

# The SAT Practice Test #8

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# The SAT<sup>®</sup>

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# Practice Test #8

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# Reading Test

## 65 MINUTES, 52 QUESTIONS

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

### DIRECTIONS

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

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

This passage is from Carlos Ruiz Zafón, *The Angel's Game*. ©2008 by Dragonworks, S.L. Translation ©2009 by Lucia Graves. The narrator, a writer, recalls his childhood in early twentieth-century Barcelona.

Even then my only friends were made of paper and ink. At school I had learned to read and write long before the other children. Where my school friends saw notches of ink on incomprehensible 5 pages, I saw light, streets, and people. Words and the mystery of their hidden science fascinated me, and I saw in them a key with which I could unlock a boundless world, a safe haven from that home, those streets, and those troubled days in which even I 10 could sense that only a limited fortune awaited me. My father didn't like to see books in the house. There was something about them—apart from the letters he could not decipher—that offended him. He used to tell me that as soon as I was ten he would 15 send me off to work and that I'd better get rid of all my scatterbrained ideas if I didn't want to end up a loser, a nobody. I used to hide my books under the mattress and wait for him to go out or fall asleep so that I could read. Once he caught me reading at night 20 and flew into a rage. He tore the book from my hands and flung it out of the window.

"If I catch you wasting electricity again, reading all this nonsense, you'll be sorry."

My father was not a miser and, despite the 25 hardships we suffered, whenever he could he gave me a few coins so that I could buy myself some treats like

the other children. He was convinced that I spent them on licorice sticks, sunflower seeds, or sweets, but I would keep them in a coffee tin under the bed, 30 and when I'd collected four or five reales I'd secretly rush out to buy myself a book.

My favorite place in the whole city was the Sempere & Sons bookshop on Calle Santa Ana. It smelled of old paper and dust and it was my 35 sanctuary, my refuge. The bookseller would let me sit on a chair in a corner and read any book I liked to my heart's content. He hardly ever allowed me to pay for the books he placed in my hands, but when he wasn't looking I'd leave the coins I'd managed to 40 collect on the counter before I left. It was only small change—if I'd had to buy a book with that pittance, I would probably have been able to afford only a booklet of cigarette papers. When it was time for me to leave, I would do so dragging my feet, a weight on 45 my soul. If it had been up to me, I would have stayed there forever.

One Christmas Sempere gave me the best gift I have ever received. It was an old volume, read and experienced to the full.

50 "Great Expectations, by Charles Dickens," I read on the cover.

I was aware that Sempere knew a few authors who frequented his establishment and, judging by the care with which he handled the volume, I thought 55 perhaps this Mr. Dickens was one of them.

"A friend of yours?"

"A lifelong friend. And from now on, he's your friend too."

That afternoon I took my new friend home,  
 60 hidden under my clothes so that my father wouldn't see it. It was a rainy winter, with days as gray as lead, and I read *Great Expectations* about nine times, partly because I had no other book at hand, partly because I did not think there could be a better one in  
 65 the whole world and I was beginning to suspect that Mr. Dickens had written it just for me. Soon I was convinced that I didn't want to do anything else in life but learn to do what Mr. Dickens had done.

1

Over the course of the passage, the main focus shifts from a

- A) general discussion of the narrator's love of reading to a portrayal of an influential incident.
- B) depiction of the narrator's father to an examination of an author with whom the narrator becomes enchanted.
- C) symbolic representation of a skill the narrator possesses to an example of its application.
- D) tale about the hardships of the narrator's childhood to an analysis of the effects of those hardships.

2

The main purpose of lines 1-10 ("Even . . . awaited me") is to

- A) introduce the characters who play a part in the narrator's story.
- B) list the difficult conditions the narrator endured in childhood.
- C) describe the passion that drives the actions the narrator recounts.
- D) depict the narrator's aspirations before he met Sempere.

3

With which of the following statements about his father would the narrator most likely agree?

- A) He lacked affection for the narrator.
- B) He disliked any unnecessary use of money.
- C) He would not have approved of Sempere's gift.
- D) He objected to the writings of Charles Dickens.

4

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

- A) Lines 24-27 ("My father . . . children")
- B) Lines 35-37 ("The bookseller . . . content")
- C) Lines 37-38 ("He hardly . . . hands")
- D) Lines 59-61 ("That afternoon . . . see it")

5

It can reasonably be inferred from the passage that the main reason that the narrator considers *Great Expectations* to be the best gift he ever received is because

- A) reading the book convinced him that he wanted to be a writer.
- B) he'd only ever been given sweets and snacks as gifts in the past.
- C) the gift meant that Sempere held him in high regard.
- D) Sempere was a friend of the book's author.

6

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

- A) Lines 38-40 ("when . . . left")
- B) Lines 48-49 ("It was . . . full")
- C) Lines 52-55 ("I was . . . them")
- D) Lines 66-68 ("Soon . . . done")

3

7

- The narrator indicates that he pays Sempere
- less than Sempere expects him to pay for the books.
  - nothing, because Sempere won't take his money.
  - the money he makes selling sweets to the other children.
  - much less for the books than they are worth.

8

- As used in line 44, "weight" most nearly means
- bulk.
  - burden.
  - force.
  - clout.

9

- The word "friend" is used twice in lines 57-58 to
- underline the importance of the narrator's connection to Sempere.
  - stress how friendships helped the narrator deal with his difficult home situation.
  - emphasize the emotional connection Sempere feels to reading.
  - imply that the narrator's sentiments caused him to make an irrational decision.

10

- Which statement best characterizes the relationship between Sempere and Charles Dickens?
- Sempere models his own writing after Dickens's style.
  - Sempere is an avid admirer of Dickens's work.
  - Sempere feels a personal connection to details of Dickens's biography.
  - Sempere considers himself to be Dickens's most appreciative reader.

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

This passage is adapted from Jeffrey Mervis, "Why Null Results Rarely See the Light of Day." ©2014 by American Association for the Advancement of Science.

The question of what to do with null results—when researchers fail to see an effect that should be detectable—has long been hotly debated among those conducting medical trials, where the results can have a big impact on lives and corporate bottom lines. More recently, the debate has spread to the social and behavioral sciences, which also have the potential to sway public and social policy. There were little hard data, however, on how often or why null results were squelched. "Yes, it's true that null results are not as exciting," political scientist Gary King of Harvard University says. "But I suspect another reason they are rarely published is that there are many, many ways to produce null results by messing up. So they are much harder to interpret."

In a recent study, Stanford political economist Neil Malhotra and two of his graduate students examined every study since 2002 that was funded by a competitive grants program called TESS (Time-sharing Experiments for the Social Sciences). TESS allows scientists to order up Internet-based surveys of a representative sample of US adults to test a particular hypothesis (for example, whether voters tend to favor legislators who boast of bringing federal dollars to their districts over those who tout a focus on policy matters).

Malhotra's team tracked down working papers from most of the experiments that weren't published, and for the rest asked grantees what had happened to their results. In their e-mailed responses, some scientists cited deeper problems with a study or more pressing matters—but many also believed the journals just wouldn't be interested. "The unfortunate reality of the publishing world [is] that null effects do not tell a clear story," said one scientist. Said another, "Never published, definitely disappointed to not see any major effects."

Their answers suggest to Malhotra that rescuing findings from the file drawer will require a shift in expectations. "What needs to change is the culture—the author's belief about what will happen if the research is written up," he says.

Not unexpectedly, the statistical strength of the findings made a huge difference in whether they were ever published. Overall, 42% of the experiments

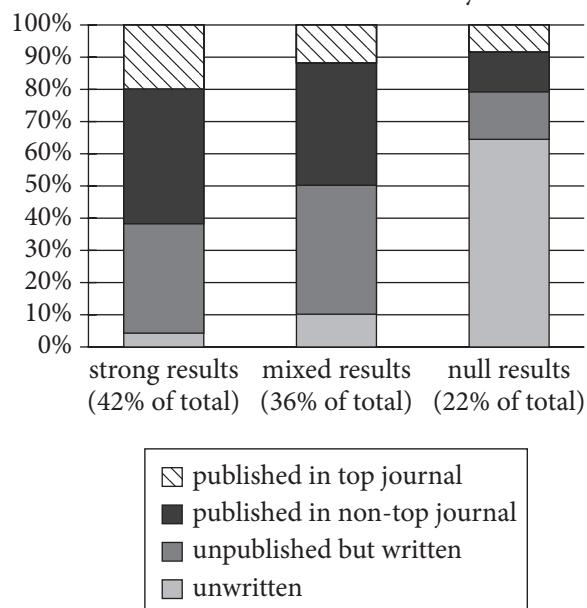
produced statistically significant results. Of those, 62% were ultimately published, compared with 21% of the null results. However, the Stanford team was surprised that researchers didn't even write up 50 65% of the experiments that yielded a null finding.

Scientists not involved in the study praise its "clever" design. "It's a very important paper" that "starts to put numbers on things we want to understand," says economist Edward Miguel of the 55 University of California, Berkeley.

He and others note that the bias against null studies can waste time and money when researchers devise new studies replicating strategies already found to be ineffective. Worse, if researchers publish 60 significant results from similar experiments in the future, they could look stronger than they should because the earlier null studies are ignored. Even more troubling to Malhotra was the fact that two scientists whose initial studies "didn't work out" 65 went on to publish results based on a smaller sample. "The non-TESS version of the same study, in which we used a student sample, did yield fruit," noted one investigator.

A registry for data generated by all experiments 70 would address these problems, the authors argue. They say it should also include a "preanalysis" plan, that is, a detailed description of what the scientist hopes to achieve and how the data will be analyzed. Such plans would help deter researchers from 75 tweaking their analyses after the data are collected in search of more publishable results.

Fates of Social Science Studies by Results



Adapted from Annie Franco, Neil Malhotra, and Gabor Simonovits, "Publication Bias in the Social Sciences: Unlocking the File Drawer." ©2014 by American Association for the Advancement of Science.

11

The passage primarily serves to

- A) discuss recent findings concerning scientific studies and dispute a widely held belief about the publication of social science research.
- B) explain a common practice in the reporting of research studies and summarize a study that provides support for a change to that practice.
- C) describe the shortcomings in current approaches to medical trials and recommend the implementation of a government database.
- D) provide context as part of a call for stricter controls on social science research and challenge publishers to alter their mindsets.

12

As used in line 21, “allows” most nearly means

- A) admits.
- B) tolerates.
- C) grants.
- D) enables.

13

As used in line 43, “strength” most nearly means

- A) attribution.
- B) exertion.
- C) toughness.
- D) significance.

14

The passage indicates that a problem with failing to document null results is that

- A) the results of related studies will be misleading.
- B) researchers may overlook promising areas of study.
- C) mistakes in the collection of null results may be overlooked.
- D) the bias against null results will be disregarded.

15

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

- A) Lines 38-40 (“Their . . . expectations”)
- B) Lines 48-50 (“However . . . finding”)
- C) Lines 56-59 (“He and . . . ineffective”)
- D) Lines 59-62 (“Worse . . . ignored”)

16

Based on the passage, to which of the following hypothetical situations would Malhotra most strongly object?

- A) A research team refuses to publish null results in anything less than a top journal.
- B) A research team excludes the portion of data that produced null results when reporting its results in a journal.
- C) A research team unknowingly repeats a study that produced null results for another research team.
- D) A research team performs a follow-up study that expands the scope of an initial study that produced null results.

17

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

- A) Lines 36-37 (“Said . . . effects”)
- B) Lines 45-48 (“Overall . . . null results”)
- C) Lines 62-68 (“Even . . . investigator”)
- D) Lines 69-73 (“A registry . . . analyzed”)

18

The last paragraph serves mainly to

- A) propose a future research project to deal with some of the shortcomings of current publishing practices noted in the passage.
- B) introduce a possible solution to problems discussed in the passage regarding the reporting of social science studies.
- C) summarize the findings of a study about experimental results explained in the passage.
- D) reinforce the importance of reexamining the results of all social science trials.

19

According to the graph, social science studies yielding strong results were

- A) unwritten over 50 percent of the time.
- B) unpublished but written 50 percent of the time.
- C) published in a top journal approximately 20 percent of the time.
- D) published in a non-top journal almost 80 percent of the time.

20

Which of the following statements is supported by the graph?

- A) Studies with mixed results were just as likely to be published as they were to be left either unpublished or unwritten.
- B) Studies with mixed results occurred more frequently than did studies with strong and null results combined.
- C) Studies with mixed results were more likely to be published in top journals than they were to be published in non-top journals.
- D) Studies with mixed results were the most common type of social science studies.

21

Which statement from the passage is most directly reflected by the data presented in the graph?

- A) Lines 30-33 (“In their . . . interested”)
- B) Lines 33-36 (“The unfortunate . . . scientist”)
- C) Lines 43-45 (“Not unexpectedly . . . published”)
- D) Lines 52-55 (“It’s a . . . Berkeley”)

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

This passage is adapted from Rachel Ehrenberg, "Salt Stretches in Nanoworld." ©2009 by Society for Science & the Public. The "nanoworld" is the world observed on a scale one billionth that of ordinary human experience.

Inflexible old salt becomes a softy in the nanoworld, stretching like taffy to more than twice its length, researchers report. The findings may lead *Line* to new approaches for making nanowires that could end up in solar cells or electronic circuits. The work also suggests that these ultra-tiny salt wires may already exist in sea spray and large underground salt deposits.

"We think nanowires are special and go to great lengths to make them," says study coauthor Nathan Moore of Sandia National Laboratories in Albuquerque. "Maybe they are more common than we think."

Metals such as gold or lead, in which bonding angles are loosey-goosey, can stretch out at temperatures well below their melting points. But scientists don't expect this superplasticity in a rigid, crystalline material like salt, Moore says.

This unusual behavior highlights that different forces rule the nanoworld, says theoretical physicist Krzysztof Kempa of Boston College. "Forget about gravity. It plays no role," he says. Surface tension and electrostatic forces are much more important at this scale.

Moore and his colleagues discovered salt's stretchiness accidentally. They were investigating how water sticks to a surface such as salt and created a super-dry salt sample for testing. After cleaving a chunk of salt about the size of a sugar cube with a razor, the scientists guided a microscope that detects forces toward the surface. When the tip was far away there was no measured force, but within about seven nanometers a very strong attraction rapidly developed between the diamond tip of the microscope and the salt. The salt actually stretched out to glom on to the microscope tip. Using an electron microscope to see what was happening, the researchers observed the nanowires.

The initial attraction between the tip and salt might be due to electrostatic forces, perhaps good old van der Waals interactions,<sup>1</sup> the researchers

speculate. Several mechanisms might lead to the elasticity, including the excessive surface tension found in the nanoworld (the same tension that allows a water strider to skim the surface of a pond).

The surface tension is so strong that as the microscope pulls away from the salt, the salt stretches, Kempa says. "The inside has no choice but to rearrange the atoms, rather than break," he says.

*50* This bizarre behavior is actually mirrored in the macroworld, the researchers say. Huge underground deposits of salt can bend like plastic, but water is believed to play a role at these scales. Perhaps salty nanowires are present in these deposits as well.

