

D) The median height of Group B is larger than the median height of Group A.

14

$$p(m) = 2m + 8$$

The function $p$ above models the total price $p(m)$, in dollars, of streaming $m$ movies per month from an online movie subscription service. The subscription service charges an $8 monthly fee plus an additional fee per movie streamed. Which of the following is the best interpretation of $p(10)$ in this context?

A) The total price for streaming 1 movie in a month is $10.

B) The total price for streaming 2 movies in a month is $10.

C) When 10 movies are streamed in a month, the total price that month is $18.

D) When 10 movies are streamed in a month, the total price that month is $28.

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CONTINUE

15

$$\frac{4x}{2(x^2-1)} - \frac{3x}{3(x^2-1)}$$

Which of the following is equivalent to the expression above for $x \neq -1$ and $x \neq 1$ ?

A) $\frac{1}{6(x-1)}$

B) $\frac{x}{6(x^2-1)}$

C) $\frac{1}{x-1}$

D) $\frac{x}{x^2-1}$

16

In the $xy$-plane, line $l$ contains the points $(2, 6)$ and $(8, 10)$. Which of the following is an equation of line $l$ ?

A) $y = \frac{2}{3}x + \frac{14}{3}$

B) $y = \frac{3}{2}x - 2$

C) $y = 2x + 6$

D) $y = 8x + 10$

17

If $x \neq 0$, which of the following expressions is equivalent to $\frac{\sqrt{16x^4y^8}}{x^3}$ ?

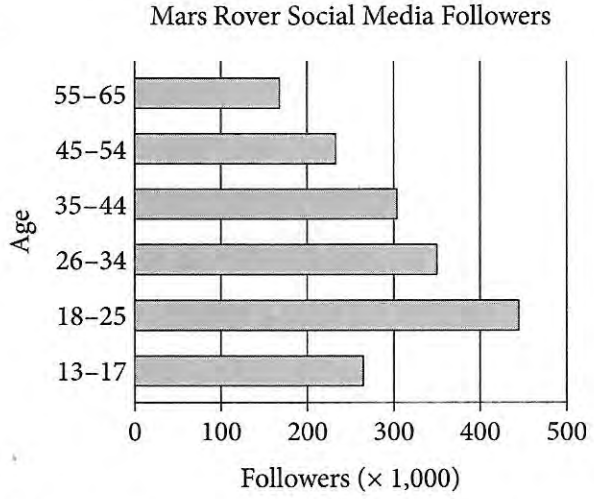
A) $8x^2y^4$

B) $4xy^4$

C) $4x^{-2}y^2$

D) $4x^{-1}y^4$

18




The total number of followers of a Mars rover's social media account is 1,764,000, as summarized by age in the graph above. Which of the following could be the median age of the followers?

A) 37

B) 29

C) 20

D) 16

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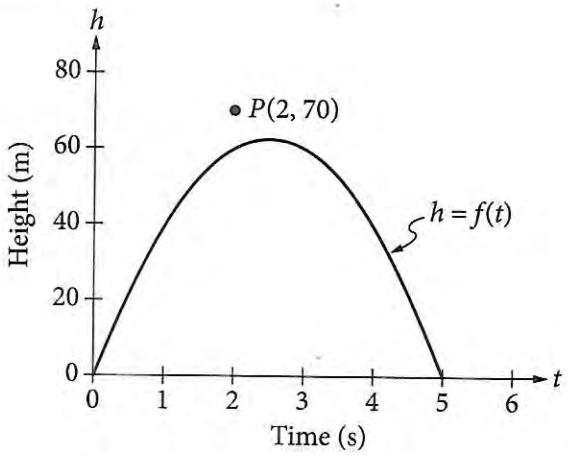
CONTINUE

19

The height, in meters, of a golf ball $t$ seconds after it was hit is given by the function $f(t) = at^2 + bt + c$, where $a$, $b$, and $c$ are constants. The graph of $f$ is shown below.




The point $P(2, 70)$ represents the height of a bird at a given point in time. Which of the following expressions correctly compares the height of the ball and the height of the bird at that point in time?

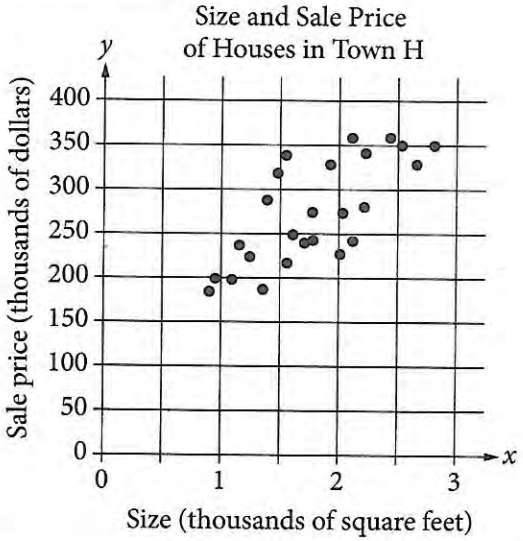
A) $f(70) > 2$

B) $f(70) < 2$

C) $f(2) > 70$

D) $f(2) < 70$

20




The scatterplot above shows the size $x$ and the sale price $y$ of 25 houses for sale in Town H. Which of the following could be an equation for a line of best fit for the data?

