



# SAT<sup>®</sup> March ,2019 US

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**Test begins on the next page.**

# Reading Test

65 MINUTES, 52 QUESTIONS

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

## DIRECTIONS

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

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

This passage is adapted from Rita Dove, *Through the Ivory Gate*. ©1992 by Rita Dove. The novel's main character, Virginia, has just found her old cello while unpacking after a move.

She had not played seriously since college. Accompanying the theater troupe's performances and clowning around as her friend Parker picked out old Beatles songs on the piano didn't count—that wasn't  
 5 real music, music that made you forget where you were, made you forget where your arms and legs ended and luscious sound began.

She had started playing the cello when she was nine, shortly after the move to Arizona. At the beginning of  
 10 the school year in Akron, every child in fourth grade had been issued a pre-instrument called a tonette so the teacher could determine who had an "aptitude" for music. Virginia had liked the neatness of the tonette, its modest musical range and how it fit into her school  
 15 desk on the right side. Whenever she covered a fingerhole, she felt the contour of its slightly raised lip and imagined she was playing the tentacle of an octopus.

She had chafed through months of scales and  
 20 simple songs, waiting for the moment when she would walk across the auditorium stage and choose: kneel among the rows of somber black cases, undo the metal clasps and fling open the lid to reveal her instrument, a flute or a clarinet, glowing softly, half buried in deep  
 25 blue velvet.

But before she could make her choice, they moved to Arizona. There, the music instruments were stored in a classroom trailer, and when she opened the flute case she nearly winced from the glare bouncing off all that polished silver, those gloating caps and hinges.  
 30 The clarinet was worse—it looked like an overdesigned walking stick, sounded like a clown laughing, and had reeds that needed to be softened in spit.

The music teacher shut the cases with a succession  
 35 of curt clicks. "That leaves the strings," she sighed, leading the way back through the noonday blaze and into the main building, where the violins, violas, cellos and double basses were housed. There, by virtue of its sonorous name, Virginia asked for the violoncello—  
 40 and was too intimidated by the teacher's growing impatience to protest when what emerged from the back closets was something resembling not a guitar, but a child-sized android. In her anguish Virginia bowed her head and blindly accepted the instrument. It was not  
 45 long, however, before she realized that she had made a good choice, for the sound of its name was synonymous with the throbbing complaint that poured out of its cumbersome body.

It took her nearly a year just to learn how to hold it  
 50 properly. She had been accustomed to practicing after school, but one weekend evening while her parents were out, she dragged the instrument into their bedroom and used pillows to prop the music on the armchair. She was just about to sit on the edge of the  
 55 bed when something, maybe the shadow thrown from the flowered lampshade or the slats of light sifting from

CONTINUE

the street, made her want to *do things right*. She got a straightback chair from the dining room and sat down correctly, bringing the instrument slowly toward her body. The lamp picked up the striations down the back of the wood, each strip slightly different, a little browner, a little more golden, but meeting its mate at the spine, a barely perceptible seam. For the first time she saw that the back of the cello was rounded like a belly, the belly of a tiger she had to bring close to her, taming it before she was torn limb from limb. She had to love and not be scared, and show the cat that it did not need to growl to protect itself. The animal stood on its hind legs and pressed its torso to hers, one paw curled like a ribbon behind her left ear. It was heavy; she sat very straight in the chair in order to support it.

*Funny how fantasy works. And memory. I haven't thought about that evening in years.* Virginia bent down and lay the cello case on its back, as she knelt to unsnap the metal clasps.

1

The repetition of the phrase “made you forget” in lines 5-6 primarily serves to

- A) emphasize the qualities Virginia associates with powerful music.
- B) re-create Virginia’s emotional reaction to the Beatles songs she once heard.
- C) suggest that Virginia’s memories of the theater troupe are fading with time.
- D) highlight the regret Virginia feels about ending her musical studies.

2

In the passage, the description of Virginia’s experience with the tonette illustrates which aspect of her relationship with music?

- A) Her extraordinary aptitude for music at a young age.
- B) Her early interest in and commitment to music.
- C) Her initial fear of failure as she learned to play music.
- D) Her resentment as a child of the time required to practice music.

3

As used in line 38, “housed” is most similar in meaning to which other word as used in the passage?

- A) “covered” (Line 15)
- B) “moved” (Line 26)
- C) “stored” (Line 27)
- D) “opened” (Line 28)

4

Based on the passage, which choice best describes Virginia’s reaction to the flute and clarinet in the classroom trailer?

- A) She is skeptical of the quality of both instruments, in particular that of the clarinet.
- B) She is repelled by the appearance of both instruments and by the sound of the clarinet.
- C) She is concerned about the poor conditions in which both instruments have been store.
- D) She is frustrated by the difficulty of playing either instrument properly.



5

According to the passage, Virginia allows herself to be assigned the violoncello because

- A) she is reluctant to request an alternative.
- B) it is the last instrument remaining in the trailer.
- C) its graceful form reminds her of a wild animal.
- D) the sound it produces has soulful attributes.

6

In the passage, the narrator suggests that Virginia perceives a relationship between which aspects of a musical instrument?

- A) What it is called and how it sounds.
- B) How it should be played and the maintenance it requires.
- C) What it looks like and how popular it is.
- D) How widely available it is and how easy it is to master.

7

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

- A) Lines 19-25 (“She...velvet”)
- B) Lines 26-30 (“But...hinges”)
- C) Lines 34-38 (“The music...housed”)
- D) Lines 44-48 (“It was...body”)

8

In the sixth paragraph (lines 49-71), the narrator suggests that Virginia recognizes a need to change her attitude toward the cello from one of

- A) uncertainty to firm commitment.
- B) dissatisfaction to reluctant acceptance.
- C) apprehension to calm affection.
- D) frustration to deep respect.

9

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

- A) Lines 49-50 (“It took...properly”)
- B) Lines 50-54 (“She had...armchair”)
- C) Lines 57-60 (“She...her body”)
- D) Lines 66-68 (“She...itself”)

10

In the context of the passage as a whole, the italicized sentences in lines 72-73 mainly serve to

- A) cast doubt on the accuracy of Virginia’s memories.
- B) introduce the point of view of a new character.
- C) suggest a contrast between real and imagined events.
- D) indicate a shift in time and perspective.

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

This passage is adapted from Elizabeth Svoboda, *What Makes a Hero? The Surprising Science of Selflessness*. ©2013 by Elizabeth Svoboda.

A variety of studies have confirmed the strength of the connection between altruism and well-being. In 1999, the behavioral medicine specialist Carolyn Schwartz, then at the University of Massachusetts, and her colleagues divided multiple sclerosis patients into two groups and had members of one group call members of the other regularly to provide them with emotional support. After tracking the groups for three years, Schwartz found that the helpers—the people in the phone-call group—reported profound improvements in their self-worth and their moods. “These people seemed to be blossoming,” Schwartz says. “They talked about how helping other people transformed their experience of multiple sclerosis from something that victimized them to something that enabled them to be a positive force in the world.”

In a 2010 survey of more than 4,500 American volunteers, 89 percent—nearly 9 in 10—stated that volunteering improved their sense of well-being, while a sizable majority reported that it lowered their stress levels and enhanced their sense of purpose in life. This connection appears to hold true regardless of culture: In a 2012 study of older Maori and non-Maori in New Zealand, those who volunteered more often scored higher on happiness measures.

In best-case scenarios, regular helping may even help stave off an early death. Analyzing data from more than seven thousand respondents collected for the government’s Longitudinal Study of Aging, the researchers Alex Harris and Carl Thoresen found that frequent volunteers had a 19 percent lower mortality risk than people who never volunteered when the subjects’ level of social support was taken into account. That means volunteering is associated with longer survival independent of the advantages social ties provide. Even more dramatically, when University of Michigan researchers studied 423 older couples who were followed for five years, those who helped others were nearly 60 percent less likely to die during the study period than those who never helped.

While many survey studies have found more or less strong associations between helping and happiness, the University of California, Riverside,

psychologist Sonja Lyubomirsky wanted to test the connection in a real-world setting. She asked students to carry out five “random acts of kindness” of their choice every week for six weeks—they could choose anything that benefited others, from making a homeless person a meal to helping a kid with a school assignment. The subjects experienced higher levels of happiness than controls when they performed all five kind acts in one day, suggesting that the well-being boost is pronounced when people help often.

Interestingly, though, students who spaced the kind acts out, performing them on different days, *didn’t* experience the same happiness boost. Lyubomirsky’s work suggests altruistic acts may need to be frequent in order to confer a lasting change in well-being. With isolated acts of helping, says the London School of Economics social scientist Francesca Borgonovi, “it could be that there’s a very short—narrowly defined in time and space—bump in happiness that doesn’t shift your [overall] happiness in any meaningful way.”

On balance, though, being generous boosts your mood and health because it strengthens your sense that you’re really doing something significant. The social psychologist Sara Konrath of the University of Michigan notes that helping others may signal our bodies to release pleasurable chemicals such as oxytocin. The boost we get from helping may also mute our stress response, causing us to release fewer jarring stress hormones such as cortisol and norepinephrine.

**CONTINUE** 

Figure 1

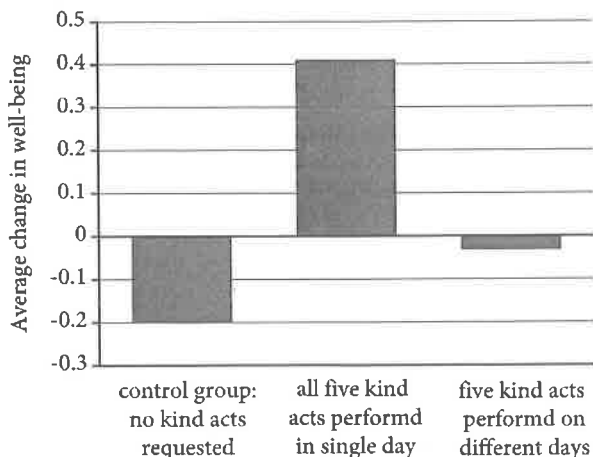
Selected Response to 2010 Survey  
of 4,500 American Adults Who Volunteered  
in the Previous Year

Survey statement	percent of respondents agreeing
Volunteering has made me feel physically healthier	68%
Volunteering has improved My sense of well-being	89%
Volunteering lowers my Stress level	73%
Volunteering enriches my Sense of purpose in life	92%

Adapted from "Volunteering and Your Health: How Giving Back Benefits Everyone." ©2010 by UnitedHealth Group.

Figure 2

Average Change in Well-Being over  
a Six-Week Period for Three Groups



Adapted from Sonja Lyubomirsky, Kennon M. Sheldon, and David Schkade, "Pursuing Happiness: the Architecture of Sustainable Change." ©2005 by the Educational Publishing Foundation.

Subjects completed measures of well-being at the beginning and end of the experiment. Positive values indicate greater well-being at the end than at the beginning; negative values indicate lower well-being at the end than at the beginning.

11

Based on the passage, which choice best describes the relationship between emotional support and well-being as shown by Schwartz's study?

- A) Both givers and recipients of emotional support reported increased well-being.
- B) Givers of emotional support reported increased well-being, while recipients reported no change.
- C) Givers of emotional support reported increased well-being.
- D) Both givers and recipients of emotional support reported initial well-being followed by a return to their previous condition.