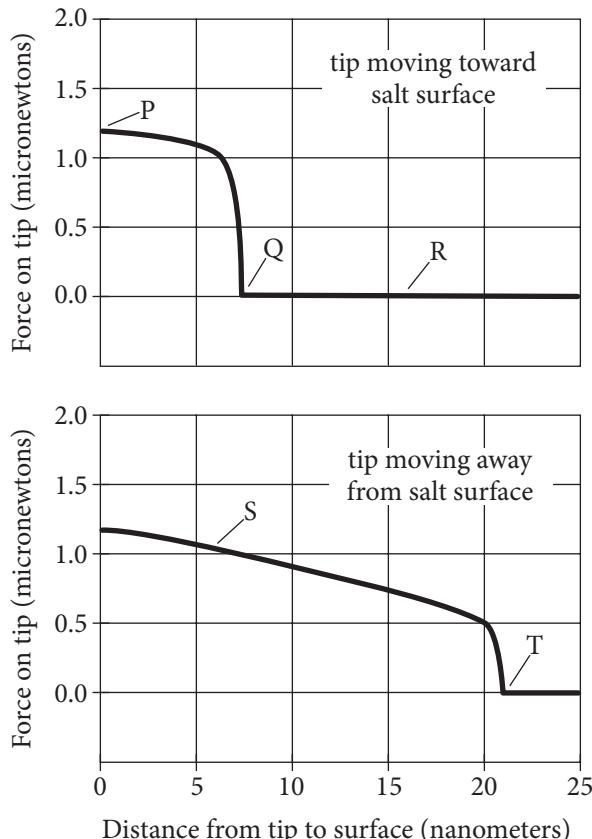
*55* "Sodium chloride<sup>2</sup> is everywhere—in the air, in our bodies," Moore says. "This may change our view of things, of what's happening at the nanoscale."

The work also suggests new techniques for making nanowires, which are often created through *60* nano-imprinting techniques, Kempa says. "We invoke the intuition of the macroworld," he says. "Maybe instead of stamping [nanowires] we should be nano-pulling them."

<sup>1</sup> Attractive forces between nearby atoms

<sup>2</sup> Common salt

Interaction of Microscope Tip with Salt Surface



Adapted from Moore et al., "Superplastic Nanowires Pulled from the Surface of Common Salt." ©2009 by American Chemical Society.

22

One central idea of the passage is that

- A) sometimes materials behave contrary to expectations.
- B) systems can be described in terms of inputs and outputs.
- C) models of materials have both strengths and weaknesses.
- D) properties of systems differ from the properties of their parts.

23

Which choice best describes the overall structure of the passage?

- A) A list of several ways in which salt's properties differ from researchers' expectations
- B) A presentation of a hypothesis regarding salt behavior, description of an associated experiment, and explanation of why the results weaken the hypothesis
- C) A description of two salt crystal experiments, the apparent disagreement in their results, and the resolution by more sensitive equipment
- D) An introduction to an interesting salt property, description of its discovery, and speculation regarding its application

24

Which choice provides the best evidence for the claim that Moore's group was surprised to observe salt stretching?

- A) Lines 17-18 ("But . . . says")
- B) Lines 26-28 ("They were . . . testing")
- C) Lines 36-38 ("Using . . . nanowires")
- D) Lines 55-56 ("Sodium . . . says")

25

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

- A) mark.
- B) control.
- C) declare.
- D) restrain.

26

According to the passage, researchers have identified which mechanism as potentially responsible for the initial attraction between the microscope tip and the salt?

- A) Gravity
- B) Nano-imprinting
- C) Surface tension
- D) Van der Waals interactions

27

As used in line 42, “lead to” most nearly means

- A) guide to.
- B) result in.
- C) point toward.
- D) start with.

28

Based on the passage, which choice best describes the relationship between salt behavior in the nanoworld and in the macroworld?

- A) In both the nanoworld and the macroworld, salt can be flexible.
- B) Salt flexibility is expected in the nanoworld but is surprising in the macroworld.
- C) Salt nanowires were initially observed in the nanoworld and later observed in the macroworld.
- D) In the nanoworld, salt’s interactions with water lead to very different properties than they do in the macroworld.

29

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

- A) Lines 12-13 (“Maybe . . . think”)
- B) Lines 22-24 (“Surface . . . scale”)
- C) Lines 39-42 (“The initial . . . speculate”)
- D) Lines 51-53 (“Huge . . . scales”)

30

According to the information in the graph, when the microscope tip is moving away from the salt surface and is 15 nanometers from the surface, what is the approximate force on the microscope tip, in microneutrons?

- A) 0
- B) 0.25
- C) 0.75
- D) 1.25

31

Based on the passage and the graph, which label on the graph indicates the point at which a salt nanowire breaks?

- A) P
- B) Q
- C) R
- D) T

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

These passages are adapted from the Lincoln-Douglas debates. Passage 1 is from a statement by Stephen Douglas. Passage 2 is from a statement by Abraham Lincoln. Douglas and Lincoln engaged in a series of debates while competing for a US Senate seat in 1858.

**Passage 1**

Mr. Lincoln likens that bond of the Federal Constitution, joining Free and Slave States together, to a house divided against itself, and says that it is *Line* contrary to the law of God, and cannot stand.

5 When did he learn, and by what authority does he proclaim, that this Government is contrary to the law of God and cannot stand? It has stood thus divided into Free and Slave States from its organization up to this day. During that period we have increased from 10 four millions to thirty millions of people; we have extended our territory from the Mississippi to the Pacific Ocean; we have acquired the Floridas and Texas, and other territory sufficient to double our geographical extent; we have increased in population, 15 in wealth, and in power beyond any example on earth; we have risen from a weak and feeble power to become the terror and admiration of the civilized world; and all this has been done under a Constitution which Mr. Lincoln, in substance, says is 20 in violation of the law of God; and under a Union divided into Free and Slave States, which Mr. Lincoln thinks, because of such division, cannot stand. Surely, Mr. Lincoln is a wiser man than those who framed the Government. . . .

25 I now come back to the question, why cannot this Union exist forever, divided into Free and Slave States, as our fathers made it? It can thus exist if each State will carry out the principles upon which our institutions were founded; to wit, the right of each 30 State to do as it pleases, without meddling with its neighbors. Just act upon that great principle, and this Union will not only live forever, but it will extend and expand until it covers the whole continent, and makes this confederacy one grand, ocean-bound 35 Republic. We must bear in mind that we are yet a young nation, growing with a rapidity unequalled in the history of the world, that our national increase is great, and that the emigration from the old world is increasing, requiring us to expand and acquire new 40 territory from time to time, in order to give our people land to live upon. If we live upon the principle

of State rights and State sovereignty, each State regulating its own affairs and minding its own business, we can go on and extend indefinitely, just 45 as fast and as far as we need the territory. . . .

**Passage 2**

In complaining of what I said in my speech at Springfield, in which he says I accepted my nomination for the Senatorship . . . he again quotes that portion in which I said that “a house divided 50 against itself cannot stand.” Let me say a word in regard to that matter. He tries to persuade us that there must be a variety in the different institutions of the States of the Union; that that variety necessarily proceeds from the variety of soil, climate, of the face 55 of the country, and the difference in the natural features of the States. I agree to all that. Have these very matters ever produced any difficulty among us? Not at all. Have we ever had any quarrel over the fact that they have laws in Louisiana designed to regulate 60 the commerce that springs from the production of sugar? Or because we have a different class relative to the production of flour in this State? Have they produced any differences? Not at all. They are the very cements of this Union. They don’t make the 65 house a “house divided against itself.” They are the props that hold up the house and sustain the Union.

But has it been so with this element of slavery? Have we not always had quarrels and difficulties over it? And when will we cease to have quarrels over it? 70 Like causes produce like effects. It is worth while to observe that we have generally had comparative peace upon the slavery question, and that there has been no cause for alarm until it was excited by the effort to spread it into new territory. Whenever it has 75 been limited to its present bounds, and there has been no effort to spread it, there has been peace. All the trouble and convulsion has proceeded from efforts to spread it over more territory. It was thus at the date of the Missouri Compromise. It was so again 80 with the annexation of Texas; so with the territory acquired by the Mexican War; and it is so now. Whenever there has been an effort to spread it there has been agitation and resistance. . . . Do you think that the nature of man will be changed, that the same 85 causes that produced agitation at one time will not have the same effect at another?

32

In the first paragraph of Passage 1, the main purpose of Douglas’s discussion of the growth of the territory and population of the United States is to

- A) provide context for Douglas’s defense of continued expansion.
- B) suggest that the division into free and slave states does not endanger the Union.
- C) imply that Lincoln is unaware of basic facts concerning the country.
- D) account for the image of the United States as powerful and admirable.

33

What does Passage 1 suggest about the US government’s provisions for the institution of slavery, as framed in the Constitution?

- A) They included no means for reconciling differences between free states and slave states.
- B) They anticipated the Union’s expansion into western territories.
- C) They provided a good basic structure that does not need to be changed.
- D) They were founded on an assumption that slavery was necessary for economic growth.

34

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

- A) Lines 10-16 (“we have . . . earth”)
- B) Lines 25-27 (“I now . . . made it”)
- C) Lines 35-39 (“We must . . . increasing”)
- D) Lines 41-45 (“If we . . . territory”)

35

As used in line 67, “element” most nearly means

- A) ingredient.
- B) environment.
- C) factor.
- D) quality.

36

Based on Passage 2, Lincoln would be most likely to agree with which claim about the controversy over slavery?

- A) It can be ended only if Northern states act unilaterally to abolish slavery throughout the United States.
- B) It would abate if attempts to introduce slavery to regions where it is not practiced were abandoned.
- C) It has been exacerbated by the ambiguity of laws regulating the holding of slaves.
- D) It is fueled in part by differences in religion and social values from state to state.

37

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

- A) Lines 56-61 (“I agree . . . sugar”)
- B) Lines 64-66 (“They don’t . . . Union”)
- C) Lines 74-76 (“Whenever . . . peace”)
- D) Lines 83-86 (“Do you . . . another”)

38

As used in line 84, “nature” most nearly means

- A) force.
- B) simplicity.
- C) world.
- D) character.

39

Which choice identifies a central tension between the two passages?

- A) Douglas proposes changes to federal policies on slavery, but Lincoln argues that such changes would enjoy no popular support.
- B) Douglas expresses concerns about the economic impact of abolition, but Lincoln dismisses those concerns as irrelevant.
- C) Douglas criticizes Lincoln for finding fault with the Constitution, and Lincoln argues that this criticism misrepresents his position.
- D) Douglas offers an interpretation of federal law that conflicts with Lincoln’s, and Lincoln implies that Douglas’s interpretation is poorly reasoned.

40

Both passages discuss the issue of slavery in relationship to

- A) the expansion of the Union.
- B) questions of morality.
- C) religious toleration.
- D) laws regulating commerce.

41

In the context of each passage as a whole, the questions in lines 25-27 of Passage 1 and lines 67-69 of Passage 2 primarily function to help each speaker

- A) cast doubt on the other’s sincerity.
- B) criticize the other’s methods.
- C) reproach the other’s actions.
- D) undermine the other’s argument.

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

This passage is adapted from Daniel Chamovitz, *What a Plant Knows: A Field Guide to the Senses*. ©2012 by Daniel Chamovitz.

The Venus flytrap [*Dionaea muscipula*] needs to know when an ideal meal is crawling across its leaves. Closing its trap requires a huge expense of energy, Line and reopening the trap can take several hours, so 5 *Dionaea* only wants to spring closed when it's sure that the dawdling insect visiting its surface is large enough to be worth its time. The large black hairs on their lobes allow the Venus flytraps to literally feel their prey, and they act as triggers that spring the 10 trap closed when the proper prey makes its way across the trap. If the insect touches just one hair, the trap will not spring shut; but a large enough bug will likely touch two hairs within about twenty seconds, and that signal springs the Venus flytrap into action.

15 We can look at this system as analogous to short-term memory. First, the flytrap encodes the information (forms the memory) that something (it doesn't know what) has touched one of its hairs. Then it stores this information for a number of 20 seconds (retains the memory) and finally retrieves this information (recalls the memory) once a second hair is touched. If a small ant takes a while to get from one hair to the next, the trap will have forgotten the first touch by the time the ant brushes up against 25 the next hair. In other words, it loses the storage of the information, doesn't close, and the ant happily meanders on. How does the plant encode and store the information from the unassuming bug's encounter with the first hair? How does it 30 remember the first touch in order to react upon the second?

35 Scientists have been puzzled by these questions ever since John Burdon-Sanderson's early report on the physiology of the Venus flytrap in 1882. A century later, Dieter Hodick and Andreas Sievers at the University of Bonn in Germany proposed that the flytrap stored information regarding how many hairs have been touched in the electric charge of its leaf. Their model is quite elegant in its simplicity. 40 In their studies, they discovered that touching a trigger hair on the Venus flytrap causes an electric action potential [a temporary reversal in the electrical polarity of a cell membrane] that induces calcium channels to open in the trap (this 45 coupling of action potentials and the opening of

calcium channels is similar to the processes that occur during communication between human neurons), thus causing a rapid increase in the concentration of calcium ions.

50 They proposed that the trap requires a relatively high concentration of calcium in order to close and that a single action potential from just one trigger hair being touched does not reach this level. Therefore, a second hair needs to be stimulated to 55 push the calcium concentration over this threshold and spring the trap. The encoding of the information requires maintaining a high enough level of calcium so that a second increase (triggered by touching the second hair) pushes the total concentration of 60 calcium over the threshold. As the calcium ion concentrations dissipate over time, if the second touch and potential don't happen quickly, the final concentration after the second trigger won't be high enough to close the trap, and the memory is lost.

65 Subsequent research supports this model. Alexander Volkov and his colleagues at Oakwood University in Alabama first demonstrated that it is indeed electricity that causes the Venus flytrap to close. To test the model they rigged up very fine 70 electrodes and applied an electrical current to the open lobes of the trap. This made the trap close without any direct touch to its trigger hairs (while they didn't measure calcium levels, the current likely led to increases). When they modified this 75 experiment by altering the amount of electrical current, Volkov could determine the exact electrical charge needed for the trap to close. As long as fourteen microcoulombs—a tiny bit more than the static electricity generated by rubbing two balloons 80 together—flowed between the two electrodes, the trap closed. This could come as one large burst or as a series of smaller charges within twenty seconds. If it took longer than twenty seconds to accumulate the total charge, the trap would remain open.

42

- The primary purpose of the passage is to
- A) discuss findings that offer a scientific explanation for the Venus flytrap's closing action.
  - B) present research that suggests that the Venus flytrap's predatory behavior is both complex and unique among plants.
  - C) identify the process by which the Venus flytrap's closing action has evolved.
  - D) provide a brief overview of the Venus flytrap and its predatory behavior.

43

- Based on the passage, a significant advantage of the Venus flytrap's requirement for multiple triggers is that it
- A) enables the plant to identify the species of its prey.
  - B) conserves the plant's calcium reserves.
  - C) safeguards the plant's energy supply.
  - D) prevents the plant from closing before capturing its prey.

44

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

- A) Lines 3-7 ("Closing . . . time")
- B) Lines 7-11 ("The large . . . across the trap")
- C) Lines 11-14 ("If the . . . action")
- D) Lines 16-18 ("First . . . hairs")

45

The use of the phrases "dawdling insect" (line 6), "happily meanders" (line 27), and "unassuming bug's encounter" (lines 28-29) in the first two paragraphs establishes a tone that is

- A) academic.
- B) melodramatic.
- C) informal.
- D) mocking.