A) $y = 200x + 100$

B) $y = 100x + 100$

C) $y = 50x + 100$

D) $y = 100x$

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CONTINUE

21

Trisha and Stacy each work at their own constant rate, whether they work alone or work together. If working alone, Trisha can finish a job 15 minutes faster than Stacy can. The equation $\frac{1}{x} + \frac{1}{x+15} = \frac{1}{18}$ can be used to find the time $x$, in minutes, it takes Trisha to finish the job working alone. Which of the following is the best interpretation of the number 18 in the equation?

A) The number of minutes it takes Trisha to finish the job working alone
B) The number of minutes it takes Stacy to finish the job working alone
C) The number of minutes it takes both of them to finish the job working together
D) The sum of the number of minutes it takes Trisha and the number of minutes it takes Stacy to each finish the job working alone

22

If $2y = x + 40$ and $3x = y + 20$, what is the value of $x + y$ ?

A) 28
B) 34
C) 38
D) 44

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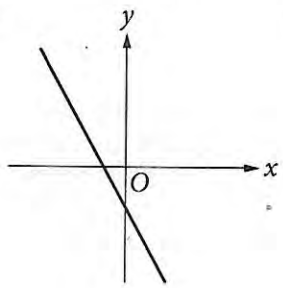
CONTINUE

23

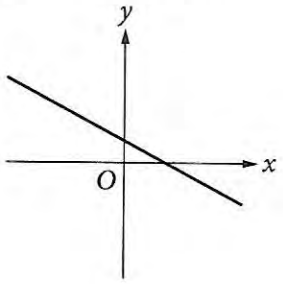
$$Ax + By = C$$

In the equation above, $A$, $B$, and $C$ are positive constants. Which of the following could be the graph of the equation in the $xy$-plane?

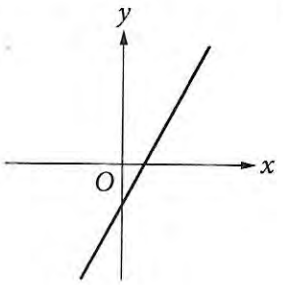
A)



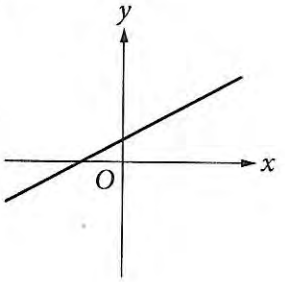

B)



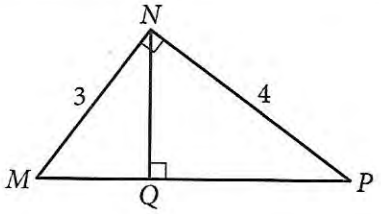

C)




D)




24




In the figure above, what is the length of $\overline{NQ}$ ?

A) 2.2

B) 2.3

C) 2.4

D) 2.5

25

The table below shows the distribution of US states according to whether they have a state-level sales tax and a state-level income tax.

2013 State-Level Taxes

| | State sales tax | No state sales tax |
|---|---|---|
| State income tax | 39 | 4 |
| No state income tax | 6 | 1 |

To the nearest tenth of a percent, what percent of states with a state-level sales tax do not have a state-level income tax?

A) 6.0%

B) 12.0%

C) 13.3%

D) 14.0%

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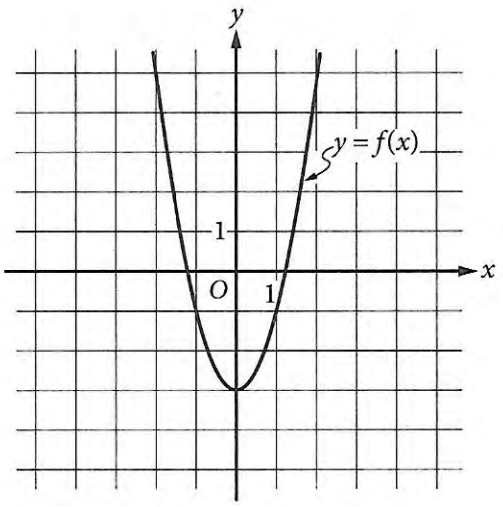
CONTINUE

26




The graph of $f(x)$ is shown above. If $g(x) = (x-1)(x-5)$, what is the value of $g(0) - f(0)$ ?

A) 8

B) 2

C) 0

D) −2

27

$$ax + b = 3x - 4$$

In the equation above, $a$ and $b$ are constants. If the equation has no solution, which of the following statements must be true about $a$ and $b$ ?