12

As used in line 16, "positive" most nearly means

- A) confident.
- B) practical.
- C) specific.
- D) beneficial.

13

As used in line 42, "associations" most nearly means

- A) links.
- B) organizations.
- C) combinations.
- D) partnerships.

14

If true, which finding of a survey of the general population would most undermine the author's interpretation of Lyubomirsky's study?

- A) The happiness boost associated with altruistic acts remains constant when more than five altruistic acts are performed in a single day.
- B) While all altruistic acts confer a happiness boost, altruistic acts that lead to immediate benefits confer the greatest boost.
- C) The amount of happiness people feel as a result of performing altruistic acts increases with the effort those acts require.
- D) Occasional altruistic acts result in long-lasting increases in the personal happiness of those who perform them.

15

In lines 61-64, the author includes the quotation from Borgonovi most likely to

- A) indicate the hypothesis that Lyubomirsky's study was intended to test.
- B) provide a possible explanation for a result of Lyubomirsky's study.
- C) criticize Lyubomirsky for failing to consider the benefits of short-term happiness.
- D) compare the results of Lyubomirsky's study with those of another study about kind acts.

16

The author most strongly suggests that people who perform altruistic acts benefit partly because of

- A) beliefs that they hold about the effect of such acts.
- B) feedback that they receive from those who benefit from such acts.
- C) changes in brain chemistry that occur when they merely think about such acts.
- D) the social approval that they receive for performing such acts.

17

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

- A) Lines 3-8 ("In 1999...support")
- B) Lines 57-59 ("Lyubomirsky's...well-being")
- C) Lines 65-67 ("On balance...significant")
- D) Lines 68-71 ("The social...oxytocin")

18

According to figure 1, the highest percentage of respondents agreed that volunteering has

- A) positively affected their physical health.
- B) given them a renewed sense of self-esteem.
- C) made them feel a greater sense of purpose.
- D) helped them control their responses to stress.



19

Based on information in the passage, it can reasonably be inferred that the majority of survey respondents represented in figure 1

- A) value volunteering because they have a high degree of empathy.
- B) may have experienced decreases in the level of certain hormones after volunteering.
- C) are likely to live longer than are volunteers who disagreed with the statements.
- D) always have higher levels of oxytocin circulating in their bloodstreams than do nonvolunteers.

20

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

- A) Lines 17-22 (“In a...life”)
- B) Lines 22-25 (“This connection...measures”)
- C) Lines 36-40 (“Even...helped”)
- D) Lines 71-74 (“The boost...norepinephrine”)

21

Which choice best states the relationship between the two figures and the passage?

- A) Both figures offer data that challenge the primary claim of the passage.
- B) Both figures provide the specific results of studies discussed in the passage.
- C) Both figures present a visual interpretation of the first study mentioned in the passage.
- D) Both figures describe studies that the author claims require further evaluation.

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

This passage is adapted from Jonathan Shaw, "The 'Bionic Leaf.'" ©2015 by Harvard Magazine Inc.

Harvard scientists have created a "bionic leaf" that converts solar energy into a liquid fuel. The work—a proof of concept in an exciting new field that might be termed biomanufacturing—is the fruit of a  
 5 collaboration between the laboratories of professor of biochemistry and systems biology Pamela Silver and professor of energy Daniel Nocera. The pair, who began collaborating two years ago, share an interest in developing energy sources that might someday have  
 10 practical application in remote locales in the developing world. Silver dubbed the system "bionic" because it joins a biological system to a clever piece of inorganic chemistry previously developed by Nocera: that invention, widely known as the *artificial leaf*,  
 15 converts solar energy into hydrogen fuel.

Nocera's artificial leaf, which serves as the fuel source in the bionic leaf, works by sandwiching a photovoltaic cell between two thin metal oxide catalysts. When submersed in a glass of water at room  
 20 temperature and normal atmospheric pressure, the artificial leaf mimics photosynthesis. Current from the silicon solar wafer is fed to the catalysts, which split water molecules: oxygen bubbles off the catalyst on one side of the wafer, while hydrogen rises from the  
 25 catalyst on the wafer's other side. Nocera has been perfecting the artificial leaf since he first demonstrated it in 2011; today, it is far more efficient than a field-grown plant, which captures only 1 percent of sunlight's energy. He says he can reach efficiencies of  
 30 70 percent to 80 percent of the underlying solar-wafer technology, which is improving constantly.

The hydrogen it produces is a versatile fuel from a chemical standpoint, Nocera reports, and could easily become the basis of a fuel cell, but it has not been  
 35 widely adopted, in part because it is a gas. Liquid fuels are much easier to handle and store, hence the new *bionic leaf's* importance.

In the bionic leaf, the hydrogen gas is fed to a metabolically engineered version of a bacterium called  
 40 *Ralstonia eutropha*. The bacteria combine the hydrogen with carbon dioxide as they divide to make more cells, and then—through a trick of

bioengineering pioneered by Anthony Sinskey, professor of microbiology and of health sciences and  
 45 technology at MIT—produce isopropanol (rubbing alcohol), which can be burned in an engine much like the gasoline additive ethanol.

"The advantage of interfacing the inorganic catalyst with biology is you have an unprecedented  
 50 platform for chemical synthesis that you don't have with inorganic catalysts alone," says Brendan Colón, a graduate student in systems biology in the Silver lab. "Life has evolved for billions of years to produce catalysts capable of making chemical modifications on  
 55 complicated molecules with surgical precision, many times at room temperature," Colón explains. "If you can use enzymes for building chemicals, you open the door to making many of the natural compounds we rely on every day," such as antibiotics, pesticides,  
 60 herbicides, fertilizer, and pharmaceuticals.

Members of Silver's lab have been working to perfect the tricky interface between the catalyst and the bacteria, so that they will thrive and grow optimally. In its first iteration, the bionic leaf matched the efficiency  
 65 of photosynthesis in plants, far below the capabilities of Nocera's underlying artificial leaf. Now the team is working to surpass blue-green algae, which—at 5 percent efficiency—do better at photosynthesis than plants. Colón has been developing a strain of the  
 70 bacterium that grows well even at the lower voltages that might be emitted by the solar wafer at the system's core on a cloudy day, for example; this could dramatically improve overall efficiency.

Ultimately, though, Silver's goal is not to create  
 75 fuels from this work, but "high-value commodities" in remote places. Fuel, she notes wryly, is cheap "because we fight wars over it"—and developing a system that could make fuel at a price lower than gasoline would  
 therefore be very difficult, she says. Drugs, on the other  
 80 hand, are high-value commodities, so engineering a bacterium to produce not isopropanol but a vitamin or a drug may be her next goal for this system.

22

The primary purpose of the passage is to

- A) discuss the development and significance of the bionic leaf.
- B) document current commercial uses of the bionic leaf.
- C) present a scientific debate about the effectiveness of the bionic leaf.
- D) analyze the differences between the artificial leaf and the bionic leaf.

23

The first paragraph implies that Silver and Nocera's research was motivated in part by a desire to address which problem?

- A) Many developing countries lack natural resources that are convertible to fuel.
- B) Liquid fuels are easier to produce than gas fuels but are less efficient.
- C) It is difficult to transfer solar energy over long distances after it is collected.
- D) Some communities lack adequate access to reliable energy sources.

24

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

- A) Lines 1-2 ("Harvard...fuel")
- B) Lines 2-7 ("The work...Nocera")
- C) Lines 7-11 ("The pair...world")
- D) Lines 11-15 ("Silver...fuel")

25

The main purpose of the second paragraph (lines 16-31) is to

- A) discuss the advantages of a potential competitor to the bionic leaf.
- B) explain the workings of a central component of the bionic leaf.
- C) describe the role of photosynthesis in the development of the bionic leaf.
- D) compare the efficiency of the bionic leaf with that of the artificial leaf.

26

The passage indicates that the artificial leaf carries out which chemical process?

- A) It splits water into hydrogen and oxygen.
- B) It splits carbon dioxide into carbon and oxygen.
- C) It combines oxygen and carbon dioxide.
- D) It combines hydrogen and carbon dioxide.

27

As used in line 28, "captures" most nearly means

- A) records.
- B) describes.
- C) uses.
- D) conquers.

28

As used in line 42, “trick” most nearly means

- A) clever technique.
- B) mischievous prank.
- C) fleeting illusion.
- D) deliberate deception.

29

Colón’s remarks in the fifth paragraph (lines 48-60) primarily serve to

- A) highlight the technological sophistication and intricate design of the bionic leaf.
- B) praise the collaborative spirit and hard work of the inventors of the bionic leaf.
- C) illustrate the careful testing and continuous improvement of the bionic leaf.
- D) emphasize the innovative nature and great potential of the bionic leaf.

30

As presented in the passage, the researchers make which assumption about the bionic leaf that has yet to be substantiated?

- A) The efficiency of the leaf can equal the efficiency of plant photosynthesis.
- B) The leaf can be used to produce chemical compounds other than isopropanol.
- C) The artificial catalysts used in the leaf can be replaced by natural catalysts.
- D) The leaf can generate a fuel that powers engines as efficiently as ethanol does.

31

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

- A) Lines 40-47 (“The bacteria...ethanol”)
- B) Lines 48-52 (“The advantage...lab”)
- C) Lines 53-56 (“Life...explains”)
- D) Lines 56-60 (“If you...pharmaceuticals”)

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

Passage 1 is adapted from Albert Luthuli's speech to the South African Congress of Democrats, delivered in 1958. Passage 2 is adapted from Harold Macmillan's address to the South African Parliament, delivered in 1960. At the time of these speeches, South Africa was in the process of transitioning from a British colony to an independent republic under a system of white-minority rule known as apartheid. Luthuli was the president of the African National Congress, a group advocating equality for black South Africans; Macmillan, the prime minister of Britain, was addressing the all-white South African Parliament.

**Passage 1**

Those of us who are in the freedom struggle in this country have really only one gospel. We may possibly shade it in different ways, but it is a gospel of democracy and freedom.

- Line 5 If we are true to South Africa, that must be our vision, a vision of South Africa as a fully democratic country. It cannot in honesty be claimed that she is yet really democratic, when only about a third of her people enjoy democratic rights, and the
- 10 rest—notwithstanding the fact that they constitute the majority—are still subjected to apartheid rule. I emphasize the words “are still” because I do believe firmly that it is not a state that can be perpetuated. Apartheid rule is the antithesis of democracy.
- 15 Apartheid—in theory and in practice—is an effort, to make Africans march back to tribalism.

Sometimes very nice and pretty phrases are used to justify this diversion from the democratic road. The one that comes to my mind is the suggestion that we

20 Africans will “develop along our own lines.” I do not know of any people who really have “developed along their own lines.” My fellow white South Africans, enjoying what is called “Western civilization,” should be the first to agree that this civilization is indebted to

25 previous civilizations, from the East, from Greece, Rome and so on. For its heritage, Western civilization is really indebted to very many sources, both ancient and modern....

The essence of development along your own lines

30 is that you must have the right to develop, and the right to determine how to develop.

Its essence is freedom and—beyond freedom—self-determination. This is the vision we hold for our future and our development.