46

In the second paragraph (lines 15–31), the discussion of short-term memory primarily functions to

- A) clarify an explanation of what prompts the Venus flytrap to close.
- B) advance a controversial hypothesis about the function of electric charges found in the leaf of the Venus flytrap.
- C) stress the distinction between the strategies of the Venus flytrap and the strategies of human beings.
- D) emphasize the Venus flytrap’s capacity for retaining detailed information about its prey.

47

According to the passage, which statement best explains why the Venus flytrap requires a second trigger hair to be touched within a short amount of time in order for its trap to close?

- A) The second trigger produces an electrical charge that reverses the charge produced by the first trigger.
- B) The second trigger stabilizes the surge of calcium ions created by the first trigger.
- C) The second trigger prompts the calcium channels to open.
- D) The second trigger provides a necessary supplement to the calcium concentration released by the first trigger.

48

Which choice describes a scenario in which Hodick and Sievers’s model predicts that a Venus flytrap will NOT close around an insect?

- A) A large insect’s second contact with the plant’s trigger hairs results in a total calcium ion concentration above the trap’s threshold.
- B) A large insect makes contact with a second trigger hair after a period of inactivity during which calcium ion concentrations have diminished appreciably.
- C) A large insect’s contact with the plant’s trigger hairs causes calcium channels to open in the trap.
- D) A large insect’s contact with a second trigger hair occurs within ten seconds of its contact with the first trigger hair.

49

As used in line 67, “demonstrated” most nearly means

- A) protested.
- B) established.
- C) performed.
- D) argued.

50

Based on the passage, what potential criticism might be made of Volkov's testing of Hodick and Sievers's model?

- A) Volkov's understanding of Hodick and Sievers's model was incorrect.
- B) Volkov's measurements did not corroborate a central element of Hodick and Sievers's model.
- C) Volkov's direct application of an electrical current would have been objectionable to Hodick and Sievers.
- D) Volkov's technology was not available to Hodick and Sievers.

51

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

- A) Lines 66-69 ("Alexander . . . close")
- B) Lines 69-71 ("To test . . . trap")
- C) Lines 71-74 ("This . . . increases")
- D) Lines 74-77 ("When . . . close")

52

Based on the passage, in studying the Venus flytrap, Volkov and his colleagues made the most extensive use of which type of evidence?

- A) Mathematical models to predict the electrical charge required to close the Venus flytrap
- B) Analysis of data collected from previous researchers' work involving the Venus flytrap's response to electricity
- C) Information obtained from monitoring the Venus flytrap's response to varying amounts of electrical current
- D) Published theories of scientists who developed earlier models of the Venus flytrap

**STOP**

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

# Writing and Language Test

35 MINUTES, 44 QUESTIONS

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

## DIRECTIONS

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

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

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

Questions 1–11 are based on the following passage and supplementary material.

### Compost: Don’t Waste This Waste

Over the past generation, people in many parts of the United States have become accustomed to dividing their household waste products into different categories for recycling. **1** Regardless, paper may go in one container, glass and aluminum in another, regular garbage in a third. Recently, some US cities have added a new category: compost, organic matter such as food scraps and yard debris. Like paper or glass recycling, composting demands a certain amount of effort from the

1

- A) NO CHANGE
- B) However,
- C) Furthermore,
- D) For example,

public in order to be successful. But the inconveniences of composting are far outweighed by its benefits.

Most people think of banana peels, eggshells, and dead leaves as “waste,” but compost is actually a valuable resource with multiple practical uses. When utilized as a garden fertilizer, compost provides nutrients to soil and improves plant growth while deterring or killing pests and preventing some plant diseases. It also enhances soil texture, encouraging healthy roots and minimizing or **2** annihilating the need for chemical fertilizers. Better than soil at holding moisture, compost minimizes water waste and storm runoff, **3** it increases savings on watering costs, and helps reduce erosion on embankments near bodies of water. In large **4** quantities, which one would expect to see when it is collected for an entire municipality), compost can be converted into a natural gas that can be used as fuel for transportation or heating and cooling systems.

2

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

- A) NO CHANGE
- B) eliminating
- C) ousting
- D) closing the door on

3

- A) NO CHANGE
- B) savings increase
- C) increases savings
- D) also it increases savings

4

- A) NO CHANGE
- B) quantities (which
- C) quantities which
- D) quantities; (which

In spite of all compost's potential uses, however, most of this so-called waste is wasted. According to the Environmental Protection Agency (EPA), over **5** 13 million tons of metal ended up in US landfills in 2009, along with over 13 million tons of yard debris. Remarkably, **6** less glass was discarded in landfills in that year than any other substance, including plastics or paper. Even **7** worse, then the squandering of this useful resource is the fact that compost in landfills cannot break down due to the lack of necessary air and moisture.

5

The writer wants to include information from the graph that is consistent with the description of compost in the passage. Which choice most effectively accomplishes this goal?

- A) NO CHANGE
- B) 6 million tons of rubber and leather
- C) 10 million tons of textiles
- D) 33 million tons of food waste

6

The writer wants to support the paragraph's main idea with accurate, relevant information from the graph. Which choice most effectively accomplishes this goal?

- A) NO CHANGE
- B) more metal
- C) more food waste
- D) more yard waste

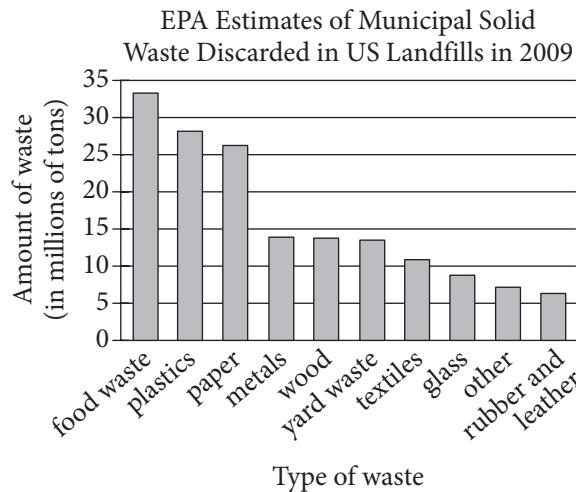
7

- A) NO CHANGE
- B) worse than
- C) worse then
- D) worse, than

As a result, organic material that is sent to landfills

8 contribute to the release of methane, a very

9 potent greenhouse gas.



Adapted from Food Waste Disposal. ©n.d. by Food Waste Disposal, LLC.

8

- A) NO CHANGE
- B) are contributing
- C) contributes
- D) have contributed

9

- A) NO CHANGE
- B) sturdy
- C) influential
- D) commanding

**10** While composting can sometimes lead to accidental pollution through the release of methane gas, cities such as San Francisco and Seattle have instituted mandatory composting laws requiring individuals and businesses to use separate bins for compostable waste. This strict approach may not work everywhere. However, given the clear benefits of composting and the environmental costs of not composting, all municipalities should encourage their residents either to create their own compost piles for use in backyard gardens **11** or to dispose of compostable materials in bins for collection.

**10**

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

- A) NO CHANGE
- B) Though government regulations vary,
- C) Armed with these facts,
- D) Mindful of this setback,

**11**

- A) NO CHANGE
- B) nor
- C) but
- D) and

Questions 12–22 are based on the following passage.

### A Lion’s Share of Luck

It’s the beginning of February, and as they do every year, thousands of people line H Street, the heart of Chinatown in Washington, DC. The crowd has gathered to celebrate Lunar New Year. The street is a sea of

**12** red. Red is the traditional Chinese color of luck and happiness. Buildings are **13** draped with festive, red, banners, and garlands. Lampposts are strung with crimson paper lanterns, which bob in the crisp winter breeze. The eager spectators await the highlight of the New Year parade: the lion dance.

Experts agree that the lion dance originated in the Han dynasty (206 BCE–220 CE); however, there is little agreement about the dance’s original purpose. Some evidence suggests that the earliest version of the dance was an attempt to ward off an evil spirit; **14** lions are obviously very fierce. Another theory is that an emperor, upon waking from a dream about a lion, hired an artist to

12

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

- A) red,
- B) red; in addition, red is
- C) red; in other words, red is
- D) red, the color; that is

13

- A) NO CHANGE
- B) draped, with festive red banners,
- C) draped with festive red banners—
- D) draped with festive red banners

14

Which choice most effectively completes the explanation of a possible origin of the lion dance?

- A) NO CHANGE
- B) the evil spirit was called Nian.
- C) villagers dressed in lion costumes to scare the spirit away.
- D) the precise location of the village remains lost to history.

choreograph the dance. **15** The current function of the dance is celebration.

The lion dance requires the strength, grace, and coordination of two dancers, **16** both of whom are almost completely hidden by the elaborate bamboo and papier-mâché lion costume that they maneuver. One person operates the lion's head as the other guides the torso and tail. Many of the moves in the dance, such as jumps, rolls, and kicks, are similar to **17** martial arts and acrobatics. The dancers must be synchronized with the music accompanying the dance—drums, cymbals, and gongs that supply the lion's roar—as well as with each other.

**15**

Which choice most effectively concludes the paragraph?

- A) NO CHANGE
- B) It turns out that the origins of the lion dance are irrelevant.
- C) Whatever its origins, today the lion dance is a joyous spectacle, a celebration of the promise of the New Year.
- D) Things are different these days, of course.

**16**

- A) NO CHANGE
- B) of which both
- C) both of them
- D) both

**17**

- A) NO CHANGE
- B) the disciplines of martial arts and acrobatics.
- C) martial artists and acrobats.
- D) those in martial arts and acrobatics.

[1] While there are many regional variations of the lion dance costume, all make extensive use of symbols and colors. [2] The lion's head is often adorned with a phoenix **18** (a mythical bird) or a tortoise (for longevity). [3] Green lions encourage friendliness. [4] Golden and red lions represent liveliness and bravery, respectively. [5] Their older counterparts, yellow and white lions, dance more slowly and deliberately. [6] In some variations, lions of different colors are different ages, and they move accordingly. [7] Black lions are the youngest; therefore, they dance quickly and playfully. [8] The appearance of the lions varies, but their message is consistent: Happy New Year. **19**

18

Which choice provides information that is most consistent in style and content with the information about the symbolism of the tortoise?

- A) NO CHANGE
- B) (for new beginnings)
- C) (from Chinese mythology)
- D) (for symbolic reasons)

19

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

- A) where it is now.
- B) after sentence 1.
- C) after sentence 3.
- D) after sentence 7.

As the parade winds its way through Chinatown, the music crescendos, and the lion dance reaches **20** it's climax with the “plucking of the greens.” Approaching a doorway in which dangles a red envelope filled with green paper money, the **21** lion's teeth snare the envelope. It then chews up the bills and spits out the **22** money-filled envelope instead of chewing it up. The crowd cheers for the lion dancers and for the prosperity and good fortune their dance foretells.

**20**

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

**21**

- A) NO CHANGE
- B) lion snares the envelope with its teeth.
- C) envelope is snared by the lion with its teeth.
- D) teeth of the lion snare the envelope.

**22**

- A) NO CHANGE
- B) envelope that had been dangling from the doorway.
- C) envelope that had the money in it.
- D) envelope.

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

**Court Reporting: Humans v. Machines**

Court reporters for years have been the record keepers of the court, taking **23** scrupulous notes during **24** hearings; depositions, and other legal proceedings.

Despite the increasing use of digital recording technologies, court reporters still play a vital role in

23

Which choice best fits with the tone of the rest of the passage?

- A) NO CHANGE
- B) super-rigorous
- C) spot-on
- D) intense

24

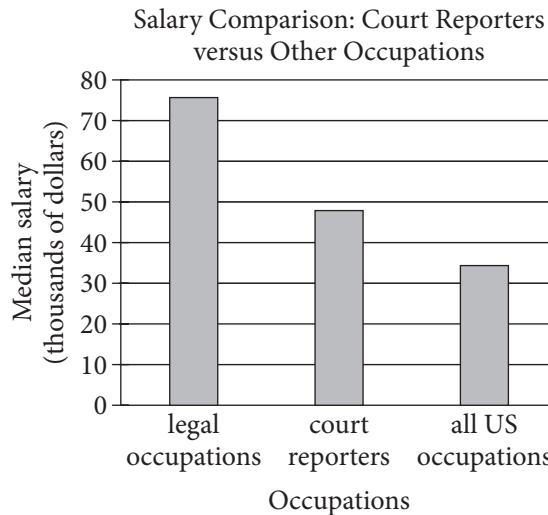
- A) NO CHANGE
- B) hearings; depositions;
- C) hearings, depositions,
- D) hearings, depositions;

courtrooms. [25] Although machines can easily make digital audio recordings of court events, they lack the nuance of human court reporters in providing a precise record.

[1] Court reporters record the spoken word in real time, most commonly using the technique of stenography. [2] A stenotype machine allows a person to type about 200 words per minute (the speed of speech is about 180 words per minute). [3] The typed words are instantaneously translated onto a computer screen for the judge to view, and the transcript is used later by people who want to review the case, such as journalists and lawyers. [4] Digital audio recording is becoming increasingly popular in courtrooms across the United States, with six states using solely audio recordings for

25

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



Adapted from Bureau of Labor Statistics, US Department of Labor, *Occupational Outlook Handbook, 2014–15 Edition*.

Should the writer make this addition here?

- A) Yes, because it supports the claim that court reporting is an important part of a trial.
- B) Yes, because it offers a relevant counterpoint to the argument that the use of digital recorders is on the rise.
- C) No, because it presents information that is not directly related to the paragraph's discussion of the role of court reporters.
- D) No, because it does not provide information about the pay scale for more experienced court reporters.

general jurisdiction sessions. [5] Proponents of going digital say that technology is the easiest way to get the most accurate record of the proceedings, as the machine records everything faithfully as it occurs and is not subject to human errors such as mishearing or mistyping. [6] However, with the rise of high-quality recording technology, reliance on court reporters **27** as a record keeper is decreasing. **28**

**26**

- A) NO CHANGE
- B) subjected to
- C) subjected from
- D) subject for

**27**

- A) NO CHANGE
- B) each as record keepers
- C) as record keepers
- D) to be a record keeper

**28**

To make this paragraph most logical, sentence 6 should be placed

- A) where it is now.
- B) after sentence 1.
- C) after sentence 3.
- D) after sentence 4.

Champions of court reporting, though, argue the

29 opposite. They argue that with the increased reliance on technology, errors actually increase. Because digital systems record 30 indiscriminately; they cannot discern important parts of the proceedings from other noises in the courtroom. 31 Despite this, a digital device does indeed record everything, but that includes loud noises, such as a book dropping, that can make the actual words spoken impossible to hear. A court reporter, however,

29

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

- A) opposite, such
- B) opposite—
- C) opposite, which is
- D) opposite; their opinion is

30

- A) NO CHANGE
- B) indiscriminately, they
- C) indiscriminately. They
- D) indiscriminately, therefore they

31

- A) NO CHANGE
- B) In other words,
- C) Therefore,
- D) Consequently,

can distinguish between the words **32** and distinguish between the extrinsic noises that need not be recorded. Also, if a witness mumbles, a human court reporter can pause court proceedings to ask the witness to repeat what he or she said. In some cases, digital recording **33** makes it necessary for the judge to make additional announcements at the beginning of a trial. Increasing use of technology is “a transition from accurate records to adequate records,” says Bob Tate, president of the Certified Court Reporters Association of New Jersey.