A) $a \neq 3$ and $b \neq 4$

B) $a = 3$ and $b \neq -4$

C) $a = 3$ and $b = -4$

D) $a = -3$ and $b = 4$

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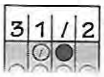
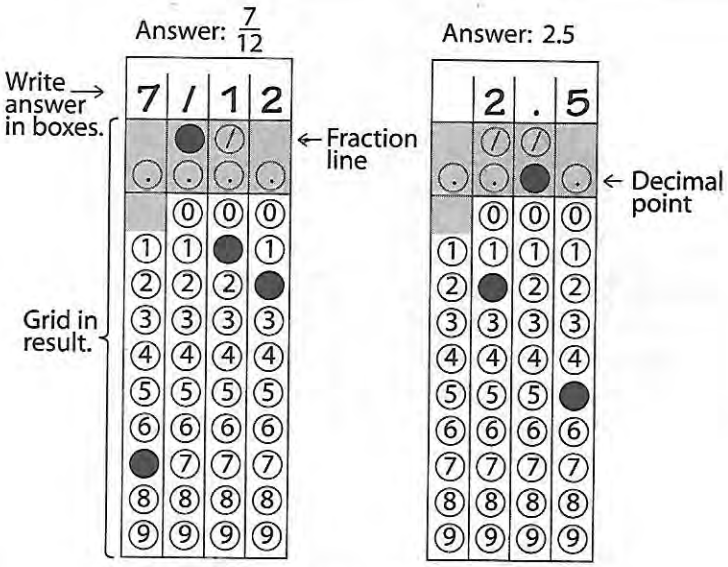
CONTINUE

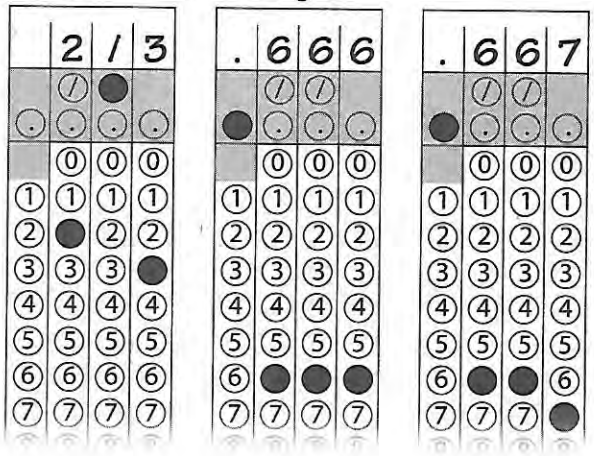
**DIRECTIONS**

**For questions 28-31**, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

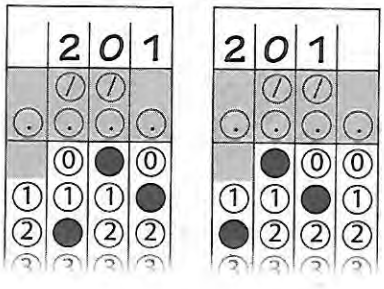
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.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




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




Answer: 201 – either position is correct




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

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CONTINUE

28

| Genre | Percent of video game sales |
|---|---|
| Action | 29% |
| Family | 28% |
| Sports | 32% |
| Strategy | 6% |
| Other | 5% |

The table above shows the distribution of genres of video games sold by a gaming company in 2010. If the total number of games sold by the gaming company was 250,000, in how many of the genres were more than 40,000 games sold?

29

$$(x-9)(x+3) = -36$$

In the equation above, what is the value of $x+3$ ?

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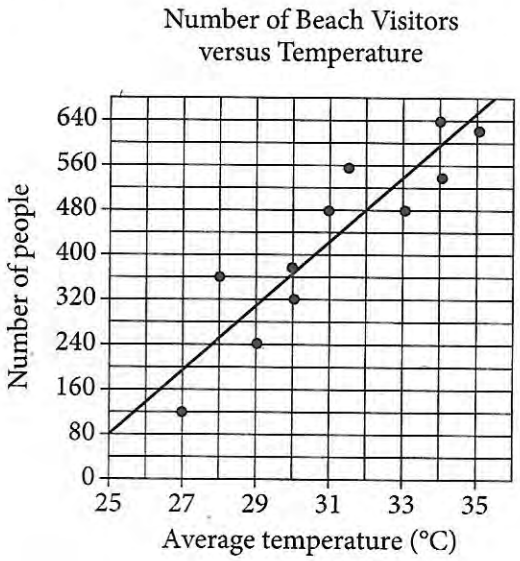
CONTINUE

**Questions 30 and 31 refer to the following information.**




Each dot in the scatterplot above represents the temperature and the number of people who visited a beach in Lagos, Nigeria, on one of eleven different days. The line of best fit for the data is also shown.

30

According to the line of best fit, what is the number of people, rounded to the nearest 10, predicted to visit this beach on a day with an average temperature of 32°C?

31

The line of best fit for the data has a slope of approximately 57. According to this estimate, how many additional people per day are predicted to visit the beach for each 5°C increase in average temperature?