- 35 One might ask, “Is this vision of a democratic society in South Africa a realizable vision? Or is it merely a mirage?” I say, it is a realizable vision. For it is in the nature of man, to yearn and struggle for freedom. The germ of freedom is in every individual,
- 40 in anyone who is a human being. In fact, the history of mankind is the history of man struggling and striving for freedom. Indeed, the very apex of human achievement is FREEDOM and not slavery. Every human being struggles to reach that apex.

**Passage 2**

- 45 The wind of change is blowing through this continent and whether we like it or not, this growth of national consciousness is a political fact. And we must all accept it as a fact, and our national policies must take account of it.
- 50 Of course you understand this better than anyone, you are sprung from Europe, the home of nationalism, and here in Africa you have yourselves created a free nation. A new nation. Indeed, in the history of our
- 55 times yours will be recorded as the first of the African nationalists. And this tide of national consciousness which is now rising in Africa, is a fact, for which you and we, and the other nations of the Western world are ultimately responsible. For its causes are to be found in the achievements of Western civilization....
- 60 I am sure you will agree that in our own areas of responsibility we must each do what we think right. What we British think right derives from a long experience both of failure and success in the management of these affairs. We try to learn and
- 65 apply the lessons of both. Our judgement of right and wrong and of justice is rooted in the same soil as yours—in Christianity and in the rule of law as the basis of a free society. This experience of our own explains why it has been our aim in the countries for
- 70 which we have borne responsibility, not only to raise the material standards of life, but to create a society that respects the rights of individuals, a society in which men are given the opportunity to grow to their full stature—and that must in our view include the
- 75 opportunity of an increasing share in political power and responsibility, a society finally in which individual merit and individual merit alone, is the criterion for a man's advancement, whether political or economic.
- 80 Finally, in countries inhabited by several different races, it has been our aim to find means by which the community can become more of a community, and fellowship fostered between its various parts.

32

In Passage 1, Luthuli argues that South Africa will become a fully democratic country only when black South Africans

- A) enjoy the same rights as white citizens.
- B) have economic as well as political power.
- C) form their own political organizations.
- D) constitute a majority of the government.

33

Luthuli refers to “very nice and pretty phrases” (line 17) primarily to show that language is being used in order to

- A) rectify an intolerable situation.
- B) obscure an indefensible governing system.
- C) undermine outspoken critics of the government.
- D) depict the daily experience of the majority of citizens.

34

When Luthuli describes the vision of a democratic society in South Africa as “realizable” (lines 36-37), he means that this vision can be

- A) acquired
- B) comprehended
- C) achieved
- D) pursued

35

In Passage 2, Macmillan implies that the growth of national consciousness in Africa is

- A) baffling, because most African nations function efficiently without strong nationalist movements.
- B) invigorating, because most African nations are ready to embrace diversity.
- C) inevitable, because nationalism in Africa is a force that cannot be stopped.
- D) remarkable, because many Europeans doubted that nationalism would take hold in Africa.

36

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

- A) Lines 45-49 (“The wind...of it”)
- B) Lines 53-55 (“Indeed...nationalists”)
- C) Lines 58-59 (“For its...civilization”)
- D) Lines 68-74 (“This...stature”)

37

In Passage 2, Macmillan presents his argument to the South African government by

- A) asserting that Britain and South Africa share certain important values.
- B) urging the government to take a leadership role among African nations.
- C) acknowledging that South Africa faces greater challenges than does Britain.
- D) lamenting Britain’s difficulties in sustaining free and just societies.

38

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

- A) Lines 50-53 (“Of course...nation”)
- B) Lines 60-61 (“I am...right”)
- C) Lines 62-64 (“What...affairs”)
- D) Lines 65-68 (“Our judgment...society”)

39

Luthuli would most likely respond to Macmillan’s demand for a society in which all individuals have a “share in political power and responsibility” (lines 75-76) by arguing that

- A) economic power is more important to black South Africans than political power.
- B) such a society is impossible as long as apartheid exists in South Africa.
- C) many black South Africans do not want to participate in a corrupt political system.
- D) many black South Africans already have significant political responsibilities.

40

Luthuli and Macmillan would most likely agree on which statement about freedom?

- A) Just societies give people the freedom to develop as individuals.
- B) Democracy cannot exist where freedom is in any way compromised.
- C) Political freedom must precede economic and social freedom.
- D) Freedom is directly related to a spirit of nationalism.

41

The speeches of Luthuli (Passage 1) and Macmillan (Passage 2) differ in their approach to social change in that

- A) Luthuli suggests that major social change in South Africa is unlikely to happen soon, while Macmillan argues that significant change is imminent.
- B) Luthuli implies that the people of South Africa themselves will initiate social change, while Macmillan emphasizes the role played by those in positions of power.
- C) Luthuli states that eliminating apartheid is only the first step toward genuine social change, while Macmillan contends that eliminating apartheid is an ultimate goal.
- D) Luthuli believes that change in South Africa will come about through collective action, while Macmillan emphasizes the need for change at the individual level.

**CONTINUE** 

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

This passage is adapted from Robert M. Hazen, *The Story of Earth: The First 4.5 Billion Years, from Stardust to Living Planet*. ©2012 by Robert M. Hazen.

The Moon is bone-dry by conventional wisdom (actually drier than bone, which retains a significant water component even when baked in the desert sun).

Line Multiple lines of evidence point to this aridity:

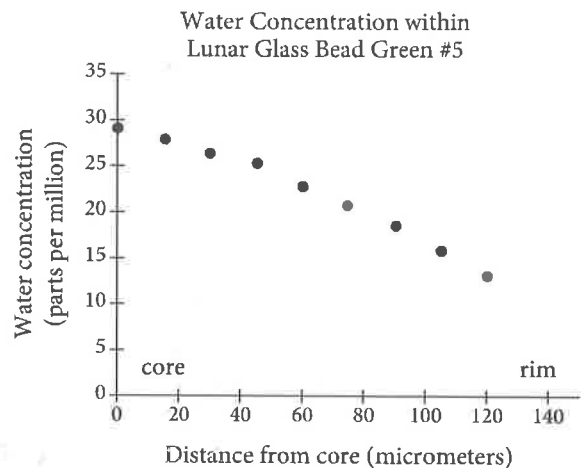
5 Earth-based telescopes reveal no characteristic infrared absorption; Moon rocks from all six Apollo landing sites held no detectable traces of water (at least by 1970 analytical standards); and the finding of unrusty iron metal after four billion years on the  
10 lunar surface would seem to preclude even a trace of corrosive water.

It's a funny thing about conventional wisdom, though. Eventually someone will challenge what everyone else knows to be true, and once in a while  
15 something really interesting will be found. In 1994 a single flyby of the Clementine spacecraft mission produced radar measurements that were consistent with water ice, though many planetary scientists were unconvinced. Four years later the Lunar Prospector  
20 employed neutron spectroscopy to detect a significant concentration of hydrogen atoms, and hence possibly water ice or water-containing minerals, near the poles. Still, many experts pointed to implanted hydrogen ions from the Sun's solar wind as a more likely source  
25 of the signal. Then in October 2009 NASA smashed the upper stage of an Atlas rocket into one of the Moon's craters (the Cabeus crater, near the southern lunar pole) and scrutinized the plume of impact debris for signs of H<sub>2</sub>O. Sure enough, the flurry of dust  
30 incorporated a small but significant amount of the life-giving stuff—enough to renew interest in lunar water and its possible origins. Three back-to-back articles in *Science* that same October established that evidence for water on the Moon is now unambiguous.

35 Enter Erik Hauri and his colleagues at the Carnegie Institution. Using an ion microprobe—a highly sensitive instrument that hadn't been available to the first generation of scientists who studied the Apollo samples—Hauri's team has revisited the  
40 colorful glass beads collected during lunar missions in the late 1960s and early 1970s. Other scientists had examined the glass beads for signs of water decades earlier, but their detection capacities were no match for the ion microprobe's ability to resolve

45 measurements at the scale of a millionth of an inch. Hauri and his coworkers polished a variety of glass beads so that their round cross sections were revealed in the ion probe. The beads' outer rims proved to be very dry, with only a few parts per million water, but  
50 the cores of the largest beads have as much as [46 parts per million]. Over billions of years, most of the glass beads' original water has evaporated to space, more from the outsides than from the cores. However, based on the significant amount of remaining water deep  
55 inside the beads, Hauri and his colleagues calculate that the original water content of the Moon's magma may have been as high as 750 parts per million—a lot of water, comparable to many volcanic rocks on Earth, and more than enough to drive surface volcanism that  
60 would have dispersed magma in explosive eruptions billions of years ago.

If that much water powered volcanoes in the Moon's past, then a great deal of water must still be locked somewhere inside the Moon's frozen interior.  
65 And since the Moon formed primarily by the wholesale excavation of Earth's primordial mantle during a collision with another massive object, our planets deep interior likely holds prodigious amounts of unseen water as well.



Adapted from Alberto E. Saal et al., "Volatile Content of lunar Volcanic Glasses and the Presence of Water in the Moon's Interior." ©2008 by Macmillan Publishers Limited.



42

According to the author, challenging the conventional wisdom

- A) usually produces unexpected outcomes.
- B) generally occurs outside of scientific circles.
- C) rarely results in technological innovations.
- D) sometimes leads to significant new insights.

43

According to the passage, which choice is true about the 1994 Clementine spacecraft mission?

- A) It provided evidence about the Moon that was featured in *Science* magazine.
- B) It was not specifically designed to detect water on the Moon.
- C) It offered preliminary indications of water on the Moon.
- D) It did not use the most up-to-date radar technology in its flyby of the Moon.

44

It can reasonably be inferred from the passage that the idea that the Moon was completely arid was reinforced in part because

- A) scientists were unfamiliar with some of the powerful analytical tools that were available to them.
- B) some scientists were willing to challenge the conventional wisdom about the Moon.
- C) evidence that might have contradicted this notion could be explained in another way.
- D) Apollo Moon rocks were not available in sufficient quantities to support valid conclusions.

45

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

- A) Lines 8-11 (“the finding...water”)
- B) Lines 12-15 (“It’s a...found”)
- C) Lines 15-19 (“In 1994...unconvinced”)
- D) Lines 23-25 (“Still...signal”)

46

As used in line 44, “resolve” most nearly means

- A) distinguish between.
- B) change into.
- C) convert to.
- D) clear from.

47

As used in line 59, “drive” most nearly means

- A) coerce.
- B) fuel.
- C) transport.
- D) maneuver.

48

The author implies that any water currently present on the Moon

- A) had its primary source on Earth.
- B) is contained mainly in glass beads.
- C) will eventually increase in volume.
- D) exists in liquid form as well as ice form.

49

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

- A) Lines 36-41 (“Using...1970s”)
- B) Lines 53-57 (“However...million”)
- C) Lines 62-64 (“If that...interior”)
- D) Lines 65-69 (“And since...well”)

50

According to the figure, at what distance from the core is the water concentration within lunar glass bead green #5 approximately 15 parts per million?

- A) 40 micrometers
- B) 60 micrometers
- C) 80 micrometers
- D) 100 micrometers

51

Based on data in the figure, which choice is a reasonable conclusion about lunar glass bead green #5?

- A) Beyond 100 micrometers from its core, water is not detectable.
- B) At no point in time did its water concentration exceed 30 parts per million.
- C) Its water concentration at 120 micrometers is approximately half that at its core.
- D) Its water concentration is 50 percent less than it once was.

52

The figure best supports which claim from the passage?