Despite the apparent benefits of using digital recording systems in courtrooms, there is still a need for the human touch in legal proceedings. At least for the foreseeable future, machines simply cannot replicate the invaluable clarification skills and adaptability of human court reporters.

**32**

- A) NO CHANGE
- B) also between the
- C) and when there are
- D) and the

**33**

Which choice provides the best supporting example for the main idea of the paragraph?

- A) NO CHANGE
- B) requires a courtroom monitor to ensure the equipment is functioning properly.
- C) leads to changes in the roles and duties of several members of the courtroom staff.
- D) has led to the need for retrial because of indistinct testimony from key witnesses.

Questions 34–44 are based on the following passage.

### Fire in Space

On Earth, fire provides light, heat, and comfort. Its creation, by a process called combustion, requires a chemical reaction between a fuel source and oxygen. The shape that fire assumes on Earth is a result of gravitational influence and the movement of molecules. In the microgravity environment of space, **34** moreover, combustion and the resulting fire behave in fundamentally different ways than they do on Earth—differences that have important implications for researchers.

A group of engineering students from the University of California at San Diego (UCSD), for example, **35** tried to find a method to make their biofuel combustion study (fuels derived from once-living material) free of the drawbacks researchers face on Earth. The standard method involves burning droplets of fuel, but Earth's gravitational influence causes the droplets to lose

34

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

35

- A) NO CHANGE
- B) strove for a method to make their study of biofuel combustion
- C) looked for a method to study biofuel combustion
- D) sought a method to study combustion of biofuels

spherical symmetry while burning. This **36** deformation results in subtle variations in density that both **37** causes uneven heat flow and limits the size of the droplets that can be tested. Specially designed “drop towers” **38** built for this purpose reduce these problems, but they provide no more than 10 seconds of microgravity, and droplet size is still too small to produce accurate models of combustion rates. **39** The UCSD students understood that these limitations had to be surmounted. As part of the program, researchers fly their experiments aboard aircraft that simulate the microgravity environment of space. The aircraft accomplish this feat by flying in parabolic paths instead of horizontal ones. On the plane’s ascent, passengers feel twice Earth’s gravitational pull, but for brief periods at the peak of the trajectory,

**36**

Which choice provides the most precise description of the phenomenon depicted in the previous sentence?

- A) NO CHANGE
- B) alteration
- C) transformation
- D) modification

**37**

- A) NO CHANGE
- B) cause uneven heat flow and limit
- C) cause uneven heat flow and limits
- D) has caused uneven heat flow and has limited

**38**

- A) NO CHANGE
- B) intended for this use
- C) constructed for this function
- D) DELETE the underlined portion.

**39**

Which choice provides the most effective transition between ideas in the paragraph?

- A) NO CHANGE
- B) The UCSD group sought to overcome these difficulties by participating in NASA’s Microgravity University program.
- C) The engineering group realized that aircraft might be the tools they were looking for.
- D) Thus, for the UCSD group, drop towers were not an adequate solution.

- 40 “weightlessness” or microgravity similar to what is experienced in space, is achieved.

These flights allowed the UCSD students to experience microgravity 41 . Specifically, they 42 investigated the combustion of biofuel droplets in microgravity for twice as long as could be accomplished

40

- A) NO CHANGE
- B) “weightlessness” or microgravity, similar to what is experienced, in space
- C) “weightlessness” or, microgravity, similar to what is experienced in space
- D) “weightlessness,” or microgravity similar to what is experienced in space,

41

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

and perform their experiment without traveling into space

Should the writer make this addition here?

- A) Yes, because it elaborates on the advantage the students gained from the flights.
- B) Yes, because it reveals that the students did not actually go into space, a point that the previous paragraph does not address.
- C) No, because it shifts focus away from the students’ experiences while on the flights.
- D) No, because it restates what has already been said in the sentence.

42

- A) NO CHANGE
- B) could investigate
- C) were investigating
- D) were able to investigate

in drop towers and to perform tests with larger droplets.

The larger, **43** spherically symmetric droplets burned longer and gave the students more reliable data on combustion rates of biofuels because the droplets' uniform shape reduced the variations in density that hinder tests performed in normal gravity. The students hope the new data will aid future research by improving theoretical models of biofuel combustion. Better combustion-rate models may even lead to the production of more fuel-efficient engines and improved **44** techniques, for fighting fires in space or at future outposts on the Moon and Mars.

43

Which choice most effectively establishes that the UCSD students' approach had solved a problem, mentioned earlier in the passage, relating to burning fuel on Earth?

- A) NO CHANGE
- B) combustible
- C) microgravity-influenced
- D) biofuel-derived

44

- A) NO CHANGE
- B) techniques for fighting fires, in space or at future outposts
- C) techniques for fighting fires in space or at future outposts
- D) techniques for fighting fires in space, or at future outposts,

**STOP**

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



# Math Test – No Calculator

**25 MINUTES, 20 QUESTIONS**

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

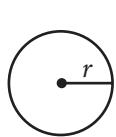
## DIRECTIONS

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

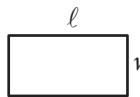
## NOTES

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

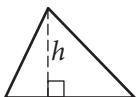
## REFERENCE



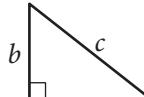
$$\begin{aligned} A &= \pi r^2 \\ C &= 2\pi r \end{aligned}$$



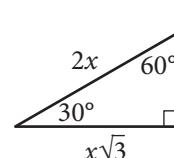
$$A = lw$$



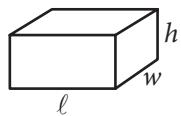
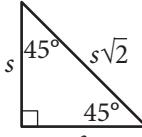
$$A = \frac{1}{2}bh$$



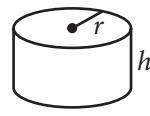
$$c^2 = a^2 + b^2$$



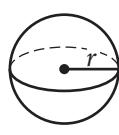
Special Right Triangles



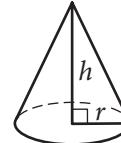
$$V = lwh$$



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



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



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



$$V = \frac{1}{3}lwh$$

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

$$3x + x + x + x - 3 - 2 = 7 + x + x$$

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

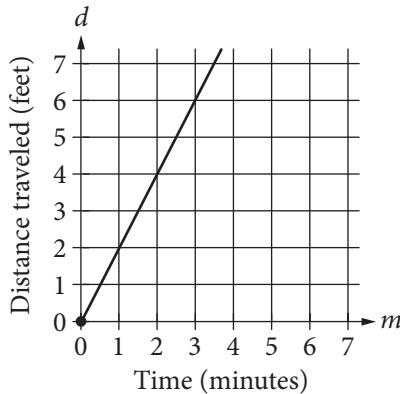
A)  $-\frac{5}{7}$

B) 1

C)  $\frac{12}{7}$

D) 3

2



The graph above shows the distance traveled  $d$ , in feet, by a product on a conveyor belt  $m$  minutes after the product is placed on the belt. Which of the following equations correctly relates  $d$  and  $m$ ?

A)  $d = 2m$

B)  $d = \frac{1}{2}m$

C)  $d = m + 2$

D)  $d = 2m + 2$



3

The formula below is often used by project managers to compute  $E$ , the estimated time to complete a job, where  $O$  is the shortest completion time,  $P$  is the longest completion time, and  $M$  is the most likely completion time.

$$E = \frac{O + 4M + P}{6}$$

Which of the following correctly gives  $P$  in terms of  $E$ ,  $O$ , and  $M$ ?

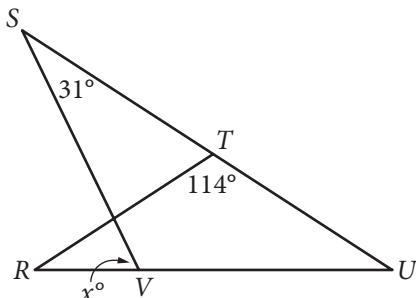
A)  $P = 6E - O - 4M$

B)  $P = -6E + O + 4M$

C)  $P = \frac{O + 4M + E}{6}$

D)  $P = \frac{O + 4M - E}{6}$

4



In the figure above,  $RT = TU$ . What is the value of  $x$ ?

- A) 72  
B) 66  
C) 64  
D) 58

5

The width of a rectangular dance floor is  $w$  feet. The length of the floor is 6 feet longer than its width. Which of the following expresses the perimeter, in feet, of the dance floor in terms of  $w$ ?

A)  $2w + 6$

B)  $4w + 12$

C)  $w^2 + 6$

D)  $w^2 + 6w$

6

$$y > 2x - 1$$

$$2x > 5$$

Which of the following consists of the  $y$ -coordinates of all the points that satisfy the system of inequalities above?

A)  $y > 6$

B)  $y > 4$

C)  $y > \frac{5}{2}$

D)  $y > \frac{3}{2}$



7

$$\sqrt{2x+6} + 4 = x + 3$$

What is the solution set of the equation above?

- A)  $\{-1\}$
- B)  $\{5\}$
- C)  $\{-1, 5\}$
- D)  $\{0, -1, 5\}$

9

$$(x - 6)^2 + (y + 5)^2 = 16$$

In the  $xy$ -plane, the graph of the equation above is a circle. Point  $P$  is on the circle and has coordinates  $(10, -5)$ . If  $\overline{PQ}$  is a diameter of the circle, what are the coordinates of point  $Q$ ?

- A)  $(2, -5)$
- B)  $(6, -1)$
- C)  $(6, -5)$
- D)  $(6, -9)$

8

$$f(x) = x^3 - 9x$$

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

Which of the following expressions is equivalent to

$$\frac{f(x)}{g(x)}, \text{ for } x > 3?$$

- A)  $\frac{1}{x+1}$
- B)  $\frac{x+3}{x+1}$
- C)  $\frac{x(x-3)}{x+1}$
- D)  $\frac{x(x+3)}{x+1}$

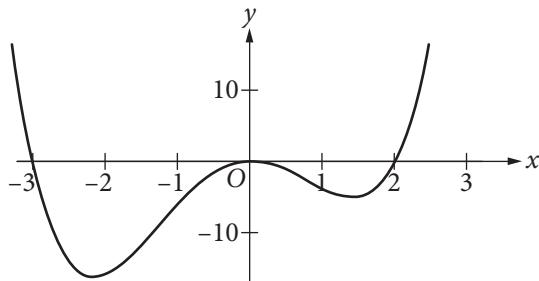
10

A group of 202 people went on an overnight camping trip, taking 60 tents with them. Some of the tents held 2 people each, and the rest held 4 people each. Assuming all the tents were filled to capacity and every person got to sleep in a tent, exactly how many of the tents were 2-person tents?

- A) 30
- B) 20
- C) 19
- D) 18



11



Which of the following could be the equation of the graph above?

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

13

Oil and gas production in a certain area dropped from 4 million barrels in 2000 to 1.9 million barrels in 2013. Assuming that the oil and gas production decreased at a constant rate, which of the following linear functions  $f$  best models the production, in millions of barrels,  $t$  years after the year 2000?

- A)  $f(t) = \frac{21}{130}t + 4$
- B)  $f(t) = \frac{19}{130}t + 4$
- C)  $f(t) = -\frac{21}{130}t + 4$
- D)  $f(t) = -\frac{19}{130}t + 4$

12

If  $\frac{2a}{b} = \frac{1}{2}$ , what is the value of  $\frac{b}{a}$ ?

- A)  $\frac{1}{8}$
- B)  $\frac{1}{4}$
- C) 2
- D) 4



14

$$\begin{aligned}y &= x^2 + 3x - 7 \\y - 5x + 8 &= 0\end{aligned}$$

How many solutions are there to the system of equations above?

- A) There are exactly 4 solutions.
- B) There are exactly 2 solutions.
- C) There is exactly 1 solution.
- D) There are no solutions.

15

$$\begin{aligned}g(x) &= 2x - 1 \\h(x) &= 1 - g(x)\end{aligned}$$

The functions  $g$  and  $h$  are defined above. What is the value of  $h(0)$  ?

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

**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 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.

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.

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

← Decimal point

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

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

.	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

.	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

Answer: 201 – either position is correct

2	0	1
0	0	0
1	1	1
2	2	2

2	0	1
1	1	1
2	2	2

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



16

$$x^2 + x - 12 = 0$$

If  $a$  is a solution of the equation above and  $a > 0$ , what is the value of  $a$ ?

17

The sum of  $-2x^2 + x + 31$  and  $3x^2 + 7x - 8$  can be written in the form  $ax^2 + bx + c$ , where  $a$ ,  $b$ , and  $c$  are constants. What is the value of  $a + b + c$ ?

18

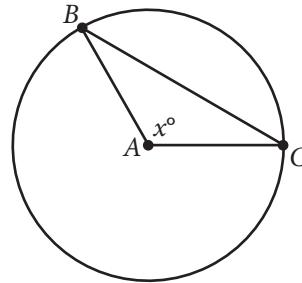
$$\begin{aligned} -x + y &= -3.5 \\ x + 3y &= 9.5 \end{aligned}$$

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

19

A start-up company opened with 8 employees. The company's growth plan assumes that 2 new employees will be hired each quarter (every 3 months) for the first 5 years. If an equation is written in the form  $y = ax + b$  to represent the number of employees,  $y$ , employed by the company  $x$  quarters after the company opened, what is the value of  $b$ ?

20



Note: Figure not drawn to scale.

In the circle above, point  $A$  is the center and the length of arc  $\widehat{BC}$  is  $\frac{2}{5}$  of the circumference of the circle. What is the value of  $x$ ?

# STOP

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



# Math Test – Calculator

**55 MINUTES, 38 QUESTIONS**

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

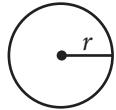
## DIRECTIONS

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

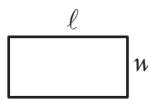
## NOTES

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

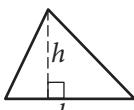
## REFERENCE



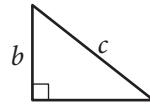
$$\begin{aligned}A &= \pi r^2 \\C &= 2\pi r\end{aligned}$$



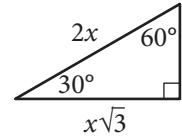
$$A = lw$$



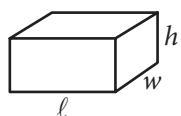
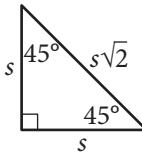
$$A = \frac{1}{2}bh$$



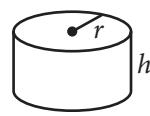
$$c^2 = a^2 + b^2$$



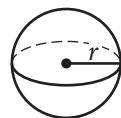
Special Right Triangles



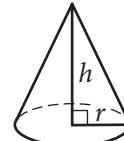
$$V = lwh$$



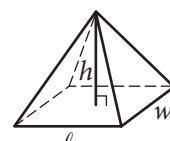
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}lwh$$

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.



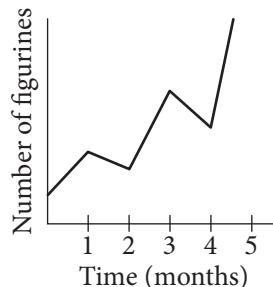
1

One pound of grapes costs \$2. At this rate, how many dollars will  $c$  pounds of grapes cost?