# STOP

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

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# Answer Key

## Wednesday, Oct. 10, Test Form

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

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

| Math Test – No Calculator | |
|---|---|
| SECTION 3 | |
| 1 | D |
| 2 | B |
| 3 | C |
| 4 | B |
| 5 | C |
| 6 | A |
| 7 | C |
| 8 | A |
| 9 | A |
| 10 | D |
| 11 | B |
| 12 | D |
| 13 | D |
| 14 | 8, 9 |
| 15 | 144 |
| 16 | 13/5, 2.6 |
| 17 | 10/3, 15/4, 25/6, 3.33, 3.75, 4.16, 4.17 |

| Math Test – Calculator | |
|---|---|
| SECTION 4 | |
| 1 | C |
| 2 | D |
| 3 | B |
| 4 | A |
| 5 | A |
| 6 | B |
| 7 | D |
| 8 | C |
| 9 | A |
| 10 | C |
| 11 | D |
| 12 | A |
| 13 | C |
| 14 | D |
| 15 | D |
| 16 | A |
| 17 | D |
| 18 | B |
| 19 | D |
| 20 | B |
| 21 | C |
| 22 | D |
| 23 | B |
| 24 | C |
| 25 | C |
| 26 | A |
| 27 | B |
| 28 | 3 |
| 29 | 6 |
| 30 | 480 |
| 31 | 285 |

**NOTE:** For schools participating in the test administration study or research group in fall 2018, correct answers will not be provided. Correct answers will also not be provided for the Saturday, Oct. 13, test form.

## Wednesday, Oct. 24, Test Form

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

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

| Math Test – No Calculator | |
|---|---|
| SECTION 3 | |
| 1 | A |
| 2 | A |
| 3 | B |
| 4 | B |
| 5 | C |
| 6 | B |
| 7 | C |
| 8 | D |
| 9 | B |
| 10 | D |
| 11 | A |
| 12 | D |
| 13 | C |
| 14 | 5 |
| 15 | 1/3, .333 |
| 16 | 16 |
| 17 | 5/2, 2.5 |

| Math Test – Calculator | |
|---|---|
| SECTION 4 | |
| 1 | A |
| 2 | A |
| 3 | D |
| 4 | A |
| 5 | C |
| 6 | B |
| 7 | C |
| 8 | B |
| 9 | C |
| 10 | C |
| 11 | B |
| 12 | D |
| 13 | A |
| 14 | C |
| 15 | A |
| 16 | C |
| 17 | B |
| 18 | D |
| 19 | C |
| 20 | A |
| 21 | B |
| 22 | D |
| 23 | B |
| 24 | A |
| 25 | C |
| 26 | D |
| 27 | D |
| 28 | 24 |
| 29 | 6 |
| 30 | 2/5, .4 |
| 31 | 5100 |

**NOTE:** For more detailed information about scores, visit **psat.org/resources**.

# Score Conversion

Score conversions show how raw scores are converted into test scores, cross-test scores, and subscores.

## IMPORTANT TO NOTE

- The section score for the Evidence-Based Reading and Writing section is calculated by adding the Reading Test score to the Writing and Language Test score and multiplying that figure by 10.
- The section score for the Math section is calculated by multiplying the Math Test score by 20.
- There is no advantage or disadvantage in taking any particular test form.
- On every test, certain scores are not available, and are referred to as "score gaps." Score gaps emerge as a result of a statistical process called *equating* in which the number of questions answered correctly and the difficulty of the questions are both considered when scoring across the different tests taken nationwide. Although the College Board works to develop tests with the same level of difficulty, the questions in them differ and therefore some can be slightly easier or harder than others. This can influence the placement of the score gaps throughout the scaled score range. With equating, test scores are equivalent and valid, regardless of when students tested or the level of difficulty of the test they took.

**NOTE:** Score conversions will not be available for the Saturday, October 13 test form or for schools participating in the test administration study or research group.

**Wednesday, Oct. 10 Test Form**

| Raw Score (# of correct answers) | Reading Test Score | Writing and Language Test Score | Math Test Score |
|---|---|---|---|
| **48** | | | 38 |
| **47** | 38 | | 37.5 |
| **46** | 37 | | 37 |
| **45** | 37 | | 36.5 |
| **44** | 36 | 38 | 36 |
| **43** | 36 | 38 | 35 |
| **42** | 35 | 37 | 34 |
| **41** | 34 | 36 | 33 |
| **40** | 34 | 36 | 32 |
| **39** | 33 | 35 | 31.5 |
| **38** | 32 | 34 | 31 |
| **37** | 32 | 33 | 30.5 |
| **36** | 31 | 33 | 30 |
| **35** | 30 | 32 | 29.5 |
| **34** | 30 | 31 | 29 |
| **33** | 29 | 31 | 28.5 |
| **32** | 29 | 30 | 28 |
| **31** | 28 | 30 | 27.5 |
| **30** | 27 | 29 | 27 |
| **29** | 27 | 29 | 26.5 |
| **28** | 26 | 28 | 26 |
| **27** | 26 | 27 | 25.5 |
| **26** | 25 | 27 | 25 |
| **25** | 25 | 26 | 24.5 |
| **24** | 25 | 26 | 24 |
| **23** | 24 | 25 | 24 |
| **22** | 23 | 24 | 23.5 |
| **21** | 23 | 24 | 23 |
| **20** | 22 | 23 | 22.5 |
| **19** | 22 | 22 | 22 |
| **18** | 21 | 21 | 21.5 |
| **17** | 20 | 21 | 21 |
| **16** | 20 | 20 | 20.5 |
| **15** | 19 | 19 | 20 |
| **14** | 19 | 18 | 19.5 |
| **13** | 18 | 18 | 19 |
| **12** | 18 | 17 | 18.5 |
| **11** | 17 | 16 | 18 |
| **10** | 17 | 16 | 17 |
| **9** | 16 | 15 | 16.5 |
| **8** | 16 | 14 | 15.5 |
| **7** | 15 | 14 | 14.5 |
| **6** | 14 | 13 | 14 |
| **5** | 13 | 13 | 13 |
| **4** | 12 | 12 | 12 |
| **3** | 11 | 11 | 11 |
| **2** | 10 | 10 | 10 |
| **1** | 9 | 9 | 9 |
| **0** | 8 | 8 | 8 |