- A) Line 4 (“Multiple...aridity”)
- B) Lines 6-8 (“Moon...standards”)
- C) Lines 25-29 (“Then...H<sub>2</sub>O”)
- D) Lines 48-51 (“The beads’...million”)

**STOP**

If you finish before time is called, you may check your work on this section only.

Do not turn to any other section.

## Writing and Language Test

35 MINUTES, 44 QUESTIONS

Turn to Section 2 of your answers 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.

#### Peanut Power

Polystyrene packing peanuts—thousands of them. That's what surrounded members of a Purdue University research team, led by chemical engineering professor Vilas G. Pol, after they had finished unpacking new equipment for a laboratory facility. Packing peanuts are a standard part of shipments, **1** as their cushiony material ensures that items, such as glassware, are not damaged in transit. Because most curbside recycling services will not collect packing peanuts, less than 10 percent of them are recycled per year, and millions of

1

- A) NO CHANGE
- B) as their cushiony material ensures that items that are shipped,
- C) which are commonly used because their cushiony material ensures that items,
- D) as their cushiony material guarantees and ensures that items,

CONTINUE 

tons end up in landfills, where they take years to decay. Pol and his team were hesitant to discard the packing peanuts and contribute to this history of waste. **2** Thus, more curbside recycling services should consider accepting packing peanuts.

Pol and his team determined that the peanuts were composed of carbon, hydrogen, and oxygen. They knew that reusable lithium-ion batteries, which are commonly used to power electronic devices, employ anodes made of carbon. A battery's anode attracts and stores ions—atoms bearing an electrical charge—when the battery is charging and releases the ions to generate electricity. By heating the peanuts and a catalyst to 1,100 °F for several hours in the presence of argon (an inert gas commonly found in Earth's atmosphere), **3** the carbon was isolated from the hydrogen and oxygen, which were released in the form of harmless water vapor. Further heating resulted in extremely thin microsheets of **4** carbon, that could be made into battery anodes.

2

Which choice best sets up the information that follows in the next paragraph?

- A) NO CHANGE
- B) Hence, many environmental scientists have sought to address this waste-management problem.
- C) As a result, the abundance of packing peanuts in today's landfills is cause for alarm.
- D) Instead, they resolved to use their chemical expertise to devise a solution.

3

- A) NO CHANGE
- B) Pol and his team were able to isolate the carbon
- C) the resulting chemical reaction isolated the carbon
- D) isolation of carbon was achieved

4

- A) NO CHANGE
- B) carbon—
- C) carbon
- D) carbon;

5 The vaporization process that separated the carbon from the hydrogen and oxygen left the surfaces of the carbon microsheets uneven and porous. According to Pol, openings in the surface made the anodes' absorption of ions more efficient; 6 on the other hand, the batteries charged faster. In addition, the anodes retained about 13 percent more 7 of them than do conventional 8 anodes which meant that the batteries could provide more electricity before needing to be recharged than conventional batteries can.

5

Which choice best sets up the main topic of the paragraph?

- A) Further research will be necessary to determine all the potential applications of Pol's method.
- B) The team presented its findings at the American Chemical Society's 2015 national meeting.
- C) The anodes of conventional lithium-ion batteries are usually made from graphite.
- D) The anodes produced by Pol and his team proved remarkably effective.

6

- A) NO CHANGE
- B) likewise,
- C) as a result,
- D) by the same token,

7

- A) NO CHANGE
- B) of these
- C) ions
- D) DELETE the underlined portion.

8

- A) NO CHANGE
- B) anodes; meaning
- C) anodes and this meant
- D) anodes, this meant



The process **9** as for recycling packing peanuts that Pol and his team developed is not all that complicated: it requires less time and energy than the **10** humdrum method of making lithium-ion batteries, which uses carbon in the form of graphite. Sherine Obare, a professor of chemistry at Western Michigan University familiar with the team's research, noted that Pol's method could be used to successfully recycle other polystyrene-based materials. This additional benefit attests to the future promise of the work being done in Pol's lab. **11** In fact, the process that Pol and his team devised would take several days fewer than the process currently used to make anodes for lithium-ion batteries.

9

- A) NO CHANGE
- B) for recycling
- C) in order to recycle
- D) from recycling

10

- A) NO CHANGE
- B) exemplary
- C) standard
- D) run-of-the-mill

11

Which choice provides the most effective conclusion for the passage?

- A) NO CHANGE
- B) Thus, lithium-ion batteries are more effective than the lithium batteries that preceded them.
- C) Furthermore, other researchers are experimenting with burning packing peanuts in order to use their heat to generate energy, a process known as thermal recycling
- D) For now, Pol and his team hope that this process will be widely adopted and will turn a ubiquitous waste product into a useful household item.

Questions 12-22 are based on the following passage and supplementary material.

### The King of Daredevil Comedy

In 1922, silent-film actor and director Harold Lloyd was walking in downtown Los Angeles when he saw an unusual sight: a man climbing up the outside of a tall office building. A crowd was gathered, mesmerized by the spectacle. Lloyd **12** watched nervously until the climber, a daredevil named Bill Strother, made it to safety. **13** Having already made a few films in the vein of “thrill comedy,” **14** the event inspired Lloyd to create his most daring film yet, and he invited Strother to be involved. The result was *Safety Last!*, the most famous movie of Lloyd’s career and a marvel of creative filming.

12

- A) NO CHANGE
- B) had watched
- C) watches
- D) has watched

13

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

[ *EXISTING SENTENCE*

]

Should the writer make this addition here?

- A) Yes, because it explains why Lloyd was nervous while watching Strother.
- B) Yes, because it makes a point that is elaborated on in the next sentence.
- C) No, because it contradicts a point made in the previous sentence.
- D) No, because it diverts the focus of the paragraph from Strother to the audience.

14

- A) NO CHANGE
- B) Lloyd was inspired
- C) it was Lloyd’s inspiration
- D) its inspiration led Lloyd

CONTINUE 

In the final scene of the movie, Lloyd's **15** character; a department store worker trying to impress his girlfriend—must climb the outside of a twelve-story building. Because modern-day composite filming techniques such as blue screen did not yet exist, let alone computer-generated special effects, Lloyd had to be creative with his stunts. He used a full-scale replica of two floors of Los Angeles's International Savings Building and set **16** them on the roofs of progressively taller buildings: **17** that is, he placed the replica on a platform atop a two-story building, then a seven-story building, then a thirteen-story building. The **18** hoax allowed Lloyd to climb only a few stories at a time while always perpetuating the illusion that he was climbing several stories higher.

15

- A) NO CHANGE
- B) character, a department store worker trying to impress his girlfriend,
- C) character, a department store worker trying to impress his girlfriend;
- D) character—a department store worker trying to impress his girlfriend

16

- A) NO CHANGE
- B) those
- C) these
- D) it

17

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

18

- A) NO CHANGE
- B) trick
- C) cheat
- D) swindle



19 Lloyd was not the only silent-film actor to attempt such risky stunts. Rather than using fake backdrops or projections, he insisted on a real city background. The camera angles in the climbing shots are 20 focused very precisely, cutting out the platform and the rooftop of the lower building but showing views of the street and other buildings in the distance. For the long shots, Lloyd used footage that Strother filmed during his own climbs, adding to the illusion that the character really was 21 clenching the side of a skyscraper.

19

Which choice best introduces the topic of the paragraph?

- A) NO CHANGE
- B) The building where Lloyd filmed much of *Safety Last!* was at the top of a hill, making it seem especially tall.
- C) For publicity, Lloyd's character in *Safety Last!* scales the side of the store where he works.
- D) Lloyd was committed to making the stunt look as realistic as possible.

20

- A) NO CHANGE
- B) focused, very precisely,
- C) focused very precisely
- D) focused; very precisely

21

- A) NO CHANGE
- B) embracing
- C) clinging to
- D) adhering to

CONTINUE 

Lloyd, a comedian as well as a stunt performer, used the dangerous climb as an avenue for comedy. Each stop along the building presents perils for Lloyd's character: a mouse running up his leg, a net tangling around him, a disorienting camera flash, a flimsy clock face. **22** To that end, Lloyd does not fall from the building, but he does succeed in keeping the audience both in stitches and on the edge of their seats. The actor and director Orson Welles said of the climbing sequence, "As a piece of comic architecture, it's impeccable." Audiences had never before seen such a daring stunt on film, and when *Safety Last!* opened to wide acclaim on April Fools' Day in 1923, Lloyd earned the nickname "the King of Daredevil Comedy."

22

- A) NO CHANGE
- B) Of course,
- C) Otherwise,
- D) Thus,

Questions 23-33 are based on the following passage.

**Give Art a Sporting Chance**

Pierre de Coubertin, the French founder of the modern Olympic Games, was a proponent of Olympism—a philosophy of life that celebrates the mind as well as the body, the arts as well as athletics. To Coubertin, this philosophy had best been embodied in the ancient Greek competitions, which prominently featured artists as both performers and commentators. Determined to bring the ideal of Olympism to the modern games, Coubertin incorporated into the 1912 Olympics an arts competition called the Pentathlon of the Muses. **23** The Olympic decathlon, a series of ten track and field events, was also introduced in 1912.

Coubertin’s pentathlon, which awarded Olympic medals for achievements in architecture, literature, music, painting, and sculpture, **24** and which was a part of every Olympic Games until 1948. Regrettably, these competitions ceased, due to a technicality: professional athletes were **25** prohibited from competing in the Olympic Games, and it was argued that professional artists (in other words, any artist who had ever sold a painting or sung for money) should be ineligible as well.

**26** Coubertin himself won a gold medal in literature in 1912.

23

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

- A) Kept, because it sets up the information that follows in the next paragraph.
- B) Kept, because it offers an important clue as to the origin of the term “pentathlon.”
- C) Deleted, because it mentions information that lacks relevance to the main topic of the passage.
- D) Deleted, because it does not indicate who was responsible for introducing the decathlon.

24

- A) NO CHANGE
- B) that
- C) and
- D) DELETE the underlined portion.

25

- A) NO CHANGE
- B) prohibitive of competition
- C) to be prohibited to compete
- D) being prohibited to competition

26

Which choice provides the most effective conclusion to the paragraph?

- A) NO CHANGE
- B) Some wonder whether this chapter in the history of the Olympic Games deserves more attention.
- C) Lacking eligible participants, the Pentathlon of the Muses was discontinued.
- D) Still, the participation of artists in the first modern Olympic arts competition was minimal.

**CONTINUE** 

[1] Although the ban against professionals competing in athletics has long since been **27** rescinded, and the International Olympic Committee (IOC)'s attempts to restore the arts competition **28** has been tepid at best.

[2] In 2000, the IOC instituted a Sport and Art Contest to "foster an active synergy between the worlds of art and sport." [3] One commentator noted that the exhibition of winning entries "had the feel of little more than a photo contest at the local library."

[4] Take the example of *Omnipotent Triumph*, a 2012 prizewinning work of sculpture by US artist Martin Linson. [5] Representing a Paralympic athlete triumphantly crossing the finish line, the sculpture **29** is a relatively small work made of bronze;

27

- A) NO CHANGE
- B) rescinded; yet,
- C) rescinded; thus,
- D) rescinded,

28

- A) NO CHANGE
- B) have been
- C) is being
- D) was

29

The writer wants to suggest that the sculpture was consistent with the philosophy of Olympism. Which choice best accomplishes this goal?