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

2

Tracy collects, sells, and trades figurines, and she tracks the number of figurines in her collection on the graph below.



On what interval did the number of figurines decrease the fastest?

- A) Between 1 and 2 months
- B) Between 2 and 3 months
- C) Between 3 and 4 months
- D) Between 4 and 5 months

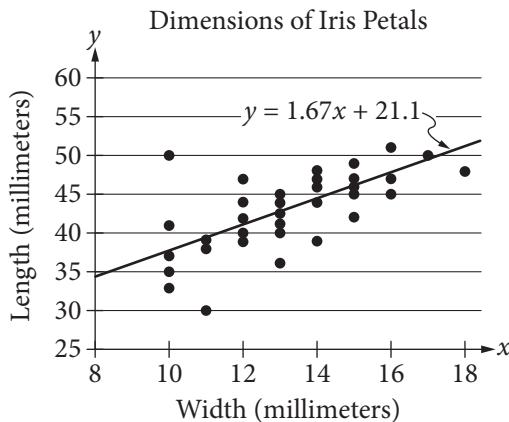


3

In a random sample of 200 cars of a particular model, 3 have a manufacturing defect. At this rate, how many of 10,000 cars of the same model will have a manufacturing defect?

- A) 150
- B) 200
- C) 250
- D) 300

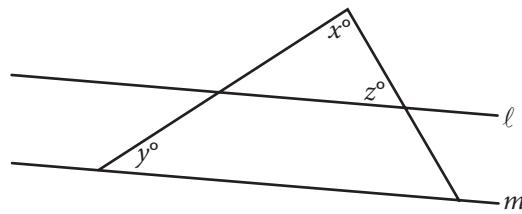
4



The scatterplot above shows data collected on the lengths and widths of *Iris setosa* petals. A line of best fit for the data is also shown. Based on the line of best fit, if the width of an *Iris setosa* petal is 19 millimeters, what is the predicted length, in millimeters, of the petal?

- A) 21.10
- B) 31.73
- C) 52.83
- D) 55.27

5



Note: Figure not drawn to scale.

In the figure above, lines  $\ell$  and  $m$  are parallel,  $y = 20$ , and  $z = 60$ . What is the value of  $x$ ?

- A) 120
- B) 100
- C) 90
- D) 80



6

Two types of tickets were sold for a concert held at an amphitheater. Tickets to sit on a bench during the concert cost \$75 each, and tickets to sit on the lawn during the concert cost \$40 each. Organizers of the concert announced that 350 tickets had been sold and that \$19,250 had been raised through ticket sales alone. Which of the following systems of equations could be used to find the number of tickets for bench seats,  $B$ , and the number of tickets for lawn seats,  $L$ , that were sold for the concert?

A)  $(75B)(40L) = 1,950$   
 $B + L = 350$

B)  $40B + 75L = 19,250$   
 $B + L = 350$

C)  $75B + 40L = 350$   
 $B + L = 19,250$

D)  $75B + 40L = 19,250$   
 $B + L = 350$

7

In the  $xy$ -plane, the graph of which of the following equations is a line with a slope of 3?

A)  $y = \frac{1}{3}x$

B)  $y = x - 3$

C)  $y = 3x + 2$

D)  $y = 6x + 3$

8

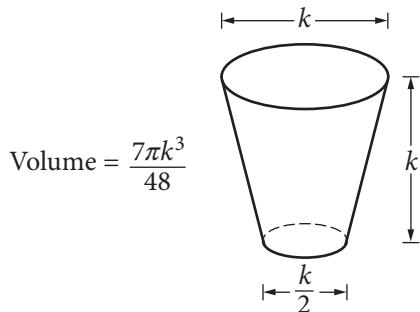
$$x + 1 = \frac{2}{x + 1}$$

In the equation above, which of the following is a possible value of  $x + 1$ ?

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



Questions 9–11 refer to the following information.



The glass pictured above can hold a maximum volume of 473 cubic centimeters, which is approximately 16 fluid ounces.

9

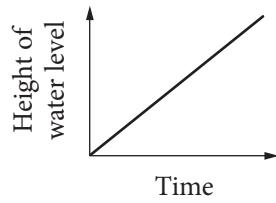
What is the value of  $k$ , in centimeters?

- A) 2.52
- B) 7.67
- C) 7.79
- D) 10.11

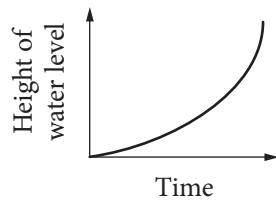
10

Water pours into the glass slowly and at a constant rate. Which of the following graphs best illustrates the height of the water level in the glass as it fills?

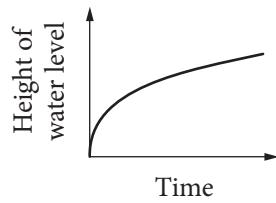
A)



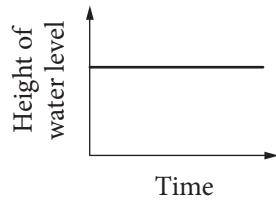
B)



C)



D)





11

Jenny has a pitcher that contains 1 gallon of water. How many times could Jenny completely fill the glass with 1 gallon of water? (1 gallon = 128 fluid ounces)

- A) 16
- B) 8
- C) 4
- D) 3

12

Roberto is an insurance agent who sells two types of policies: a \$50,000 policy and a \$100,000 policy. Last month, his goal was to sell at least 57 insurance policies. While he did not meet his goal, the total value of the policies he sold was over \$3,000,000. Which of the following systems of inequalities describes  $x$ , the possible number of \$50,000 policies, and  $y$ , the possible number of \$100,000 policies, that Roberto sold last month?

- A)  $x + y < 57$   
 $50,000x + 100,000y < 3,000,000$
- B)  $x + y > 57$   
 $50,000x + 100,000y > 3,000,000$
- C)  $x + y < 57$   
 $50,000x + 100,000y > 3,000,000$
- D)  $x + y > 57$   
 $50,000x + 100,000y < 3,000,000$

13

If  $a^{-\frac{1}{2}} = x$ , where  $a > 0$ , what is  $a$  in terms of  $x$ ?

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

14

Which of the following is a value of  $x$  for which the expression  $\frac{-3}{x^2 + 3x - 10}$  is undefined?

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



15

A granite block in the shape of a right rectangular prism has dimensions 30 centimeters by 40 centimeters by 50 centimeters. The block has a density of 2.8 grams per cubic centimeter. What is the mass of the block, in grams? (Density is mass per unit volume.)

- A) 336
- B) 3,360
- C) 16,800
- D) 168,000

16

Number of Adults Contracting Colds

	Cold	No cold	Total
Vitamin C	21	129	150
Sugar pill	33	117	150
Total	54	246	300

The table shows the results of a research study that investigated the therapeutic value of vitamin C in preventing colds. A random sample of 300 adults received either a vitamin C pill or a sugar pill each day during a 2-week period, and the adults reported whether they contracted a cold during that time period. What proportion of adults who received a sugar pill reported contracting a cold?

- A)  $\frac{11}{18}$
- B)  $\frac{11}{50}$
- C)  $\frac{9}{50}$
- D)  $\frac{11}{100}$

17

Ages of 20 Students Enrolled in a College Class

Age	Frequency
18	6
19	5
20	4
21	2
22	1
23	1
30	1

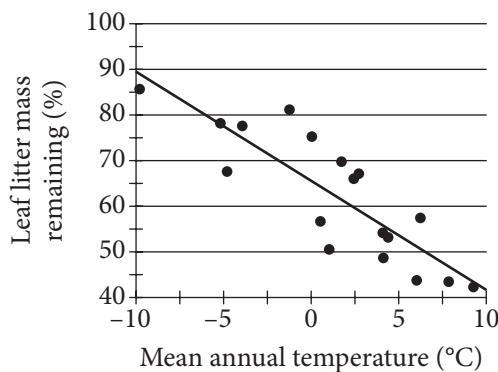
The table above shows the distribution of ages of the 20 students enrolled in a college class. Which of the following gives the correct order of the mean, median, and mode of the ages?

- A) mode < median < mean
- B) mode < mean < median
- C) median < mode < mean
- D) mean < mode < median



18

The figure below shows the relationship between the percent of leaf litter mass remaining after decomposing for 3 years and the mean annual temperature, in degrees Celsius ( $^{\circ}\text{C}$ ), in 18 forests in Canada. A line of best fit is also shown.



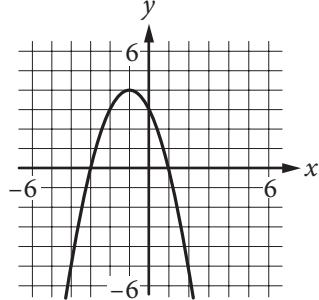
A particular forest in Canada, whose data is not included in the figure, had a mean annual temperature of  $-2^{\circ}\text{C}$ . Based on the line of best fit, which of the following is closest to the predicted percent of leaf litter mass remaining in this particular forest after decomposing for 3 years?

- A) 50%
- B) 63%
- C) 70%
- D) 82%

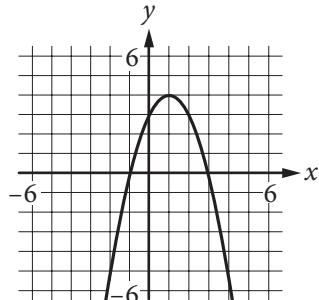
19

The range of the polynomial function  $f$  is the set of real numbers less than or equal to 4. If the zeros of  $f$  are  $-3$  and  $1$ , which of the following could be the graph of  $y = f(x)$  in the  $xy$ -plane?

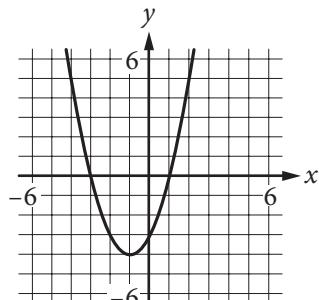
A)



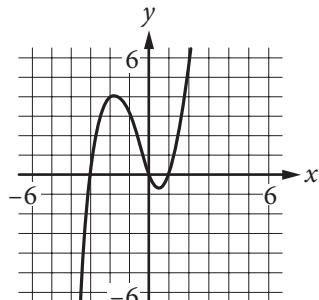
B)



C)



D)





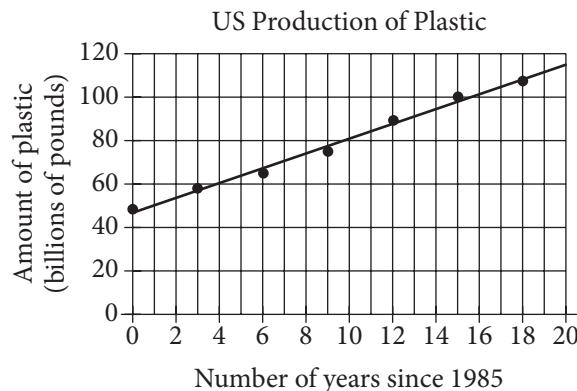
20

The average annual energy cost for a certain home is \$4,334. The homeowner plans to spend \$25,000 to install a geothermal heating system. The homeowner estimates that the average annual energy cost will then be \$2,712. Which of the following inequalities can be solved to find  $t$ , the number of years after installation at which the total amount of energy cost savings will exceed the installation cost?

- A)  $25,000 > (4,334 - 2,712)t$
- B)  $25,000 < (4,334 - 2,712)t$
- C)  $25,000 - 4,334 > 2,712t$
- D)  $25,000 > \frac{4,332}{2,712}t$

**Questions 21 and 22 refer to the following information.**

Between 1985 and 2003, data were collected every three years on the amount of plastic produced annually in the United States, in billions of pounds. The graph below shows the data and a line of best fit. The equation of the line of best fit is  $y = 3.39x + 46.89$ , where  $x$  is the number of years since 1985 and  $y$  is the amount of plastic produced annually, in billions of pounds.



21

Which of the following is the best interpretation of the number 3.39 in the context of the problem?

- A) The amount of plastic, in billions of pounds, produced in the United States during the year 1985
- B) The number of years it took the United States to produce 1 billion pounds of plastic
- C) The average annual plastic production, in billions of pounds, in the United States from 1985 to 2003
- D) The average annual increase, in billions of pounds, of plastic produced per year in the United States from 1985 to 2003



22

Which of the following is closest to the percent increase in the billions of pounds of plastic produced in the United States from 2000 to 2003?

- A) 10%
- B) 44%
- C) 77%
- D) 110%

23

$$M = 1,800(1.02)^t$$

The equation above models the number of members,  $M$ , of a gym  $t$  years after the gym opens. Of the following, which equation models the number of members of the gym  $q$  quarter years after the gym opens?

A)  $M = 1,800(1.02)^{\frac{q}{4}}$

B)  $M = 1,800(1.02)^{4q}$

C)  $M = 1,800(1.005)^{4q}$

D)  $M = 1,800(1.082)^q$

24

For the finale of a TV show, viewers could use either social media or a text message to vote for their favorite of two contestants. The contestant receiving more than 50% of the vote won. An estimated 10% of the viewers voted, and 30% of the votes were cast on social media. Contestant 2 earned 70% of the votes cast using social media and 40% of the votes cast using a text message. Based on this information, which of the following is an accurate conclusion?

- A) If all viewers had voted, Contestant 2 would have won.
- B) Viewers voting by social media were likely to be younger than viewers voting by text message.
- C) If all viewers who voted had voted by social media instead of by text message, Contestant 2 would have won.
- D) Viewers voting by social media were more likely to prefer Contestant 2 than were viewers voting by text message.



25

Population of Greenleaf, Idaho

Year	Population
2000	862
2010	846

The table above shows the population of Greenleaf, Idaho, for the years 2000 and 2010. If the relationship between population and year is linear, which of the following functions  $P$  models the population of Greenleaf  $t$  years after 2000?

- A)  $P(t) = 862 - 1.6t$
- B)  $P(t) = 862 - 16t$
- C)  $P(t) = 862 + 16(t - 2,000)$
- D)  $P(t) = 862 - 1.6(t - 2,000)$

26

To determine the mean number of children per household in a community, Tabitha surveyed 20 families at a playground. For the 20 families surveyed, the mean number of children per household was 2.4. Which of the following statements must be true?

- A) The mean number of children per household in the community is 2.4.
- B) A determination about the mean number of children per household in the community should not be made because the sample size is too small.
- C) The sampling method is flawed and may produce a biased estimate of the mean number of children per household in the community.
- D) The sampling method is not flawed and is likely to produce an unbiased estimate of the mean number of children per household in the community.



27

In the  $xy$ -plane, the point  $(p, r)$  lies on the line with equation  $y = x + b$ , where  $b$  is a constant. The point with coordinates  $(2p, 5r)$  lies on the line with equation  $y = 2x + b$ . If  $p \neq 0$ , what is the value of  $\frac{r}{p}$ ?