**Wednesday, Oct. 24 Test Form**

| Raw Score (# of correct answers) | Reading Test Score | Writing and Language Test Score | Math Test Score |
|---|---|---|---|
| **48** | | | 38 |
| **47** | 38 | | 35.5 |
| **46** | 36 | | 33.5 |
| **45** | 35 | | 32 |
| **44** | 35 | 38 | 31 |
| **43** | 34 | 36 | 30.5 |
| **42** | 33 | 35 | 29.5 |
| **41** | 32 | 34 | 29 |
| **40** | 31 | 33 | 28.5 |
| **39** | 30 | 32 | 28 |
| **38** | 30 | 31 | 27.5 |
| **37** | 29 | 31 | 27 |
| **36** | 28 | 30 | 26.5 |
| **35** | 28 | 29 | 26.5 |
| **34** | 27 | 29 | 26 |
| **33** | 26 | 28 | 25.5 |
| **32** | 26 | 28 | 25 |
| **31** | 25 | 27 | 24.5 |
| **30** | 25 | 26 | 24 |
| **29** | 25 | 26 | 24 |
| **28** | 24 | 25 | 23.5 |
| **27** | 24 | 24 | 23 |
| **26** | 23 | 24 | 22.5 |
| **25** | 22 | 23 | 22.5 |
| **24** | 22 | 22 | 22 |
| **23** | 21 | 22 | 21.5 |
| **22** | 21 | 21 | 21.5 |
| **21** | 20 | 20 | 21 |
| **20** | 20 | 20 | 20.5 |
| **19** | 20 | 19 | 20 |
| **18** | 19 | 19 | 19.5 |
| **17** | 19 | 18 | 19 |
| **16** | 18 | 18 | 19 |
| **15** | 18 | 17 | 18.5 |
| **14** | 17 | 17 | 18 |
| **13** | 17 | 16 | 17.5 |
| **12** | 17 | 16 | 17 |
| **11** | 16 | 15 | 16.5 |
| **10** | 16 | 15 | 16 |
| **9** | 15 | 14 | 15 |
| **8** | 15 | 14 | 14.5 |
| **7** | 14 | 13 | 13.5 |
| **6** | 13 | 13 | 12.5 |
| **5** | 12 | 12 | 12 |
| **4** | 11 | 11 | 11 |
| **3** | 10 | 10 | 10.5 |
| **2** | 9 | 10 | 9.5 |
| **1** | 9 | 9 | 8.5 |
| **0** | 8 | 8 | 8 |

# Percentiles

A student's percentile rank represents the percentage of students who score equal to or lower than their score. For example, if a student's score is in the 75th percentile, 75% of a comparison group achieved scores at or below that student's score. Two types of percentile ranks, comparing student scores to two different reference populations, are provided in this publication for both total and section scores.

**Nationally representative percentiles** are derived from a research study of U.S. students in the 10th or 11th grade and are weighted to represent all U.S. students in those grades, regardless of whether they typically take the PSAT/NMSQT or the PSAT 10.

**User group percentiles** are based on the actual scores of students who took the PSAT/NMSQT and the PSAT 10 in the past three school years.

## Percentiles for Total Scores

| | 10TH GRADE | | 11TH GRADE | |
|---|---|---|---|---|
| | PERCENTILES | | PERCENTILES | |
| Total Score | Nationally Representative Sample | PSAT/NMSQT and PSAT 10 User | Nationally Representative Sample | PSAT/NMSQT and PSAT 10 User |
| 1520 | 99+ | 99+ | 99+ | 99+ |
| 1510 | 99+ | 99+ | 99+ | 99+ |
| 1500 | 99+ | 99+ | 99+ | 99+ |
| 1490 | 99+ | 99+ | 99+ | 99+ |
| 1480 | 99+ | 99+ | 99+ | 99 |
| 1470 | 99+ | 99+ | 99+ | 99 |
| 1460 | 99+ | 99+ | 99+ | 99 |
| 1450 | 99+ | 99+ | 99+ | 98 |
| 1440 | 99+ | 99+ | 99+ | 98 |
| 1430 | 99+ | 99 | 99+ | 98 |
| 1420 | 99 | 99 | 99 | 97 |
| 1410 | 99 | 99 | 99 | 97 |
| 1400 | 99 | 99 | 99 | 97 |
| 1390 | 99 | 99 | 99 | 96 |
| 1380 | 99 | 99 | 99 | 96 |
| 1370 | 99 | 99 | 99 | 95 |
| 1360 | 99 | 98 | 98 | 95 |
| 1350 | 98 | 98 | 98 | 94 |
| 1340 | 98 | 98 | 98 | 94 |
| 1330 | 98 | 98 | 97 | 93 |
| 1320 | 98 | 98 | 97 | 93 |
| 1310 | 97 | 97 | 97 | 92 |
| 1300 | 97 | 97 | 96 | 91 |
| 1290 | 97 | 97 | 96 | 91 |
| 1280 | 97 | 96 | 95 | 90 |
| 1270 | 96 | 96 | 95 | 89 |
| 1260 | 96 | 95 | 94 | 88 |
| 1250 | 95 | 95 | 94 | 87 |
| 1240 | 95 | 94 | 93 | 86 |
| 1230 | 94 | 94 | 92 | 85 |
| 1220 | 94 | 93 | 92 | 84 |
| 1210 | 93 | 93 | 91 | 83 |
| 1200 | 92 | 92 | 90 | 82 |
| 1190 | 91 | 91 | 89 | 81 |
| 1180 | 91 | 90 | 88 | 79 |
| 1170 | 90 | 89 | 87 | 78 |
| 1160 | 89 | 88 | 86 | 77 |
| 1150 | 88 | 87 | 85 | 75 |
| 1140 | 87 | 86 | 84 | 74 |
| 1130 | 86 | 85 | 83 | 72 |
| 1120 | 84 | 84 | 82 | 70 |
| 1110 | 83 | 83 | 81 | 69 |