- A) NO CHANGE
- B) evocatively fuses athletic and artistic achievement;
- C) memorably reflects Linson's distinctive approach to representing human anatomy;
- D) shows the athlete making the victory sign with his arms;

however, the lack of publicity about the competition **30** consigned Linson's work to virtual obscurity. **31**

Reinstituting the Pentathlon of the Muses as a high-profile Olympic competition would provide valuable international exposure for artists. If artists were to receive medals during the Olympic Games just as athletes do, and if the competitions were broadcast to the estimated four billion viewers tuning in worldwide, talented artists such as Linson **32** were reaching a much broader audience. The effect on artists would be considerable, but the greatest change would be the effect on viewers. Much as the Olympics' athletic competitions have inspired people around the world to **33** embrace sport and exercise, reinvigorated artistic competitions could promote enthusiasm for artistic achievements and restore Coubertin's ideal.

30

- A) NO CHANGE
- B) consigned and then relegated Linson's work
- C) consigned the sculpture by Linson—since not many people had heard about it—
- D) led

31

The writer wants to add the following sentence to the paragraph.

[ *missing sentence*

]

The sentence would most logically be placed after

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

32

- A) NO CHANGE
- B) had reached
- C) will reach
- D) would reach

33

- A) NO CHANGE
- B) envelop
- C) encompass
- D) admit

CONTINUE 

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

### Finding Meaning at the Zoo

For most zookeepers, the highlight of the workday is the time they spend interacting with animals. **34** Besides, zookeepers spend much of their time performing activities that do not involve contact with animals: cleaning cages, preparing food, and **35** they also conduct educational programs, to name a few. Still, most zookeepers report very high levels of job satisfaction. A major reason for their enthusiasm is that they regard zookeeping not just as a job but also as an expression of their identity and values.

34

- A) NO CHANGE
- B) As a result,
- C) In other words,
- D) However,

35

- A) NO CHANGE
- B) the conducting of
- C) conducting
- D) conduct

People who become zookeepers typically exhibit an early concern for animals. Before beginning their careers, many volunteer at animal shelters or veterinary clinics and then attend college to obtain a degree in zookeeping or a related field such as biology or ecology. **36** Most zookeepers identify closely with their profession and consider their work morally important. These findings about zookeepers are demonstrated in a study by business professors J. Stuart Bunderson and Jeffery Thompson. Bunderson and Thompson asked 982 zookeepers from 157 different zoos to respond to statements about their work using a scale of 1 to 7, with 1 signifying that the respondent strongly disagreed with the proposition and 7 that he or she strongly agreed. When presented with statements asserting that their personal identity is based on their profession, such as “The animal keeping profession’s successes are my successes,” zookeepers gave numerical responses averaging 5.21.

**37** Moreover, the average response did not reach 7 for

36

Which choice most effectively combines the underlined sentences?

- A) Two findings about zookeepers, which are that most identify closely with their profession and consider their work morally important, are demonstrated in a study by business professors J. Stuart Bunderson and Jeffery Thompson.
- B) A study by business professors J. Stuart Bunderson and Jeffery Thompson a study that focused on zookeepers, demonstrates that most zookeepers identify closely with their profession and consider their work morally important.
- C) As a study by business professors J. Stuart Bunderson and Jeffery Thompson demonstrates, most zookeepers identify closely with their profession and consider their work morally important.
- D) Most zookeepers, found in a study by business professors J. Stuart Bunderson and Jeffery Thompson to identify closely with their profession, also consider their work morally important.

37

Which choice most effectively uses information from the table to support a main finding of Bunderson and Thompson’s study?

- A) NO CHANGE
- B) The agreement rating for statements about occupational importance was lower than that for statements about work meaningfulness.
- C) Similarly, they expressed high levels of agreement with statements about their moral duty to do a good job, with responses averaging 5.49.
- D) Furthermore, their sense of duty to the zoo was only slightly greater than their willingness to sacrifice on its behalf—a difference of just 0.15.



any category. The experience of Meghan **38** Nemes a zookeeper at Capron Park Zoo in Attleboro, Massachusetts, shows how seriously zookeepers take their work. “When my animal gets stressed, I get stressed,” she says. This leads her to think constantly about how she can make the **39** animals’ lives easier.

Zookeepers’ Agreement Ratings of Statements about Their Occupation

Statement category	Mean rating
Occupational identification	5.21
Moral duty	5.49
Occupational importance	5.45
Work meaning fullness	5.82
Perceived duty to organization	5.67
Willingness to sacrifice	5.52

Adapted from J. Stuart Bunderson and Jeffery Thompson, “The Call of the Wild: Zookeepers, Callings, and the Double-Edged Sword of Deeply Meaningful Work.” ©2009 by Johnson Graduate School, Cornell University

38

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

39

- A) NO CHANGE
- B) animals’ live’s
- C) animal’s lives’
- D) animals lives



The wholehearted commitment of zookeepers to their profession can lead them to make sacrifices. In their study, Bunderson and Thompson gauged zookeepers' willingness to give up free time to perform important tasks at the zoo without additional pay; the responses, which averaged **40** 5.82, showed a widespread willingness to sacrifice for the job. Siobhán McCann, another zookeeper at Capron Park Zoo, exemplifies this **41** disposition, she says she is comfortable working weekends and holidays to care for the zoo's animals.

**42** On top of interacting with the zoo's visitors, zookeepers perform physically demanding tasks and often

40

Which choice provides accurate information from the table?

- A) NO CHANGE
- B) 5.45,
- C) 5.49,
- D) 5.52,

41

- A) NO CHANGE
- B) disposition; she says,
- C) disposition, she says,
- D) disposition: she says

42

Which choice provides the most effective transition from the previous paragraph?

- A) NO CHANGE
- B) In addition to working long and unusual hours,
- C) Though they enjoy many aspects of their jobs,
- D) Despite working with many types of animals,

CONTINUE

accept pay that is low **43** relative to their educational achievements. Yet for many, a love of animals and a commitment to animal conservation **44** makes these sacrifices not just tolerable but meaningful.

43

Which choice is most consistent with the style of the passage as a whole?

- A) NO CHANGE
- B) even when they are super educated.
- C) despite their having a whole bunch of education.
- D) when compared with their attainments of an educational nature.

44

- A) NO CHANGE
- B) make
- C) is making
- D) has made

**STOP**

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



## Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

### DIRECTIONS

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

### NOTES

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

### REFERENCE

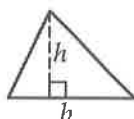


$$A = \pi r^2$$

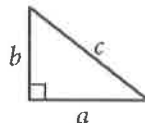
$$C = 2\pi r$$



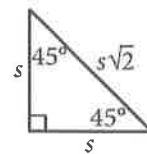
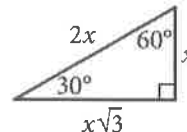
$$A = \ell w$$



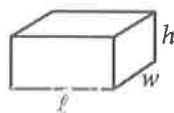
$$A = \frac{1}{2}bh$$



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



Special Right Triangles



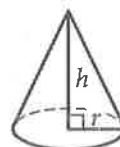
$$V = \ell wh$$



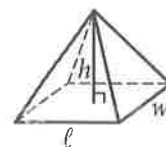
$$V = \pi r^2 h$$



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



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



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

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

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

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



1

Tony spends \$80 per month on public transportation. A 10-ride pass costs \$12.50, and a single-ride pass costs \$1.50. If  $g$  represents the number of 10-ride passes Tony buys in a month and  $t$  represents the number of single-ride passes Tony buys in a month, which of the following equations best represents the relationship between  $g$  and  $t$ ?

- A)  $g + t = 80$
- B)  $g + t = 1.50 + 12.50$
- C)  $1.50g + 12.50t = 80$
- D)  $12.50g + 1.50t = 80$

2

$$T = 1,000 + 18h$$

In the equation above,  $T$  represents Brittany's total take-home pay, in dollars, for her first week of work, where  $h$  represents the number of hours she worked that week and 1,000 represents a sign-on bonus. If Brittany's total take-home pay was \$1,576, for how many hours was Brittany paid for her first week of work?

- A) 16
- B) 32
- C) 55
- D) 88

3

A clothing store is having a sale on shirts and pants. During the sale, the cost of each shirt is \$15 and the cost of each pair of pants is \$25. Geoff can spend at most \$120 at the store. If Geoff buys  $s$  shirts and  $p$  pairs of pants, which of the following must be true?

- A)  $15s + 25p \leq 120$
- B)  $15s + 25p \geq 120$
- C)  $25s + 15p \leq 120$
- D)  $25s + 15p \geq 120$

4

What is the solution to  $-3(x - 5) = -2x + 4$ ?

- A) 11
- B)  $\frac{19}{5}$
- C) -9
- D) -19



5

$$f(x) = x^3 + 3x^2 - 6x - 1$$

For the function  $f$  defined above, what is the value of  $f(-1)$ ?

- A) -11
- B) -7
- C) 7
- D) 11

6

Triangle  $ABC$  and triangle  $DEF$  are similar triangles, where  $\overline{AB}$  and  $\overline{DE}$  are corresponding sides. If  $DE=2AB$  and the perimeter of triangle  $ABC$  is 20, what is the perimeter of triangle  $DEF$ ?

- A) 10
- B) 40
- C) 80
- D) 120

7

There were no jackrabbits in Australia before 1788 when 24 jackrabbits were introduced. By 1920 the population of jackrabbits had reached 10 billion. If the population had grown exponentially, this would correspond to a 16.2% increase, on average, in the population each year. Which of the following functions best models the population  $p(t)$  of jackrabbits  $t$  years after 1788?

- A)  $p(t) = 1.162(24)^t$
- B)  $p(t) = 24(2)^{1.162t}$
- C)  $p(t) = 24(1.162)^t$
- D)  $p(t) = (24 \cdot 1.162)^t$



8

Which of the following is equivalent to the sum of  $3x^4 + 2x^3$  and  $4x^4 + 7x^3$ ?

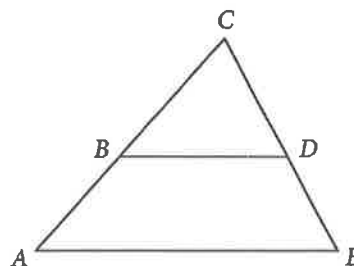
- A)  $16x^4$
- B)  $7x^6 + 9x^6$
- C)  $12x^4 + 14x^3$
- D)  $7x^4 + 9x^3$

9

The function  $f$  is defined by  $f(x) = x^2$ , and the function  $g$  is defined by  $g(x) = x^2 + 3$ . Which of the following translations of the graph of  $f$  in the  $xy$ -plane results in the graph of  $g$ ?

- A) A translation 3 units downward
- B) A translation 3 units upward
- C) A translation 3 units to the left
- D) A translation 3 units to the right

10



Note: Figure not drawn to scale.

In the figure above, segments  $AE$  and  $BD$  are parallel. If angle  $BDC$  measures  $58^\circ$  and angle  $ACE$  measures  $62^\circ$ , what is the measure of angle  $CAE$ ?