A)  $\frac{2}{5}$

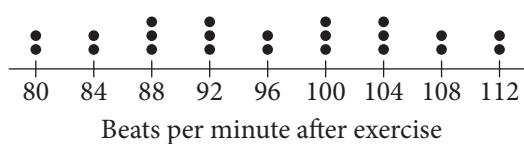
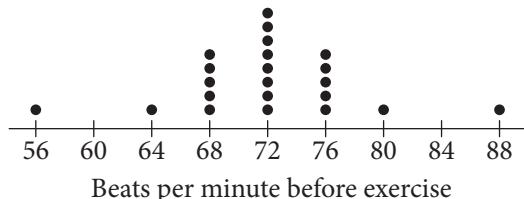
B)  $\frac{3}{4}$

C)  $\frac{4}{3}$

D)  $\frac{5}{2}$

28

The 22 students in a health class conducted an experiment in which they each recorded their pulse rates, in beats per minute, before and after completing a light exercise routine. The dot plots below display the results.



Let  $s_1$  and  $r_1$  be the standard deviation and range, respectively, of the data before exercise, and let  $s_2$  and  $r_2$  be the standard deviation and range, respectively, of the data after exercise. Which of the following is true?

- A)  $s_1 = s_2$  and  $r_1 = r_2$
- B)  $s_1 < s_2$  and  $r_1 < r_2$
- C)  $s_1 > s_2$  and  $r_1 > r_2$
- D)  $s_1 \neq s_2$  and  $r_1 = r_2$

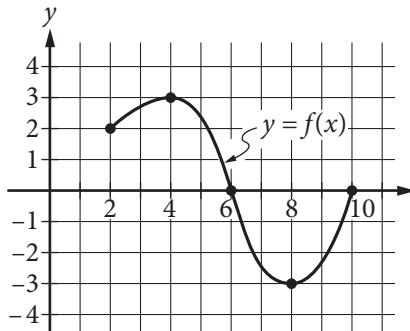


29

A photocopy machine is initially loaded with 5,000 sheets of paper. The machine starts a large job and copies at a constant rate. After 20 minutes, it has used 30% of the paper. Which of the following equations models the number of sheets of paper,  $p$ , remaining in the machine  $m$  minutes after the machine started printing?

- A)  $p = 5,000 - 20m$
- B)  $p = 5,000 - 75m$
- C)  $p = 5,000(0.3)^{\frac{m}{20}}$
- D)  $p = 5,000(0.7)^{\frac{m}{20}}$

30



$x$	$g(x)$
-2	1
-1	2
0	3
1	4
2	5
3	6
4	7

The complete graph of the function  $f$  and a table of values for the function  $g$  are shown above. The maximum value of  $f$  is  $k$ . What is the value of  $g(k)$ ?

- A) 7
- B) 6
- C) 3
- D) 0

**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  $\frac{7}{2}$ . (If  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.

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

← Fraction line

Grid in result.

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

← Decimal point

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

Answer: 2.5

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

.	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

.	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

Answer: 201 – either position is correct

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

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

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



31

There are two atoms of hydrogen and one atom of oxygen in one molecule of water. How many atoms of hydrogen are there in 51 molecules of water?

32

$$x - \frac{1}{2}a = 0$$

If  $x = 1$  in the equation above, what is the value of  $a$ ?

33

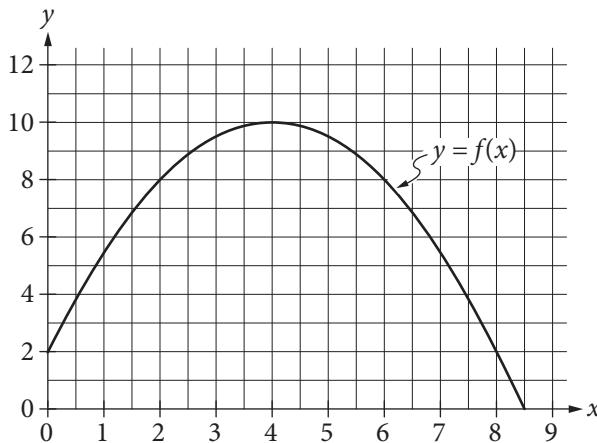
In the  $xy$ -plane, the equations  $x + 2y = 10$  and  $3x + 6y = c$  represent the same line for some constant  $c$ . What is the value of  $c$ ?

34

On April 18, 1775, Paul Revere set off on his midnight ride from Charlestown to Lexington. If he had ridden straight to Lexington without stopping, he would have traveled 11 miles in 26 minutes. In such a ride, what would the average speed of his horse have been, to the nearest tenth of a mile per hour?



35



The graph of the function  $f$ , defined by

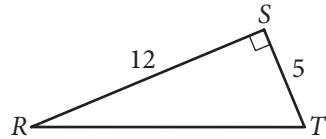
$$f(x) = -\frac{1}{2}(x - 4)^2 + 10, \text{ is shown in the } xy\text{-plane}$$

above. If the function  $g$  (not shown) is defined by

$$g(x) = -x + 10, \text{ what is one possible value of } a \text{ such}$$

that  $f(a) = g(a)$  ?

36

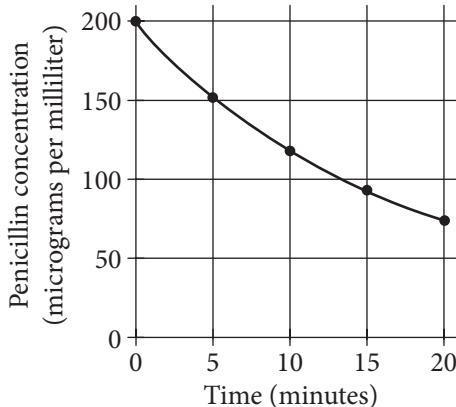


In triangle  $RST$  above, point  $W$  (not shown) lies on  $\overline{RT}$ . What is the value of  $\cos(\angle RSW) - \sin(\angle WST)$  ?



Questions 37 and 38 refer to the following information.

Minutes after injection	Penicillin concentration (micrograms per milliliter)
0	200
5	152
10	118
15	93
20	74



When a patient receives a penicillin injection, the kidneys begin removing the penicillin from the body. The table and graph above show the penicillin concentration in a patient's bloodstream at 5-minute intervals for the 20 minutes immediately following a one-time penicillin injection.



37

According to the table, how many more micrograms of penicillin are present in 10 milliliters of blood drawn from the patient 5 minutes after the injection than are present in 8 milliliters of blood drawn 10 minutes after the injection?

38

The penicillin concentration, in micrograms per milliliter, in the patient's bloodstream  $t$  minutes after the penicillin injection is modeled by the function  $P$  defined by  $P(t) = 200b^{\frac{t}{5}}$ . If  $P$  approximates the values in the table to within 10 micrograms per milliliter, what is the value of  $b$ , rounded to the nearest tenth?

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**STOP**

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

## Answer Explanations

# SAT Practice Test #8

## Section 1: Reading Test

### QUESTION 1

**Choice A is the best answer.** The first paragraph explains the narrator's love of reading: "Even then my only friends were made of paper and ink. . . . Where my school friends saw notches of ink on incomprehensible pages, I saw light, streets, and people." The fourth paragraph reiterates this love in its description of the bookshop as a "sanctuary" and "refuge." The shift in focus occurs in the last six paragraphs, which recount the gift of a book that transforms the narrator's love of reading into a desire to write: "I did not think there could be a better [book] in the whole world and I was beginning to suspect that Mr. Dickens had written it just for me. Soon I was convinced that I didn't want to do anything else in life but learn to do what Mr. Dickens had done." Thus the passage's overall focus shifts from the narrator's love of reading to a specific incident that influences his decision to become a writer.

Choice B is incorrect because the passage never focuses on the narrator's father, who primarily serves to illustrate the narrator's determination to read books despite all obstacles. Choice C is incorrect because the passage focuses on the narrator's desire to write rather than on whatever skill he may have as a writer. Choice D is incorrect because the passage doesn't make the narrator's childhood hardships its central focus or analyze the effects of those hardships.

### QUESTION 2

**Choice C is the best answer.** In the first paragraph, the third sentence describes the narrator's love of reading ("where my school friends saw notches of ink on incomprehensible pages, I saw light, streets, and people"), and the fourth sentence describes the role that reading played in the narrator's life ("a safe haven from that home, those streets, and those troubled days in which even I could sense that only a limited fortune awaited me"). The remainder of the passage recounts incidents in which the narrator's actions arise from his love of, and dependence on, reading. Thus the third and fourth sentences can be seen as describing a passion that accounts for those actions.

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Choice A is incorrect because although the narrator’s “school friends” are mentioned in passing in the third sentence, they aren’t introduced as proper characters and make no further appearance in the passage. Choice B is incorrect because the passage doesn’t list the difficult conditions of the narrator’s childhood until after these sentences. Choice D is incorrect because the narrator’s aspirations aren’t discussed until the last paragraph of the passage.

### QUESTION 3

**Choice C is the best answer.** The tenth paragraph shows that upon returning home, the narrator hides the gift (the “new friend”) that Sempere had given him: “That afternoon I took my new friend home, hidden under my clothes so that my father wouldn’t see it.” It can be inferred from this sentence that the narrator’s concern arises from an awareness that his father would disapprove of the gift.

Choice A is incorrect because although the passage discusses the father’s hostility toward the narrator’s love of reading, there is no indication that the father is not affectionate to the narrator more generally; indeed, the third paragraph depicts the father’s generosity toward the narrator. Choice B is incorrect because the father’s generosity toward the narrator, as depicted in the third paragraph, clearly shows that the father encourages unnecessary purchases of such things as candy. Choice D is incorrect because although the first paragraph shows that the father is hostile toward books in general, there is no indication in the passage that Dickens or any other author is a specific object of the father’s disdain.

### QUESTION 4

**Choice D is the best answer.** The previous question asks which statement about the narrator’s father would the narrator most likely agree with. The answer, that his father wouldn’t have approved of Sempere’s gift to the narrator, is best supported in the tenth paragraph: “That afternoon I took my new friend home, hidden under my clothes so that my father wouldn’t see it.” It can be inferred from this sentence that the narrator is aware of his father’s likely disapproval of the gift (the “new friend”).

Choices A, B, and C are incorrect because the cited lines don’t support the answer to the previous question. Instead, they show the father giving his own gift to the narrator (choice A) and illustrate how the narrator was treated when in Sempere’s bookshop (choices B and C).

### QUESTION 5

**Choice A is the best answer.** The last paragraph makes clear the narrator’s enthusiasm for Charles Dickens’s *Great Expectations*, and it can be inferred from the last sentence of this paragraph that this enthusiasm motivated the narrator to aspire to a career as a writer: “Soon I was convinced that I didn’t want to do anything else in life but learn to do what Mr. Dickens had done.”

Choice B is incorrect because the passage doesn't discuss gifts the narrator has received in the past; although the father sometimes gave the narrator money to buy sweets and snacks, these weren't gifts since the narrator made the purchases himself. Choice C is incorrect because although it is clear from the passage that Sempere was kind and even indulgent to the narrator, there is no suggestion that this treatment was inspired by respect for the narrator. Choice D is incorrect because there is no suggestion that the narrator took Sempere's figurative designation of Dickens as a "lifelong friend" in the ninth paragraph to be a literal statement.

## QUESTION 6

**Choice D is the best answer.** The previous question asks why the narrator considers *Great Expectations* to be the greatest gift he ever received. The answer, that the book convinced him to become a writer, is best supported by the last sentence of the last paragraph: "Soon I was convinced that I didn't want to do anything else in life but learn to do what Mr. Dickens had done."

Choices A, B, and C are incorrect because the cited lines don't support the answer to the previous question. Instead, they explain the narrator's interactions with the bookseller (choice A), describe the book's physical condition (choice B), and indicate the narrator's initial, erroneous assumption that Sempere knew Charles Dickens personally (choice C).

## QUESTION 7

**Choice D is the best answer.** In the fourth paragraph, the narrator explains that although Sempere normally didn't charge him for books, he still left Sempere a few coins as payment: "It was only small change—if I'd had to buy a book with that pittance, I would probably have been able to afford only a booklet of cigarette papers." These lines signal the narrator's awareness that he was paying less for the books than they were worth.

Choice A is incorrect because the passage states that Sempere didn't expect or want the narrator to pay: "He hardly ever allowed me to pay for the books." Choice B is incorrect because the fourth paragraph makes clear that even if Sempere didn't want the narrator's money, the narrator would still "leave the coins I'd managed to collect." Choice C is incorrect because the third paragraph states that the money with which the narrator paid Sempere was originally given to the narrator by his father.

## QUESTION 8

**Choice B is the best answer.** In the fourth paragraph, the narrator describes his reluctance to leave Sempere's bookshop: "When it was time for me to leave, I would do so dragging my feet, a weight on my soul." In this context, "weight" most nearly means burden.

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Choices A, C, and D are incorrect because in the context of the narrator having to do something he doesn't want to, a "weight" he had to carry most nearly means a burden, not a bulk (choice A), force (choice C), or clout (choice D).

## QUESTION 9

**Choice C is the best answer.** When, in the eighth paragraph, the narrator asks Sempere if the author Charles Dickens is a friend of his, Sempere replies, in the ninth paragraph, that Dickens is a "lifelong friend. And from now on, he's your friend too." Sempere designated Dickens a "friend" of both himself and the narrator, who had never heard of the author before. This signals that the use of "friend" in these lines is figurative and emphasizes Sempere's emotional connection to Dickens and, more generally, to reading. It also signals Sempere's hope that the narrator will come to have a similar connection to Dickens.

Choices A, B, and D are incorrect because the word "friend" is used in these lines to emphasize Sempere's connection to reading, rather than his connection to the narrator (choice A), the narrator's relationships or home life (choice B), or the narrator's emotional state or decision making (choice D).

## QUESTION 10

**Choice B is the best answer.** In the ninth paragraph, Sempere describes the author Charles Dickens to the narrator: "A lifelong friend. And from now on, he's your friend too." As the reader can reasonably assume that Sempere doesn't actually know Dickens, this description can be read as signaling Sempere as an avid admirer of Dickens's work.

Choice A is incorrect because the passage describes Sempere as a bookseller, not a writer. Choice C is incorrect because although the passage implies Sempere feels an emotional connection to Dickens, it doesn't suggest that this connection arises from any similarity between Sempere's life and that of Dickens. Choice D is incorrect because even if the passage implies that Sempere admires Dickens's work, Sempere's admiration isn't discussed in relation to that felt by other readers of Dickens, nor is Sempere shown to compare himself to other such readers.

## QUESTION 11

**Choice B is the best answer.** The first paragraph describes the widespread practice of not reporting null results, or results in which researchers fail to see an effect that should be detectable. The second through sixth paragraphs discuss a study that examined how scientists have dealt with null results. The seventh and eighth paragraphs discuss the negative consequences that null results pose for future research and the possible creation of a registry for all data produced by research studies, reported and unreported alike, as a remedy for those

consequences. Therefore, the purpose of the passage as a whole is to explain a common practice in the reporting of research studies and summarize a study that provides support for a change to that practice.

Choice A is incorrect because the passage doesn't dispute a widely held belief about the publication of social science research; rather, it suggests a solution to deal with a long-debated problem. Choice C is incorrect because while the passage hints at possible shortcomings in research trials, it doesn't describe them in detail; because it addresses other kinds of research besides medical trials; and because it doesn't call for a government database, specifically. Choice D is incorrect because the passage calls for changes to the reporting of research results, rather than to research methodology itself, and because it doesn't address the publishers of research at all.

## QUESTION 12

**Choice D is the best answer.** The second paragraph states that “TESS allows scientists to order up Internet-based surveys.” In the context of the service that the TESS program provides to scientists, “allows” most nearly means enables.