## Percentiles for Total Scores (continued)

| Total Score | 10TH GRADE PERCENTILES | | 11TH GRADE PERCENTILES | |
|---|---|---|---|---|
| | Nationally Representative Sample | PSAT/NMSQT and PSAT 10 User | Nationally Representative Sample | PSAT/NMSQT and PSAT 10 User |
| 1100 | 82 | 81 | 79 | 67 |
| 1090 | 81 | 80 | 77 | 65 |
| 1080 | 79 | 78 | 76 | 63 |
| 1070 | 78 | 77 | 74 | 62 |
| 1060 | 76 | 76 | 73 | 60 |
| 1050 | 75 | 74 | 70 | 58 |
| 1040 | 73 | 72 | 68 | 56 |
| 1030 | 71 | 71 | 65 | 54 |
| 1020 | 69 | 69 | 63 | 52 |
| 1010 | 67 | 67 | 61 | 51 |
| 1000 | 65 | 66 | 59 | 49 |
| 990 | 63 | 64 | 57 | 47 |
| 980 | 62 | 62 | 55 | 45 |
| 970 | 60 | 60 | 53 | 43 |
| 960 | 58 | 58 | 51 | 41 |
| 950 | 56 | 56 | 48 | 40 |
| 940 | 54 | 54 | 46 | 38 |
| 930 | 52 | 53 | 44 | 36 |
| 920 | 50 | 51 | 42 | 34 |
| 910 | 48 | 49 | 39 | 32 |
| 900 | 46 | 47 | 37 | 31 |
| 890 | 44 | 45 | 35 | 29 |
| 880 | 42 | 43 | 33 | 27 |
| 870 | 40 | 41 | 31 | 26 |
| 860 | 38 | 38 | 29 | 24 |
| 850 | 36 | 36 | 28 | 23 |
| 840 | 33 | 34 | 26 | 21 |
| 830 | 31 | 32 | 24 | 20 |
| 820 | 28 | 30 | 21 | 18 |
| 810 | 26 | 28 | 20 | 17 |
| 800 | 24 | 26 | 18 | 15 |
| 790 | 22 | 24 | 15 | 14 |
| 780 | 19 | 22 | 14 | 12 |
| 770 | 17 | 20 | 12 | 11 |
| 760 | 15 | 18 | 10 | 10 |
| 750 | 13 | 16 | 8 | 9 |
| 740 | 11 | 14 | 8 | 8 |
| 730 | 9 | 12 | 7 | 7 |
| 720 | 8 | 10 | 5 | 6 |
| 710 | 6 | 9 | 3 | 5 |
| 700 | 5 | 7 | 2 | 4 |
| 690 | 4 | 6 | 2 | 3 |
| 680 | 3 | 5 | 1 | 3 |
| 670 | 2 | 4 | 1 | 2 |
| 660 | 2 | 4 | 1- | 2 |
| 650 | 1 | 3 | 1- | 2 |
| 640 | 1 | 2 | 1- | 1 |
| 630 | 1 | 2 | 1- | 1 |
| 620 | 1 | 2 | 1- | 1 |
| 610 | 1- | 1 | 1- | 1 |
| 600 | 1- | 1 | 1- | 1 |
| 590 | 1- | 1 | 1- | 1 |
| 580 | 1- | 1 | 1- | 1- |
| 570 | 1- | 1 | 1- | 1- |
| 560 | 1- | 1 | 1- | 1- |
| 550 | 1- | 1 | 1- | 1- |
| 540 | 1- | 1- | 1- | 1- |
| 530 | 1- | 1- | 1- | 1- |
| 520 | 1- | 1- | 1- | 1- |
| 510 | 1- | 1- | 1- | 1- |
| 500 | 1- | 1- | 1- | 1- |
| 490 | 1- | 1- | 1- | 1- |
| 480 | 1- | 1- | 1- | 1- |
| 470 | 1- | 1- | 1- | 1- |
| 460 | 1- | 1- | 1- | 1- |
| 450 | 1- | 1- | 1- | 1- |
| 440 | 1- | 1- | 1- | 1- |
| 430 | 1- | 1- | 1- | 1- |
| 420 | 1- | 1- | 1- | 1- |
| 410 | 1- | 1- | 1- | 1- |
| 400 | 1- | 1- | 1- | 1- |
| 390 | 1- | 1- | 1- | 1- |
| 380 | 1- | 1- | 1- | 1- |
| 370 | 1- | 1- | 1- | 1- |
| 360 | 1- | 1- | 1- | 1- |
| 350 | 1- | 1- | 1- | 1- |
| 340 | 1- | 1- | 1- | 1- |
| 330 | 1- | 1- | 1- | 1- |
| 320 | 1- | 1- | 1- | 1- |
| Mean Score | 939 | 934 | 969 | 1014 |
| Standard Deviation | 170 | 180 | 168 | 197 |