- A)  $58^\circ$
- B)  $60^\circ$
- C)  $62^\circ$
- D)  $120^\circ$

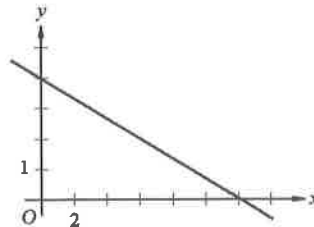


11

An oceanographer uses the equation  $s = \frac{3}{2}p$  to model the speed  $s$ , in knots, of an ocean wave, where  $p$  represents the period of the wave, in seconds. Which of the following represents the period of the wave in terms of the speed of the wave?

- A)  $p = \frac{2}{3}s$
- B)  $p = \frac{3}{2}s$
- C)  $p = \frac{2}{3} + s$
- D)  $p = \frac{3}{2} + s$

12



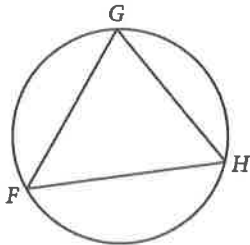
Which of the following could be an equation for the graph shown in the  $xy$ -plane above?

- A)  $y = -\frac{2}{3}x + 8$
- B)  $y = -\frac{3}{2}x + 4$
- C)  $y = -\frac{1}{3}x + 4$
- D)  $y = -\frac{4}{3}x + 8$

CONTINUE



13



Note: Figure not drawn to scale.

Triangle  $FGH$  is inscribed in the circle above. If arc  $\widehat{FG}$  is congruent to arc  $\widehat{GH}$ , and the measure of  $\angle G$  is  $30^\circ$ , what is the measure of  $\angle H$ ?

- A)  $30^\circ$
- B)  $60^\circ$
- C)  $75^\circ$
- D)  $120^\circ$

14

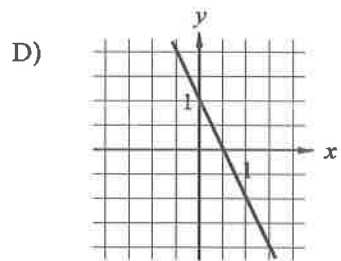
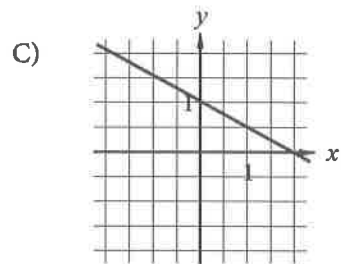
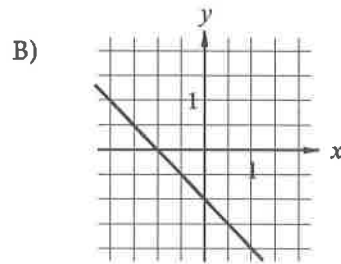
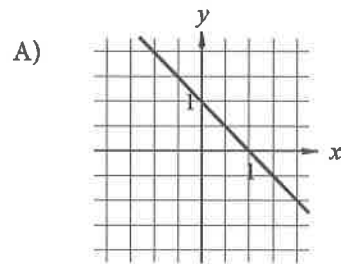
Which of the following is equivalent to  $\sqrt[3]{x^2 + 8x + 16}$ , where  $x > 0$ ?

- A)  $(x+4)^4$
- B)  $(x+4)^2$
- C)  $(x+4)$
- D)  $(x+4)^{\frac{1}{2}}$

15

$$ax + by = b$$

In the equation above,  $a$  and  $b$  are constants and  $0 < a < b$ . Which of the following could represent the graph of the equation in the  $xy$ -plane?



CONTINUE





**DIRECTIONS**

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

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

3	1	/	2
○	○	○	○

 is entered into the grid, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

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

Write answer in boxes. →

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

← Fraction line

Grid in result. {

Answer: 2.5

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

← Decimal point

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

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

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

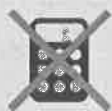
.	6	6	7
○	○	○	○
0	0	0	0
①	①	①	①
②	②	②	②
③	③	③	③
④	④	④	④
⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨

Answer: 201 – either position is correct

2	0	1
○	○	○
0	0	0
①	①	①
②	②	②
③	③	③
④	④	④
⑤	⑤	⑤
⑥	⑥	⑥
⑦	⑦	⑦
⑧	⑧	⑧
⑨	⑨	⑨

2	0	1	
○	○	○	○
0	0	0	0
①	①	①	①
②	②	②	②
③	③	③	③
④	④	④	④
⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨

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



16

$$x + x = 9$$

What value of  $x$  satisfies the equation given?

17

$$\frac{11x - 33}{x - 3} = x$$

What is the solution to the equation above?

18

$$\begin{aligned} 2x + 3y &= 31 \\ 3x - y &= 30 \end{aligned}$$

If  $(x, y)$  is the solution to the system of equations above, what is the value of  $100x + 40y$ ?

19

If  $t > 0$  and  $(3t)^2 - 5(3t) - 14 = 0$ , what is the value of  $t$ ?

20

$$h(x) = x^3 + ax^2 + bx + c$$

The function  $h$  is defined above, where  $a$ ,  $b$ , and  $c$  are integer constants. If the zeros of the function are  $-5$ ,  $6$ , and  $7$ , what is the value of  $c$ ?

**STOP**

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

**CONTINUE** 



# Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

## DIRECTIONS

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

## NOTES

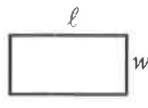
- The use of a calculator is permitted.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated, the domain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

## REFERENCE

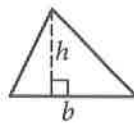


$$A = \pi r^2$$

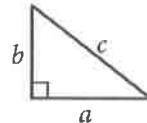
$$C = 2\pi r$$



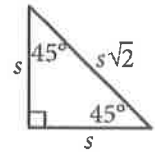
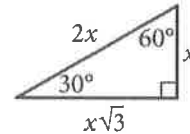
$$A = \ell w$$



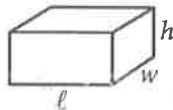
$$A = \frac{1}{2}bh$$



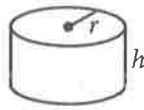
$$c^2 = a^2 + b^2$$



Special Right Triangles



$$V = \ell wh$$



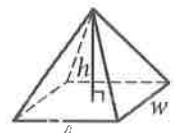
$$V = \pi r^2 h$$



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



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



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

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

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

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

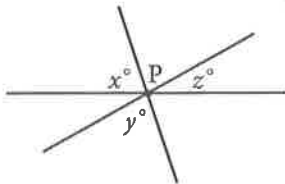


1

Makayla is planning an event in a 5,400-square-foot room. If there should be at least 8 square feet per person, what is the maximum number of people that could attend this event?

- A) 588
- B) 675
- C) 15,274
- D) 43,200

2



Note: Figure not drawn to scale.

In the figure, three lines intersect at point  $P$ . If  $x=65$  and  $y=75$ , what is the value of  $z$ ?

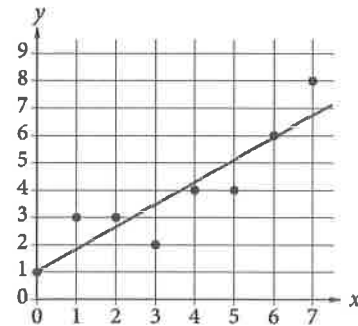
- A) 140
- B) 80
- C) 40
- D) 20

3

If  $\frac{1}{2}x - \frac{1}{6}x = 1$ , what is the value of  $x$ ?

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

4



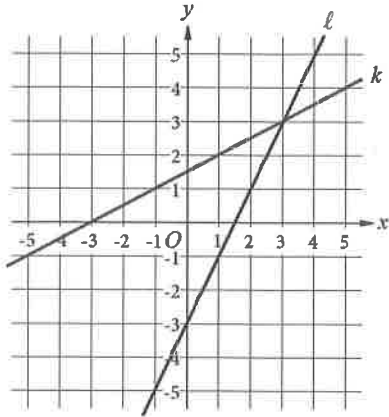
The scatterplot above shows eight data points in the  $xy$ -plane. A line of best fit is also shown for the data. If each data point is shifted 3 units upward and a new line of best fit for the shifted points is drawn, how will the value of the  $y$ -intercept of the new line compare with that of the line shown?

- A) It will increase.
- B) It will decrease.
- C) It will remain the same.
- D) There will no longer be a  $y$ -intercept.

CONTINUE



5



Lines  $\ell$  and  $k$  in the  $xy$ -plane above are the graphs of the equations in a system. How many solutions does the system of equations have?

- A) None
- B) One
- C) Two
- D) More than two

6

Gerardo has 3 blue shirts and  $w$  white shirts in his closet, and these are the only shirts in his closet. If Gerardo selects a shirt at random from his closet, which of the following gives the probability that Gerardo will select a white shirt?

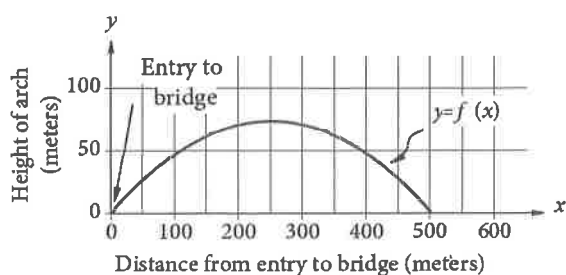
- A)  $\frac{w}{3+w}$
- B)  $\frac{3}{3+w}$
- C)  $\frac{w}{3}$
- D)  $\frac{3}{w}$



7

$$f(x) = -0.001160(x - 251.5)^2 + 73.37$$

The vertical height, in meters, of the upper arch of the Harbor Bridge in Sydney, Australia, above the roadway of the bridge can be modeled by the function above, where  $x$  is the horizontal distance along the roadway, in meters, from the entry to the bridge. The graph of  $y=f(x)$  is shown in the  $xy$ -plane below.



In the graph, the point  $(0, 0)$  represents the entry to the bridge. Which of the following points represents the exit from the bridge on the opposite end?

- A)  $(0, 73.37)$
- B)  $(0, 503.0)$
- C)  $(73.37, 0)$
- D)  $(503.0, 0)$

8

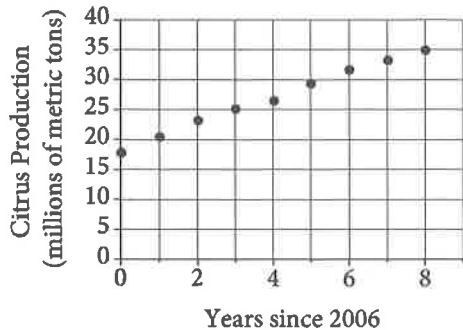
The graph of  $y=f(x)$  is a line in the  $xy$ -plane that passes through the point  $(0, 2)$  and has a slope of 5. Which of the following equations could define the function  $f$ ?

- A)  $f(x) = -\frac{1}{2}x + 5$
- B)  $f(x) = -\frac{1}{5}x + 2$
- C)  $f(x) = 2x + 5$
- D)  $f(x) = 5x + 2$



9

Citrus Production in China (2006-2014)



The scatterplot above shows the citrus production, in millions of metric tons, in China from 2006 through 2014. Which of the following could be the slope of a line of best fit for these data?

- A) 2.12
- B) 5.25
- C) 7.80
- D) 10.29

10

$$f(x) = (x+4)(x-1)(2x-3)$$

The function  $f$  is defined above. Which of the following is NOT an  $x$ -intercept of the graph of the function in the  $xy$ -plane?