Choices A, B, and C are incorrect because in the context of the passage's discussion of TESS, “allows” most nearly means enables, not admits (choice A), tolerates (choice B), or grants (choice C).

## QUESTION 13

**Choice D is the best answer.** The fifth paragraph of the passage addresses the “statistical strength” of certain scientific findings. In this context, “strength” most nearly means significance, or importance.

Choices A, B, and C are incorrect because in the context of the statistical importance of scientific findings, “strength” most nearly means significance, not attribution (choice A), exertion (choice B), or toughness (choice C).

## QUESTION 14

**Choice A is the best answer.** The seventh paragraph discusses the negative consequences of not publishing null results, emphasizing that “worse, if researchers publish significant results from similar experiments in the future, they could look stronger than they should because the earlier null studies are ignored.” In other words, failing to document null results means that the results of later, related studies will not be as accurate as they appear.

Choices B, C, and D are incorrect because the passage does not indicate that failing to document null results can cause promising areas of research to be overlooked (choice B), cause errors in data collection practices that lead to null results being overlooked (choice C), or lessen bias against null results (choice D).

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## QUESTION 15

**Choice D is the best answer.** The previous question asks what the passage indicates could result from failing to document null results. The answer, that the results of future studies will be misleading, is best supported in the seventh paragraph: “Worse, if researchers publish significant results from similar experiments in the future, they could look stronger than they should because the earlier null studies are ignored.”

Choices A, B, and C are incorrect because the cited lines don’t support the answer to the previous question. Instead, choice A suggests how the findings of a study about null results may affect existing beliefs about such results; choice B explains how infrequently null results had been written up, according to Malhotra’s study; and choice C illustrates a problem resulting from the failure to document null results, but one that is unrelated to the fact that this documentation failure may make the results of future, related studies appear more valid than they are.

## QUESTION 16

**Choice B is the best answer.** The last two sentences of the seventh paragraph identify a particular research scenario that Malhotra uncovered in his study: “Even more troubling to Malhotra was the fact that two scientists whose initial studies ‘didn’t work out’ went on to publish results based on a smaller sample. ‘The non-TESS version of the same study, in which we used a student sample, did yield fruit,’ noted one investigator.” Since Malhotra especially objected to these researchers’ suppression of data that produced null results and their subsequent publication of related data that were statistically significant, it can be inferred that the hypothetical situation to which he would most strongly object is one in which researchers publish their study results in a journal but exclude the portion of data that produced null results.

Choices A and D are incorrect because the seventh paragraph, which identifies a research scenario that Malhotra disapproved of, provides no basis for an inference that he would especially object to a team’s insisting on publishing null results in a top journal only (choice A) or a team’s expanding the scope of a study that had produced null results (choice D). Choice C is incorrect because although the first sentence of the seventh paragraph indicates Malhotra’s concern that failing to publish null results can mean that other researchers unwittingly replicate strategies that produced null results in prior studies, the paragraph goes on to identify other scenarios as being “worse” and “even more troubling” from Malhotra’s perspective.

## QUESTION 17

**Choice C is the best answer.** The previous question asks about which hypothetical situation Malhotra would most strongly object to. The answer, that he would most strongly object to researchers' reporting their findings but failing to disclose the null results, is best supported at the end of the seventh paragraph: "Even more troubling to Malhotra was the fact that two scientists whose initial studies 'didn't work out' went on to publish results based on a smaller sample. 'The non-TESS version of the same study, in which we used a student sample, did yield fruit,' noted one investigator."

Choices A, B, and D are incorrect because the cited lines don't support the answer to the previous question about which situation Malhotra would most strongly object to. Instead, they cite another researcher's attitude toward null results from his or her own study (choice A), compare the publication rate for studies that produce null results with that for studies that produce statistically significant results (choice B), and describe the recommendation by Malhotra and his team for the creation of a database to remedy problems resulting from the nonpublication of null results (choice D).

## QUESTION 18

**Choice B is the best answer.** After describing problems that could arise from the failure to report null results, the passage shifts in the last paragraph to a potential solution to such problems: "A registry for data generated by all experiments would address these problems, the authors argue." The paragraph goes on to imply that a registry could solve such problems by deterring the suppression of null results.

Choice A is incorrect because the last paragraph proposes a "registry for data" rather than a future research project. Choice C is incorrect because the summary of the results of Malhotra's study occurs in the fifth paragraph, not in the last. Choice D is incorrect because the last paragraph of the passage does not mention reexamining results already obtained in social science trials.

## QUESTION 19

**Choice C is the best answer.** The far left bar of the graph pertains to social science studies that produced strong results. This bar shows that approximately 20 percent (or two full increments of 10 percent) of such studies were published in a top journal.

Choice A is incorrect because the graph shows that approximately 5 percent of social science studies that produced strong results were unwritten, rather than over 50 percent. Choice B is incorrect because the graph shows that about 30 percent of social science studies that produced strong results were unpublished but written, rather than 50 percent. Choice D is incorrect because the graph shows that slightly over 40 percent of social science studies that produced strong results were published in a non-top journal, rather than almost 80 percent.

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## QUESTION 20

**Choice A is the best answer.** The middle bar of the graph pertains to social science studies that produced mixed results. The top 50 percent of this bar represents studies that were published. The bottom 50 percent of this bar represents studies that were either unpublished or went unwritten. Since each of the two categories accounts for 50 percent of the total, it can be said that studies with mixed results were just as likely to be published as they were to be left either unpublished or unwritten.

Choice B is incorrect because the graph indicates that roughly 42 percent of social science studies produced strong results and roughly 22 percent produced null results; together, these two percentages far exceed the 36 percent accounted for by studies that produced mixed results. Choice C is incorrect because the graph shows that roughly 12 percent of studies that produced mixed results were published in top journals, well less than the percentage published in non-top journals (approximately 38 percent). Choice D is incorrect because the graph indicates that studies that produced strong results accounted for approximately 42 percent of all studies, while those that produced mixed results only accounted for around 36 percent of all studies.

## QUESTION 21

**Choice C is the best answer.** The first sentence of the fifth paragraph states, “Not unexpectedly, the statistical strength of the findings made a huge difference in whether they were ever published.” This statement is supported by the graph, which shows that more than 60 percent of social science studies that produced strong results were published, while only about 50 percent of studies with mixed results and about 20 percent of studies with null results were published.

Choices A, B, and D are incorrect because none of the cited lines contain information that is represented by the data in the graph. Instead, they recount scientists’ explanations for why they didn’t publish their null results (choices A and B) and highlight claims about the importance of Malhotra’s study (choice D).

## QUESTION 22

**Choice A is the best answer.** The first paragraph explains that in the nanoworld, salt can be seen “stretching like taffy.” The third paragraph notes that while this elasticity was expected in metals, it wasn’t imagined for salt: “But scientists don’t expect this superplasticity in a rigid, crystalline material like salt.” The rest of the passage explores this unexpected behavior of salt. Therefore it can be said that one of the central ideas of the passage is that materials don’t always behave as scientists might expect them to.

Choices B, C, and D are incorrect because the passage focuses on the unexpected way that salt reacts in the nanoworld, not on the role of inputs and outputs in systems (choice B), the relative strengths and weaknesses of models (choice C), or how the properties of systems differ from the properties of their parts (choice D).

## QUESTION 23

**Choice D is the best answer.** The first five paragraphs introduce salt's ability to stretch "like taffy to more than twice its length." In the fifth paragraph, the passage shifts into an explanation of how "Moore and his colleagues discovered salt's stretchiness." The last paragraph speculates about the possible application of this discovery: "The work also suggests new techniques for making nanowires, which are often created through nano-imprinting techniques." The passage's overall structure can therefore be seen as consisting of an introduction to an interesting salt property, followed by a description of how the property was discovered, followed by a speculation regarding applications of this property.

Choice A is incorrect because the passage discusses only one way in which salt differed from researchers' expectations. Choice B is incorrect because the passage begins not with a hypothesis about salt's behavior but with an explanation of its behaviors. Choice C is incorrect because the passage discusses complementary observations of salt crystals rather than two experiments involving salt that yield seemingly conflicting results.

## QUESTION 24

**Choice A is the best answer.** That Moore's group was surprised to observe salt stretching is most directly suggested by the last sentence of the third paragraph: "But scientists don't expect this superplasticity in a rigid, crystalline material like salt, Moore says."

Choices B, C, and D are incorrect because the cited lines don't support the idea that Moore's group was surprised to observe salt stretching. Instead, they explain how the group happened upon their observation (choice B), the measures the group took to investigate the stretching further (choice C), and how common salt is in nature (choice D).

## QUESTION 25

**Choice B is the best answer.** The first sentence of the fourth paragraph states, "This unusual behavior highlights that different forces rule the nanoworld." In this context, to "rule" most nearly means to control.

Choices A, C, and D are incorrect because in the context of a discussion of forces that operate on the nanoworld, to "rule" most nearly means to control, not to mark (choice A), declare (choice C), or restrain (choice D).

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## QUESTION 26

**Choice D is the best answer.** The first sentence of the sixth paragraph identifies “electrostatic forces, perhaps good old van der Waals interactions” as the potential cause of the initial attraction between the microscope tip and the salt.

Choices A, B, and C are incorrect because the first sentence of the sixth paragraph clearly identifies the potential cause of the initial attraction between the microscope tip and the salt as van der Waals interactions, not as gravity (choice A), nano-imprinting (choice B), or surface tension (choice C).

## QUESTION 27

**Choice B is the best answer.** The sixth paragraph says that “several mechanisms might lead to” salt’s elasticity. In this context, the phrase “lead to” most nearly means result in.

Choices A, C, and D are incorrect because in the context of something causing salt molecules to exhibit elasticity, the phrase “lead to” most nearly means result in, not guide to (choice A), point toward (choice C), or start with (choice D).

## QUESTION 28

**Choice A is the best answer.** The first paragraph of the passage makes clear that salt exhibits elasticity (“stretching like taffy”) in the nanoworld, and the eighth paragraph explains that salt possesses some degree of elasticity in the macroworld as well: “Huge underground deposits of salt can bend like plastic, but water is believed to play a role at these scales.” Thus flexibility describes the relationship between salt’s behavior in both the nanoworld and the macroworld.

Choice B is incorrect because the third paragraph explains that “scientists don’t expect” salt’s flexibility in the nanoworld, not that they do expect it; moreover, there is no indication that salt’s flexibility in the macroworld is surprising. Choice C is incorrect because the passage doesn’t make clear whether nanowires were first observed in the nanoworld or the macroworld. Choice D is incorrect because the passage does not examine the interaction of salt and water in the nanoworld or suggest that such interaction causes salt to have properties that are different from those it possesses in the macroworld.

## QUESTION 29

**Choice D is the best answer.** The previous question asks about which description of the relationship between salt behavior in the nanoworld and in the macroworld can be inferred from the passage. The answer, that salt is flexible or elastic in both worlds, is best supported in the eighth paragraph: “Huge underground deposits of salt can bend like plastic, but water is believed to play a role at these scales.” These lines suggest that in the macroworld, as in the nanoworld, salt possesses flexibility.

Choices A, B, and C are incorrect because the cited lines don't support the answer to the previous question. Instead, they highlight the prevalence of nanowires (choice A), identify which forces dominate the nanoworld (choice B), and offer a tentative explanation for an observation discussed in the passage (choice C).

### QUESTION 30

**Choice C is the best answer.** The lower graph, which shows the “tip moving away from salt surface,” indicates that when the microscope tip was 15 nanometers from the surface, the force on the tip was approximately 0.75 microneutrons.

Choices A, B, and D are incorrect because the graph shows that when the microscope tip was 15 nanometers from the salt surface, the force on the tip was approximately 0.75 microneutrons, not 0 microneutrons (choice A), 0.25 microneutrons (choice B), or 1.25 microneutrons (choice D).

### QUESTION 31

**Choice D is the best answer.** The bottom graph illustrates the process described in the first sentence of the seventh paragraph of the passage: “as the microscope pulls away from the salt, the salt stretches.” On the graph, the stretching of the salt is represented by the amount of force, in microneutrons, exerted on the microscope tip as the tip moves away from the salt surface. The graph shows that force was exerted on the tip until the tip reached point T at approximately 22 nanometers from the salt surface; from point T on, the force was 0 microneutrons. It can be inferred that since no force is being exerted after point T, point T is the point at which a salt nanowire breaks.

Choices A, B, and C are incorrect because the labels P, Q, and R all appear on the top graph, which represents data on the movement of the microscope tip toward the salt surface. As the fifth sentence of the fifth paragraph explains, when the microscope tip moved toward the salt, “the salt actually stretched out to glom on to the microscope tip.” Therefore, the first graph shows the salt attaching itself to the microscope tip and forming nanowires, not the breaking of a nanowire.

### QUESTION 32

**Choice B is the best answer.** In the first paragraph of Passage 1, Douglas argues that throughout the period in which the United States had both free and slave states, the nation as a whole “increased from four millions to thirty millions of people . . . extended our territory from the Mississippi to the Pacific Ocean . . . acquired the Floridas and Texas . . . [and had] risen from a weak and feeble power to become the terror and admiration of the civilized world.” It can reasonably be inferred that Douglas cites such growth in territory and population to make the point that the division into free and slave states was obviously not a threat to the country’s health or survival.

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Choice A is incorrect because although it can be inferred that Douglas would argue for continued expansion of the United States, he cites the expansion it has already undergone as support for perpetuating the division into free and slave states. Choice C is incorrect because although Douglas implies that basic facts pertaining to the historical growth of the nation cast doubt on Lincoln's political agenda, he doesn't imply that Lincoln is unaware of those facts. Choice D is incorrect because although Douglas notes that the United States is globally perceived to be powerful, he doesn't imply that this perception can be accounted for by the nation's record of growth.

### QUESTION 33

**Choice C is the best answer.** In the second paragraph of Passage 1, Douglas uses a rhetorical question to stress that the division into slave and free states has existed since the beginning of the United States: "I now come back to the question, why cannot this Union exist forever, divided into Free and Slave States, as our fathers made it?" It can be inferred from this question that Douglas believes that since this division is long-standing, the provisions for it in the US Constitution have provided a good basic structure that doesn't need to be changed.

Choice A is incorrect because in Passage 1, Douglas doesn't observe that the US Constitution's provisions for slavery lack a means for reconciling differences between slave states and free states. Choice B is incorrect because although Douglas stresses that the provisions for slavery are long-standing, he doesn't characterize them as having somehow anticipated the Union's expansion to the west. Choice D is correct because although it can be inferred from Passage 1 that Douglas believes the provisions for slavery have had a positive economic impact, he nowhere implies that the founders based them on an assumption that slavery was economically necessary.

### QUESTION 34

**Choice B is the best answer.** The previous question asks about how Douglas, in Passage 1, characterizes the Constitution's provisions for slavery. The answer, that Douglas believes they provided a good basic structure and don't need to be changed, is best supported in the first sentence of the second paragraph of Passage 1: "I now come back to the question, why cannot this Union exist forever, divided into Free and Slave States, as our fathers made it?"

Choices A, C, and D are incorrect because the cited lines don't support the answer to the previous question. Instead, they describe the various ways in which the nation has expanded since its founding (choice A), stress the likelihood that the nation will only continue to expand (choice C), and assert the importance of the sovereignty of individual states to the future expansion of the nation (choice D).