## Percentiles for Section Scores

| | 10TH GRADE | | | | 11TH GRADE | | | |
|---|---|---|---|---|---|---|---|---|
| | Evidence-Based Reading and Writing | | Math | | Evidence-Based Reading and Writing | | Math | |
| | PERCENTILES | | PERCENTILES | | PERCENTILES | | PERCENTILES | |
| Section Score | Nationally Representative Sample | PSAT/NMSQT and PSAT 10 User | Nationally Representative Sample | PSAT/NMSQT and PSAT 10 User | Nationally Representative Sample | PSAT/NMSQT and PSAT 10 User | Nationally Representative Sample | PSAT/NMSQT and PSAT 10 User |
| **760** | 99+ | 99+ | 99+ | 99+ | 99+ | 99+ | 99+ | 99+ |
| **750** | 99+ | 99+ | 99+ | 99+ | 99+ | 99+ | 99+ | 99 |
| **740** | 99+ | 99+ | 99+ | 99 | 99+ | 99 | 99+ | 98 |
| **730** | 99+ | 99+ | 99 | 99 | 99+ | 99 | 99 | 97 |
| **720** | 99+ | 99+ | 99 | 99 | 99+ | 98 | 99 | 96 |
| **710** | 99 | 99 | 99 | 99 | 99+ | 97 | 98 | 96 |
| **700** | 99 | 99 | 99 | 98 | 99+ | 96 | 98 | 95 |
| **690** | 99 | 98 | 98 | 98 | 99 | 95 | 97 | 94 |
| **680** | 98 | 98 | 98 | 98 | 99 | 94 | 97 | 93 |
| **670** | 98 | 97 | 97 | 97 | 98 | 93 | 96 | 93 |
| **660** | 97 | 97 | 97 | 97 | 97 | 91 | 95 | 92 |
| **650** | 97 | 96 | 96 | 97 | 96 | 89 | 95 | 91 |
| **640** | 96 | 95 | 96 | 96 | 95 | 88 | 94 | 90 |
| **630** | 95 | 94 | 95 | 95 | 93 | 86 | 93 | 89 |
| **620** | 93 | 92 | 95 | 95 | 91 | 84 | 92 | 87 |
| **610** | 92 | 91 | 94 | 94 | 90 | 81 | 91 | 85 |
| **600** | 90 | 89 | 92 | 92 | 88 | 79 | 90 | 83 |
| **590** | 89 | 87 | 91 | 91 | 86 | 76 | 88 | 81 |
| **580** | 87 | 85 | 89 | 89 | 85 | 73 | 86 | 78 |
| **570** | 85 | 83 | 86 | 87 | 82 | 70 | 83 | 75 |
| **560** | 82 | 80 | 84 | 85 | 80 | 67 | 81 | 72 |
| **550** | 79 | 78 | 82 | 82 | 77 | 63 | 77 | 69 |
| **540** | 76 | 75 | 79 | 80 | 74 | 60 | 73 | 65 |
| **530** | 73 | 72 | 76 | 77 | 71 | 56 | 69 | 62 |
| **520** | 70 | 68 | 72 | 74 | 67 | 53 | 65 | 58 |
| **510** | 66 | 65 | 69 | 71 | 63 | 49 | 62 | 55 |
| **500** | 63 | 62 | 66 | 68 | 60 | 46 | 58 | 52 |
| **490** | 59 | 59 | 62 | 64 | 55 | 43 | 54 | 48 |
| **480** | 56 | 55 | 57 | 60 | 50 | 39 | 49 | 44 |
| **470** | 53 | 52 | 52 | 56 | 46 | 36 | 43 | 40 |
| **460** | 49 | 49 | 49 | 52 | 42 | 33 | 40 | 36 |
| **450** | 46 | 45 | 46 | 48 | 39 | 31 | 37 | 33 |