- A)  $-4, 0$
- B)  $\left(-\frac{2}{3}, 0\right)$
- C)  $(1, 0)$
- D)  $\left(\frac{3}{2}, 0\right)$



Questions 11 and 12 refer to the following information

$t$	$C(t)$
1	8.5
2	11
3	13.5
4	16

The length  $C(t)$ , in inches, of a channel catfish in an Iowa river  $t$  years after the first year of life can be approximated by the linear function  $C$ . Some values of  $C(t)$  are given in the table above.

$$F(t) = 3t + 4$$

The length  $F(t)$ , in inches, of a flathead catfish in the same Iowa river  $t$  years after the first year of life can be approximated by the linear function  $F$ , defined by the equation above.

11

According to the model, which of the following is closest to the expected age, to the nearest whole year, of a flathead catfish that is 31 inches long?

- A) 10 years old
- B) 13 years old
- C) 98 years old
- D) 106 years old

12

Which of the following equations could define  $C$  as a function of  $t$ ?

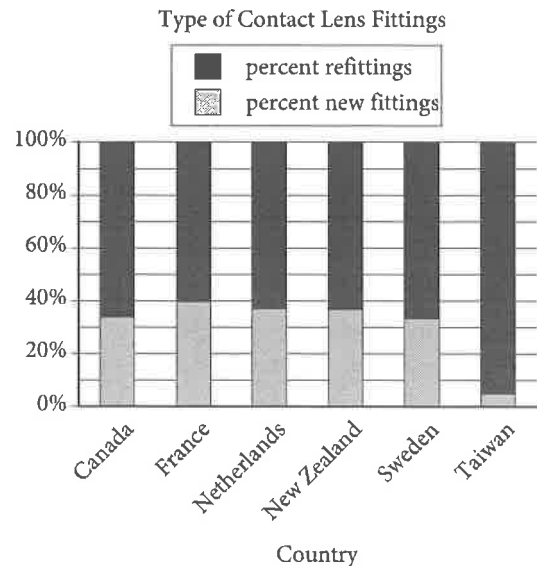
- A)  $C(t) = 2.5t + 6$
- B)  $C(t) = \frac{2}{5}t + 8.5$
- C)  $C(t) = 2.5t + 8.5$
- D)  $C(t) = \frac{2}{5}t + 8.1$





Questions 13 and 14 refer to the following information

Country	Total fittings	Mean age
Canada	936	34.6
France	1,470	34.9
Netherlands	943	35.0
New Zealand	721	36.3
Sweden	436	36.3
Taiwan	1,574	26.6



The results of an international survey of contact lens fittings during a given time period are summarized in the table and bar graph above. The table shows the number of total fittings and the mean age, in years, of the patients who were fitted for contact lenses during the time period. The total fittings consisted of new contact lens fittings and refittings. The bar graph shows the percent of the patients who received new fittings and the percent who received refittings.

13

What is the range, in years, of the mean ages of the patients surveyed who had contact lens fittings in the countries shown?

- A) 8.0
- B) 8.4
- C) 9.7
- D) 10.3

14

Of the following, which best approximates the number of patients surveyed who received refittings in New Zealand?

- A) 274
- B) 358
- C) 447
- D) 585

**CONTINUE**



15

A park ranger asked a random sample of visitors how far they hiked during their visit. Based on the responses, the estimated mean was found to be 4.5 miles, with an associated margin of error of 0.5 miles. Which of the following is the best conclusion from these data?

- A) It is likely that all visitors hiked between 4 and 5 miles.
- B) It is likely that most visitors hiked exactly 4.5 miles.
- C) It is not possible that any visitor hiked less than 3 miles.
- D) It is plausible that the mean distance hiked for all visitors is between 4 and 5 miles.

16

Observed Matings among Fruit Flies

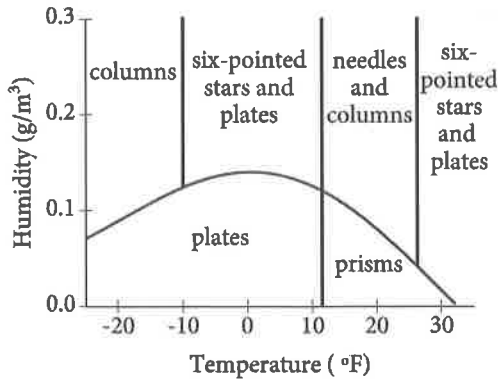
		Female fruit fly group		Total
		Female raised on starch	Female raised on maltose	
Male fruit fly group	Male raised on starch	22	9	31
	Male raised on maltose	8	20	28
Total		30	29	59

The table above shows the observed mating frequencies among a group of fruit flies raised on either a starch medium or a maltose medium. What fraction of the observed matings were between fruit flies that were raised on the same medium?

- A)  $\frac{9}{31}$
- B)  $\frac{17}{59}$
- C)  $\frac{31}{59}$
- D)  $\frac{42}{59}$



17



The figure above shows a graph with six regions that correspond to temperature, in degrees Fahrenheit ( $^{\circ}\text{F}$ ), and humidity conditions, in grams of water vapor per cubic meter of air ( $\text{g}/\text{m}^3$ ), that will result in different snow crystal shapes when the crystals are grown in a laboratory. Based on the graph, which of the following is a combination of temperature and humidity at which prisms will be formed?

- A)  $5^{\circ}\text{F}$  and  $0.15 \text{ g}/\text{m}^3$
- B)  $15^{\circ}\text{F}$  and  $0.18 \text{ g}/\text{m}^3$
- C)  $20^{\circ}\text{F}$  and  $0.02 \text{ g}/\text{m}^3$
- D)  $30^{\circ}\text{F}$  and  $0.08 \text{ g}/\text{m}^3$

18

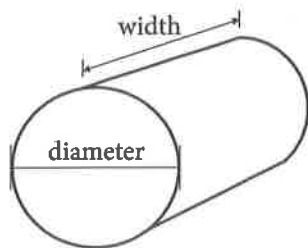
A sample of 40 fourth-grade students was selected at random from a certain school. The 40 students completed a survey about the morning announcements, and 32 thought the announcements were helpful. Which of the following is the largest population to which the results of the survey can be applied?

- A) The 40 students who were surveyed
- B) All fourth-grade students at the school
- C) All students at the school
- D) All fourth-grade students in the county in which the school is located



**Questions 19 and 20 refer to the following information**

Ryan is comparing five different hay balers (machines that make bales of hay). The bales made are all in the shape of a cylinder, as shown below.



The price of each hay baler and the dimensions of the bales of hay it makes are shown in the table below.

Hay baler	Bale diameter range	Bale width	Price
A	32-51 in	46 in	\$19,800
B	35-60 in	46 in	\$27,900
C	35-72 in	46 in	\$32,000
D	35-65 in	62 in	\$37,500
E	32-72 in	62 in	\$46,900

19

Of the following, which ratio is closest to the width of bales made by hay baler *A* to the width of bales made by hay baler *D*?

- A) 0.74:1
- B) 1.35:1
- C) 1.74:1
- D) 17:1

20

Which of the following is closest to the percent by which the price of hay baler *E* exceeds the price of hay baler *C*?

- A) 18.9%
- B) 31.8%
- C) 40.5%
- D) 46.6%



21

$$\begin{aligned}x - y &= 1 \\ x + y &= x^2 - 3\end{aligned}$$

Which ordered pair is a solution to the system of equations above?

- A)  $(1 + \sqrt{3}, \sqrt{3})$
- B)  $(\sqrt{3}, -\sqrt{3})$
- C)  $(1 + \sqrt{5}, \sqrt{5})$
- D)  $(\sqrt{5}, -1 + \sqrt{5})$

22

The graph of the exponential function  $g$  in the  $xy$ -plane passes through the points  $(0, 1)$ ,  $(1, 4)$ , and  $(2, 16)$ . Which of the following is NOT true?

- A) A line can be drawn that does not intersect the graph of  $g$ .
- B) A line can be drawn that intersects the graph of  $g$  at exactly one point.
- C) A line can be drawn that intersects the graph of  $g$  at exactly two points.
- D) A line can be drawn that intersects the graph of  $g$  at exactly three points.

23

In a right triangle, the tangent of one of the two acute angles is  $\frac{\sqrt{3}}{3}$ . What is the tangent of the other acute angle?

- A)  $-\frac{\sqrt{3}}{3}$
- B)  $-\frac{3}{\sqrt{3}}$
- C)  $\frac{\sqrt{3}}{3}$
- D)  $\frac{3}{\sqrt{3}}$

24

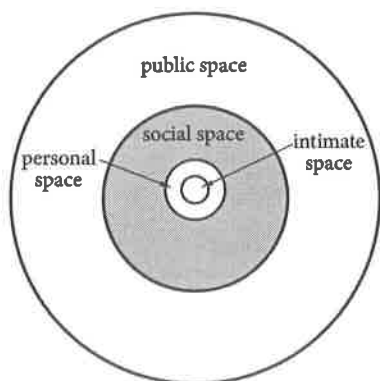
In the  $xy$ -plane, line  $\ell$  has a slope of 2. If line  $k$  is perpendicular to line  $\ell$ , which of the following could be an equation of line  $k$ ?

- A)  $-10x - 5y = 20$
- B)  $3x - 6y = 14$
- C)  $4x - 2y = 17$
- D)  $6x + 12y = 36$

CONTINUE 



25



Note: Figure not drawn to scale.

The diagram above represents Edward T. Hall's concept of space surrounding a person defined by four nonoverlapping regions. Intimate space is the region inside a circle of radius 1 foot. Personal space is the region within a circle of radius 4 feet but outside intimate space. Social space is the region within a circle of radius 12 feet but outside personal space. Public space is the region within a circle of radius 25 feet but outside social space. What is the area, in square feet, of the shaded region representing a person's social space?

- A)  $127\pi$
- B)  $128\pi$
- C)  $144\pi$
- D)  $625\pi$

26

Anita created a batch of green paint by mixing 2 ounces of blue paint with 3 ounces of yellow paint. She must mix a second batch using the same ratio of blue and yellow paint as the first batch. If she uses 5 ounces of blue paint for the second batch, how much yellow paint should Anita use?

- A) Exactly 5 ounces
- B) 3 ounces more than the amount of yellow paint used in the first batch
- C) 1.5 times the amount of yellow paint used in the first batch
- D) 1.5 times the amount of blue paint used in the second batch

27

$$ax - 4(3 + 2x) = -12$$

In the equation above,  $a$  is a constant. For what value of  $a$  does the equation have infinitely many solutions?

- A)  $-8$
- B)  $-2$
- C)  $2$
- D)  $8$



28

The wholesale price of a kilogram of lentils decreased by 1% from the previous month for six consecutive months. If  $x$  is the number of months since the price began to drop and  $y$  is the cost of a kilogram of lentils, which of the following equations could model the cost of lentils over this time period?

- A)  $y = 0.99x + 1.65$
- B)  $y = 1.01x + 1.65$
- C)  $y = 1.65(0.99)^x$
- D)  $y = 1.65(1.01)^x$

29

$$\frac{2}{x-2} + \frac{3}{x+5} = \frac{rx+t}{(x-2)(x+5)}$$

The equation above is true for all  $x > 2$ , where  $r$  and  $t$  are positive constants. What is the value of  $rt$ ?

- A)  $-20$
- B)  $15$
- C)  $20$
- D)  $60$

30

If  $ax + a = 3$ , where  $a$  is a nonzero constant, which of the following must be equal to  $x+1$ ?

- A)  $3$
- B)  $a$
- C)  $3a$
- D)  $\frac{3}{a}$

CONTINUE 

**DIRECTIONS**

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

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

Write answer in boxes. →

Grid in result. ←

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

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

← Fraction line

Answer: 2.5

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

← Decimal point

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

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

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

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

Answer: 201 – either position is correct

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

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

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



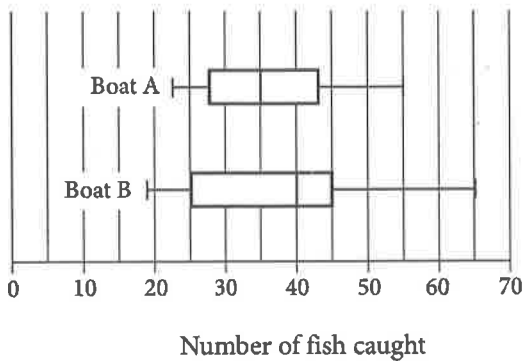


31

$$\sqrt{x+4} = 11$$

What value of  $x$  satisfies the equation above?

32



The box plots above summarize the distribution of the number of fish caught each day on two commercial fishing boats for a season. By how many fish does the median number of fish caught each day on Boat B exceed the median number on Boat A?

33

If  $a$  is the mean and  $b$  is the median of nine consecutive integers, what is the value of  $|a-b|$ ?

34

$$y = -16t^2 + 64t + 80$$

The equation above gives the height of an object above the ground,  $y$ , in feet,  $t$  seconds after it is launched from a platform. How many seconds after it is launched does the object reach the ground?



35

$$I = \frac{V}{R}$$

The formula above is Ohm's law for an electric circuit with current  $I$ , in amperes, potential difference  $V$ , in volts, and resistance  $R$ , in ohms. A circuit has a resistance of 500 ohms, and its potential difference will be generated by  $n$  six-volt batteries that produce a total potential difference of  $6n$  volts. If the circuit is to have a current of no more than 0.25 ampere, what is the greatest number,  $n$ , of six-volt batteries that can be used?

36

In the  $xy$ -plane, line  $k$  intersects the  $y$ -axis at the point  $(0, -6)$  and passes through the point  $(2, 2)$ . If the point  $(20, w)$  lies on line  $k$ , what is the value of  $w$ ?

37

In a science classroom, when labs are performed, students are seated at lab tables. If the teacher assigns 2 students to each lab table, 4 additional lab tables will be needed to seat all of the students. If the teacher assigns 4 students to each lab table, 4 lab tables will not be used. How many students are in the science class?

38

The number  $y$  is 20% greater than the number  $x$ . The number  $z$  is 20% less than  $y$ . The number  $z$  is how many times  $x$ ?

**STOP**

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

**CONTINUE** 

**No Test Material On This Page**



# SAT<sup>®</sup> March 2019 US



## ESSAY BOOK

### DIRECTIONS

The essay gives you an opportunity to show how effectively you can read and comprehend a passage and write an essay analyzing the passage. In your essay, you should demonstrate that you have read the passage carefully, present a clear and logical analysis, and use language precisely.

Your essay must be written on the lines provided in your answer booklet; except for the Planning Page of the answer booklet, you will receive no other paper on which to write. You will have enough space if you write on every line, avoid wide margins, and keep your handwriting to a reasonable size. Remember that people who are not familiar with your handwriting will read what you write. Try to write or print so that what you are writing is legible to those readers.

**You have 50 minutes to read the passage and write an essay in response to the prompt provided inside this booklet.**

### REMINDERS

- Do not write your essay in this booklet. Only what you write on the lined pages of your answer booklet will be evaluated.
- An off-topic essay will not be evaluated.

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As you read the passage below, consider how authors uses

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

Adapted from Lawrence Norden and Christopher Famighetti, "Aging Voting Machines Are a Threat to Democracy" ©2016 by huffingtonpost.com. Originally published September 28, 2016.

- 1 It should not be difficult to rally our elected leaders to remedy an eminently fixable problem threatening our democracy: the looming crisis resulting from our nation's outdated voting machines.
- 2 In the vast majority of states, aging voting machines are approaching the end of their useful lives. To continue to use this equipment past its projected lifespan could be disastrous. After years of wear-and-tear, machine parts like motherboards, memory cards, and touch screens begin to fail. When this happens on Election Day, machines must be taken out of service. Voters can be forced to wait in line—sometimes for hours—while repairs are made or machines substituted.
- 3 This can only shake confidence in the electoral process, and in worst case scenarios can impact election results. In the 2012 election, according a study by political scientists from Harvard and MIT, between 500,000 and 700,000 votes were lost nationally because of long lines. Absent action to replace or upgrade machines, this problem will only grow worse.
- 4 A little history is in order. After the 2000 presidential election debacle, involving "hanging chads" on paper ballots in Florida, Congress passed a law allocating more than \$2 billion to the states to replace obsolete voting equipment. By 2006, the vast majority of election jurisdictions had deployed new machines.
- 5 Voting system experts agree that most machines purchased since 2000 have a projected lifespan of between 10 and 15 years. Today, 43 states are using systems that will be at least 10 years old in 2016; 14 are using machines that will be at least 15 years old. No one expects a laptop computer to last for 10 years. It is wrong to expect these electronic voting machines, many of which use laptop technology from the 1990s, to last much longer.
- 6 For a high-profile example of what can go wrong with antiquated machines consider Virginia's 2014 election. Following reports of machines crashing or registering votes incorrectly, the state Board of Elections commissioned an expert review to look at 27 malfunctioning touch screen machines. In 26 of them, they found the glue holding the touch screens in place had degraded, knocking them out of alignment so votes were not recorded properly. That problem may not be limited to Virginia. The same model of this antiquated machine is still used in 20 states.

- 7 Security is another problem with older machines. In a related investigation, looking at a different machine, Virginia investigators found wireless cards that could allow “an external party to access the [machine] and modify the data without notice from a nearby location.”
- 8 In the years since those machines were purchased, much has been learned about how to design voting systems that are more user friendly and accessible to all. We have developed techniques that can audit the count of paper ballots, to ensure that the software on new machines is correctly tallying votes.
- 9 As it is, maintaining the outdated machines used today is often a struggle. As voting systems age, the parts necessary to support them go out of production. Some election officials have to resort to finding parts on eBay.
- 10 It is too late for most jurisdictions to acquire new voting machines in time for the 2016 election. But that does not mean there is time to waste. To ensure new machines are in place before 2018 or even 2020, planning and budgeting must begin immediately.
- 11 Even in the absence of new machines, there are important steps that states and counties can take in the next several months to reduce failures or minimize their impact on voting next November. Officials should test every voting machine before Election Day to catch problems ahead of time. Training poll workers on how to deal with machine problems is also critical. Poll workers who know what to do in case of machine problems can make the difference between a major Election Day fiasco and a brief delay.
- 12 Of course, the fragile state of voting machines is no secret to those election officials who need to replace them. What too many lack is the money to do so.
- 13 Congress has a role to play. As it did 13 years ago, Washington should provide an infusion of money to help purchase new machines. But today, few in Congress of either party are talking about this problem. Realistically, given how soon action needs to be taken, states are going to have to provide the majority of funds. At a moment of intense budget pressures, replacing all of the aging machines will not be cheap—the total cost could easily reach \$1 billion nationwide. But even in tough budget times, this is an essential investment. The mechanics of democracy are too important to rely on outdated systems that are increasingly prone to failure.

Write an essay in which you explain how authors build an argument to persuade her audience that the outdated U.S. voting machines should be replaced. In your essay, analyze how Lawrence Norden and Christopher Famighetti use one or more of the features listed in the box above (or features of your own choice) to strengthen the logic and persuasiveness of her argument. Be sure that your analysis focuses on the most relevant features of the passage.

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

YOUR NAME (PRINT) .....

LAST

FIRST

MI

TEST CENTER .....

NUMBER

NAME OF TEST CENTER

ROOM NUMBER

# The SAT

## GENERAL DIRECTIONS

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

## MARKING ANSWERS

- Be sure to mark your answer sheet properly.

COMPLETE MARK ● EXAMPLES OF INCOMPLETE MARKS



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

## USING YOUR TEST BOOK

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

## SCORING

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

## IMPORTANT

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

9	TEST ID					
	(Copy from back of test book.)					

8	FORM CODE					
	(Copy and grid as on back of test book.)					
A	A	A	A	0	0	0
B	B	B	B	1	1	1
C	C	C	C	2	2	2
D	D	D	D	3	3	3
E	E	E	E	4	4	4
F	F	F	F	5	5	5
G	G	G	G	6	6	6
H	H	H	H	7	7	7
I	I	I	I	8	8	8
J	J	J	J	9	9	9
K	K	K	K			
L	L	L	L			
M	M	M	M			
N	N	N	N			
O	O	O	O			
P	P	P	P			
Q	Q	Q	Q			
R	R	R	R			
S	S	S	S			
T	T	T	T			
U	U	U	U			
V	V	V	V			
W	W	W	W			
X	X	X	X			
Y	Y	Y	Y			
Z	Z	Z	Z			

Follow this link for more information on scoring your practice test:  
[www.sat.org/scoring](http://www.sat.org/scoring)

**DO NOT OPEN THIS BOOK UNTIL THE SUPERVISOR TELLS YOU TO DO SO.**

# 3/9/2019 SAT QAS

WRITING		READING		NO CALC		CALC	
1	A	1	A	1	D	1	B
2	D	2	B	2	B	2	C
3	B	3	C	3	A	3	C
4	C	4	B	4	A	4	A
5	D	5	A	5	C	5	B
6	C	6	A	6	B	6	A
7	C	7	D	7	C	7	D
8	A	8	C	8	D	8	D
9	B	9	D	9	B	9	A
10	C	10	D	10	B	10	B
11	D	11	C	11	A	11	A
12	A	12	D	12	C	12	A
13	B	13	A	13	C	13	C
14	B	14	D	14	D	14	C
15	B	15	B	15	C	15	D
16	D	16	A	16	4.5, 9/2	16	D
17	A	17	C	17	11	17	C
18	B	18	C	18	1220	18	B
19	D	19	B	19	7/3, 2.33	19	A
20	A	20	D	20	210	20	D
21	C	21	B			21	A
22	B	22	A			22	D
23	C	23	D			23	D
24	D	24	C			24	D
25	A	25	B			25	B
26	C	26	A			26	D
27	D	27	C			27	D
28	B	28	A			28	C
29	B	29	D			29	C
30	A	30	B			30	D
31	B	31	D			31	117
32	D	32	A			32	5
33	A	33	B			33	0
34	D	34	C			34	5
35	C	35	C			35	20
36	C	36	A			36	74
37	C	37	A			37	32
38	D	38	D			38	.96, 24/25
39	A	39	B				
40	D	40	A				
41	D	41	B				
42	B	42	D				
43	A	43	C				
44	B	44	C				
		45	D				
		46	A				
		47	B				
		48	A				
		49	D				
		50	D				
		51	C				
		52	D				

## CURVE

3/9/19 US (QAS)			
	W	R	M
-1	39	39	790
-2	38	38	770
-3	37	38	760
-4	35	37	740
-5	35	36	730
-6	34	35	720