## Percentiles for Section Scores (continued)

| | 10TH GRADE | | | | 11TH GRADE | | | |
|---|---|---|---|---|---|---|---|---|
| | Evidence-Based Reading and Writing | | Math | | Evidence-Based Reading and Writing | | Math | |
| | PERCENTILES | | PERCENTILES | | PERCENTILES | | PERCENTILES | |
| Section Score | Nationally Representative Sample | PSAT/NMSQT and PSAT 10 User | Nationally Representative Sample | PSAT/NMSQT and PSAT 10 User | Nationally Representative Sample | PSAT/NMSQT and PSAT 10 User | Nationally Representative Sample | PSAT/NMSQT and PSAT 10 User |
| **440** | 43 | 42 | 40 | 43 | 35 | 28 | 31 | 29 |
| **430** | 39 | 39 | 36 | 39 | 31 | 25 | 26 | 26 |
| **420** | 36 | 35 | 31 | 35 | 28 | 22 | 23 | 23 |
| **410** | 32 | 32 | 26 | 30 | 26 | 20 | 20 | 19 |
| **400** | 28 | 28 | 23 | 26 | 23 | 17 | 18 | 16 |
| **390** | 24 | 25 | 19 | 21 | 20 | 15 | 14 | 13 |
| **380** | 21 | 21 | 15 | 17 | 16 | 12 | 11 | 10 |
| **370** | 17 | 17 | 12 | 14 | 12 | 10 | 9 | 9 |
| **360** | 13 | 14 | 10 | 11 | 10 | 8 | 6 | 7 |
| **350** | 10 | 11 | 7 | 8 | 7 | 6 | 3 | 5 |
| **340** | 7 | 8 | 5 | 6 | 6 | 5 | 2 | 4 |
| **330** | 5 | 6 | 3 | 5 | 4 | 3 | 1 | 3 |
| **320** | 3 | 4 | 2 | 4 | 2 | 2 | 1 | 2 |
| **310** | 2 | 3 | 2 | 3 | 1 | 2 | 1- | 2 |
| **300** | 1 | 2 | 1 | 2 | 1- | 1 | 1- | 1 |
| **290** | 1- | 1 | 1 | 2 | 1- | 1 | 1- | 1 |
| **280** | 1- | 1 | 1- | 1 | 1- | 1 | 1- | 1 |
| **270** | 1- | 1 | 1- | 1 | 1- | 1- | 1- | 1 |
| **260** | 1- | 1 | 1- | 1 | 1- | 1- | 1- | 1- |
| **250** | 1- | 1- | 1- | 1 | 1- | 1- | 1- | 1- |
| **240** | 1- | 1- | 1- | 1 | 1- | 1- | 1- | 1- |
| **230** | 1- | 1- | 1- | 1- | 1- | 1- | 1- | 1- |
| **220** | 1- | 1- | 1- | 1- | 1- | 1- | 1- | 1- |
| **210** | 1- | 1- | 1- | 1- | 1- | 1- | 1- | 1- |
| **200** | 1- | 1- | 1- | 1- | 1- | 1- | 1- | 1- |
| **190** | 1- | 1- | 1- | 1- | 1- | 1- | 1- | 1- |
| **180** | 1- | 1- | 1- | 1- | 1- | 1- | 1- | 1- |
| **170** | 1- | 1- | 1- | 1- | 1- | 1- | 1- | 1- |
| **160** | 1- | 1- | 1- | 1- | 1- | 1- | 1- | 1- |
| **Mean Score** | 468 | 470 | 470 | 464 | 480 | 511 | 489 | 503 |
| **Standard Deviation** | 94 | 99 | 88 | 93 | 92 | 105 | 88 | 103 |

# NMSC Selection Index

The National Merit® Scholarship Program is an annual academic competition among high school students for recognition and college scholarships. The program is conducted by National Merit Scholarship Corporation (NMSC), a not-for-profit organization that operates without government assistance.

## The NMSC Selection Index

Reported on a scale ranging from 48 to 228, the Selection Index score is calculated by doubling the sum of the Reading, Writing and Language, and Math Test scores. For example, a Reading score of 23, a Writing and Language score of 20, and a Math score of 26.5 would result in a Selection Index score of 139 [2(23+20+26.5)].

## How NMSC Uses the Selection Index

NMSC uses the Selection Index score to designate groups of students to receive recognition in the National Merit Scholarship Program. Entry to NMSC's competition for scholarships to be offered in 2020 is determined by students' responses to program entry questions on the 2018 PSAT/NMSQT answer sheet. Both the printed PSAT/NMSQT student score report and the online report show the student's Selection Index, the student's responses to entry items, and whether the student meets participation requirements. Currently, about 1.6 million test takers meet requirements to enter NMSC's competition each year. Almost all entrants are in their third year (grade 11, junior year) of high school.

Of the 1.6 million NMSC program entrants, about 50,000 will earn 2018 PSAT/NMSQT scores high enough to qualify them for recognition. These students will be notified of their standing through their high schools in September 2019. Students who qualify to continue in the competition for scholarships to be offered in 2020 must then meet academic and other requirements specified by NMSC to be considered for awards.

A detailed description of the National Merit Scholarship Program is published in the *Guide to the National Merit Scholarship Program*, mailed to high school principals each fall. For students and parents, information about the competition is given in the *PSAT/NMSQT Student Guide* and at **www.nationalmerit.org**.

For inquiries about any aspect of the National Merit Program—including entry requirements, the selection process, and awards to be offered—contact NMSC directly:

**www.nationalmerit.org**
847-866-5100
National Merit Scholarship Corporation
1560 Sherman Avenue, Suite 200
Evanston, IL 60201-4897