## QUESTION 35

**Choice C is the best answer.** In the first sentence of the second paragraph of Passage 2, Lincoln raises a question about how the consequences of the division of the United States into slave states and free states compare with the consequences of the other ways in which states differ from each other: “But has it been so with this element of slavery?” In this context, the word “element” most nearly means factor.

Choices A, B, and D are incorrect because in the context of Lincoln’s discussion of the “element of slavery,” the word “element” most nearly means factor, not ingredient (choice A), environment (choice B), or quality (choice D).

## QUESTION 36

**Choice B is the best answer.** In the second paragraph of Passage 2, Lincoln asserts that the controversy surrounding slavery in the United States has died down whenever the institution of slavery has been restricted geographically: “Whenever it has been limited to its present bounds, and there has been no effort to spread it, there has been peace.” Since Lincoln associates peace on this issue with geographical limits on the institution of slavery itself, it can be inferred that he would agree that the controversy would abate if all attempts to establish slavery in new regions ceased.

Choice A is incorrect because Lincoln neither urges Northern states to attempt to abolish slavery unilaterally nor implies that such an attempt would extinguish the controversy over slavery. Choice C is incorrect because Lincoln neither suggests that the laws regulating slavery are ambiguous nor that such ambiguity exacerbates controversy over slavery. Choice D is incorrect because Lincoln never attributes the controversy over slavery to differences in religion or social values from one state to another.

## QUESTION 37

**Choice C is the best answer.** The previous question asks which claim about the controversy over slavery would Lincoln agree with. The answer, that the controversy would abate if attempts to spread slavery to regions where it isn’t practiced were abandoned, is best supported in the second paragraph of Passage 2: “Whenever [slavery] has been limited to its present bounds, and there has been no effort to spread it, there has been peace.”

Choices A, B, and D are incorrect because the cited lines don’t support the answer to the previous question. Instead, they discuss state-to-state differences in laws regulating issues other than slavery (choice A), assert that the differences among the various states generally benefit the nation (choice B), and ask a philosophical question that doesn’t directly address the issue of slavery (choice D).

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## QUESTION 38

**Choice D is the best answer.** In the last sentence of Passage 2, Lincoln asks about the likelihood that people will fundamentally change: “Do you think that the nature of man will be changed?” In this context, the word “nature” most nearly means character.

Choices A, B, and C are incorrect because in the context of a discussion of the “nature of man,” the word “nature” most nearly means character, not force (choice A), simplicity (choice B), or world (choice C).

## QUESTION 39

**Choice C is the best answer.** In the first paragraph of Passage 1, Douglas claims that Lincoln considers the Constitution to be “a house divided against itself,” due to its provisions for the division of the nation into slave states and free states, and to be “in violation of the law of God.” In Passage 2, Lincoln objects to this characterization of his position and devotes the majority of the passage to clarifying that it isn’t the Constitution he finds fault with, or even its provisions for slavery, but rather with attempts to spread slavery to regions where it isn’t currently practiced. Therefore it can be said that a central tension between the two passages arises from, on the one hand, Douglas’s criticism of Lincoln for finding fault with the Constitution and, on the other, Lincoln’s insistence that Douglas has misrepresented his position.

Choice A is incorrect because Douglas (Passage 1) proposes no changes to federal policies on slavery and because Lincoln (Passage 2) doesn’t consider whether changes to such policies would enjoy popular support. Choice B is incorrect because Douglas (Passage 1) never expresses concern about the potential impact of abolition on the US economy and because Lincoln (Passage 2) neither discusses such an impact nor dismisses concerns about it. Choice D is incorrect because neither passage offers any interpretation of federal law.

## QUESTION 40

**Choice A is the best answer.** In the first paragraph of Passage 1, Douglas discusses the issue of slavery in the context of the division of free states and slave states throughout the period when the United States “extended our territory from the Mississippi to the Pacific Ocean” and “acquired the Floridas and Texas, and other territory sufficient to double our geographical extent.” In the second paragraph of Passage 2, Lincoln asserts that the controversy over slavery has historically been “excited by the effort to spread [slavery] into new territory,” as in the case of Missouri, Texas, and “the territory acquired by the Mexican War.” Therefore, it can be said that, notwithstanding their differences of opinion, both Douglas and Lincoln discuss the issue of slavery in relationship to the expansion of the Union.

Choices B, C, and D are incorrect because it is in relationship to the nation's expansion that both passages discuss the issue of slavery, not in relationship to questions of morality (choice B), religious toleration (choice C), or laws regulating commerce (choice D).

## QUESTION 41

**Choice D is the best answer.** In the second paragraph of Passage 1, Douglas asks the rhetorical question: “why cannot this Union exist forever, divided into Free and Slave States, as our fathers made it?” The remainder of the paragraph amounts to an answer to this rhetorical question and a refutation of Lincoln’s viewpoint on slavery, as represented by Douglas. In the second paragraph of Passage 2, Lincoln asks a series of rhetorical questions: “But has it been so with this element of slavery? Have we not always had quarrels and difficulties over it? And when will we cease to have quarrels over it?” These questions imply that there are flaws in Douglas’s equating the division into slave states and free states with other, more unambiguously beneficial differences from state to state. The remainder of the second paragraph expands on these flaws. Therefore, it can be said that in context, the rhetorical questions asked by each speaker serve to undermine the argument of the other speaker.

Choice A is incorrect because in asking rhetorical questions, neither Douglas nor Lincoln casts doubt on the sincerity of his opponent. Choices B and C are incorrect because although Douglas and Lincoln find fault with each other’s ideas, they don’t criticize each other’s methods (choice B) or reproach each other’s actions (choice C).

## QUESTION 42

**Choice A is the best answer.** The first two paragraphs of the passage describe the physical process by which the Venus flytrap closes its trap but also note certain long-standing questions about that process: “How does the plant encode and store the information from the unassuming bug’s encounter with the first hair? How does it remember the first touch in order to react upon the second?” The passage then answers those questions by discussing, in the third and fourth paragraphs, a study conducted by Dieter Hodick and Andreas Sievers that identified the physiological means behind the closing of the Venus flytrap’s trap and, in the last paragraph, a study conducted by Alexander Volkov that confirmed and built on Hodick and Sievers’s findings. The primary purpose of the passage can therefore be seen as discussing scientific findings that explain how the Venus flytrap closes its trap.

Choice B is incorrect because the passage doesn’t discuss the Venus flytrap’s ability to close its trap in the context of the abilities of other plants. Choice C is incorrect because the passage discusses how the closing action operates but not how it has evolved. Choice D is incorrect because the passage doesn’t provide an overview of the Venus flytrap and its predatory behavior; it merely notes in passing that the closing action has a predatory function.

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## QUESTION 43

**Choice C is the best answer.** The first paragraph discusses the challenge posed to the Venus flytrap by the opening and closing of its trap: “Closing its trap requires a huge expense of energy, and reopening the trap can take several hours, so *Dionaea* only wants to spring closed when it’s sure that the dawdling insect visiting its surface is large enough to be worth its time.” Since closing and reopening the trap requires the expense of precious energy, it can be inferred that by guarding against unnecessary closing, multiple triggers safeguard the plant’s energy supply.

Choice A is incorrect because the passage never indicates that multiple triggers allow the Venus flytrap to identify which species its prey belongs to, only that they allow it to gauge the prey’s size. Choice B is incorrect because although the passage implies that the plant needs to conserve energy and indicates that calcium is involved in the trap-closing mechanism, there is no indication that the plant’s calcium reserves themselves require conservation. Choice D is incorrect because it can be inferred from the passage that the advantage of multiple triggers is that they prevent the Venus flytrap from closing on the improper prey rather than from prematurely closing on the proper prey; the passage never implies that when touched by its proper prey, the Venus flytrap is at risk of closing too soon to capture it.

## QUESTION 44

**Choice A is the best answer.** The previous question asks what the Venus flytrap gains from requiring multiple triggers before closing. The answer, that multiple triggers allow the plant to conserve energy, is best supported near the beginning of the first paragraph: “Closing its trap requires a huge expense of energy, and reopening the trap can take several hours, so *Dionaea* only wants to spring closed when it’s sure that the dawdling insect visiting its surface is large enough to be worth its time.”

Choices B, C, and D are incorrect because the cited lines don’t support the answer to the previous question. Instead, they describe how the hairs on the Venus flytrap function and how the system of multiple triggers works (choices B and C) and explain how the plant preserves a memory, as it were, that something has touched the trigger hairs (choice D).

## QUESTION 45

**Choice C is the best answer.** The phrases “dawdling insect,” “happily meanders,” and “unassuming bug’s encounter” are less typical of word choices made in formal, scientific writing than of those made in less formal writing modes. Therefore, the tone that these phrases establish is best described as informal.

Choices A, B, and D are incorrect because the phrases establish a tone that is informal, not academic (choice A), melodramatic (choice B), or mocking (choice D).

## QUESTION 46

**Choice A is the best answer.** The first paragraph describes the mechanism that prompts the Venus flytrap to close its trap. The second paragraph makes an analogy of each step of that mechanism to an aspect of short-term memory formation in humans and then poses questions about the precise physiological terms in which those steps are carried out. It can therefore be said that the discussion of short-term memory serves to clarify the first paragraph's explanation of what prompts the trap of the Venus flytrap to close.

Choice B is incorrect because it is the third paragraph, not the second, that discusses the function of electric charges in the Venus flytrap; moreover, the passage presents this function as a fact, not as a controversial hypothesis. Choice C is incorrect because rather than stressing the differences between Venus flytraps and humans, the analogy in the second paragraph stresses their superficial similarities. Choice D is incorrect because the second paragraph implies that the Venus flytrap's capacity for retaining information is far from detailed: "something (it doesn't know what) has touched one of its hairs."

## QUESTION 47

**Choice D is the best answer.** The third paragraph explains that touching a single trigger hair results in "a rapid increase in the concentration of calcium ions" in the plant. The fourth paragraph further explains that the calcium concentration produced by this initial touch isn't enough to cause the trap to close, but that a second hair touch will bring the total concentration to the level necessary to close the trap: "a second hair needs to be stimulated to push the calcium concentration over this threshold and spring the trap."

Choices A and B are incorrect because the fourth paragraph explains that the second trigger supplements the action of the first trigger, not that it reverses it (choice A) or stabilizes its effect (choice B). Choice C is incorrect because the third paragraph clearly states that the calcium channels open after the first trigger hair is touched, not the second.

## QUESTION 48

**Choice B is the best answer.** The fourth paragraph explains that the Venus flytrap will close only if a second hair is stimulated to "push the calcium concentration over this threshold and spring the trap." But the last sentence of the paragraph notes that the calcium concentrations "dissipate over time," and if enough time elapses after the first trigger, "the final concentration after the second trigger won't be high enough to close the trap." It can be inferred, then, that if a large insect didn't touch a second trigger hair until after the calcium ion concentrations had diminished appreciably, the Venus flytrap would fail to close.

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Choice A is incorrect because the fourth paragraph makes clear that if the calcium concentration goes above the trap’s threshold, the plant will close, not remain open. Choice C is incorrect because as the third paragraph explains, the touching of the trigger hair and opening of the calcium ion channels don’t act to keep the trap open but are instead a precondition for the closing of the trap (though closing will occur only if a second trigger hair is touched). Choice D is incorrect because the last sentence of the fifth paragraph explains that the threshold for the time that can elapse between the touching of the first and second trigger hairs is twenty seconds, meaning that a large insect touching two hairs within ten seconds would almost certainly make the plant close.

### QUESTION 49

**Choice B is the best answer.** The second sentence of the last paragraph says that Alexander Volkov and his colleagues “first demonstrated that it is indeed electricity that causes the Venus flytrap to close.” In this context, the word “demonstrated” most nearly means established.

Choices A, C, and D are incorrect because in the context of scientists showing what causes the Venus flytrap to close, the word “demonstrated” most nearly means established, not protested (choice A), performed (choice C), or argued (choice D).

### QUESTION 50

**Choice B is the best answer.** As described in the third paragraph, Hodick and Sievers’s model emphasizes that the Venus flytrap closes by means of an electrical charge triggered when the plant’s hairs are touched. But as explained in the last paragraph, when Alexander Volkov tested this model, the design of his experiment involved the direct application of an electrical charge, which “made the trap close without any direct touch to its trigger hairs.” Therefore, Volkov’s work could be criticized because his design omitted, rather than corroborated, a central element of Hodick and Sievers’s model—namely, the physical stimulation of the hairs.

Choice A is incorrect because although the last paragraph explains that Volkov omitted an element of Hodick and Sievers’s model when designing his own experiment, there is no suggestion that he did so out of a faulty understanding of their model. Choice C is incorrect because it is impossible to know from the passage if Hodick and Sievers would have objected to Volkov’s methods. Choice D is incorrect because the passage doesn’t indicate whether the technology Volkov used had been available to Hodick and Sievers when they formulated their model.

## QUESTION 51

**Choice C is the best answer.** The previous question asks what potential criticism might be made of Volkov’s testing of Hodick and Sievers’s model. The answer, that a central element of that model wasn’t corroborated by Volkov’s measurements, is best supported in the last paragraph: “This made the trap close without any direct touch to its trigger hairs (while they didn’t measure calcium levels, the current likely led to increases).” Because the physical touch to the hairs figured in Hodick and Sievers’s model, it can be said that Volkov’s decision to apply an electrical current directly to the plant means that he failed to corroborate a central element of their model.

Choices A, B, and D are incorrect because the cited lines don’t support the answer to the previous question. Instead, they summarize the basic agreement of Volkov’s work with Hodick and Sievers’s model (choice A) and describe steps in Volkov’s experimental design that are related to the application of an electrical current but don’t directly address the omission of the central element of the physical touch to the hairs (choices B and D).

## QUESTION 52

**Choice C is the best answer.** The second sentence of the last paragraph says that the focus of Volkov’s work was the role of electricity in the Venus flytrap’s closing mechanism. The paragraph goes on to explain that by applying electricity directly to the plant and “altering the amount of electrical current, Volkov could determine the exact electrical charge needed for the trap to close.” It is therefore accurate to say that Volkov and his colleagues made the most extensive use of information obtained from measuring the plant’s response to varying amounts of electrical current.

Choice A is incorrect because although the last paragraph explains that Volkov’s work was based on Hodick and Sievers’s mathematical model in which an electrical charge is required to close the Venus flytrap, that model isn’t described as predicting the precise amount of charge required; moreover, although Volkov made use of this earlier model, it served as a starting point, and his work made greater use of the findings generated by his experiment. Choice B is incorrect because the passage doesn’t describe Volkov’s work as having involved analysis of data from earlier studies on the plant’s response to electricity. Choice D is incorrect because although the last paragraph explains that Volkov based his work on Hodick and Sievers’s earlier model, this was the sole model that Volkov relied on, and there is no suggestion that he made use of multiple “published theories” or “earlier models”; moreover, he made more extensive use of data generated by his own experiment than of Hodick and Sievers’s model.

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## Section 2: Writing and Language Test

### QUESTION 1

**Choice D is the best answer.** The prepositional phrase “for example” logically connects the two sentences and correctly indicates that what follows in the second sentence will be examples of household waste products: paper, glass, aluminum, and garbage.

Choices A, B, and C are incorrect because they don’t indicate the true relationship between the two sentences. “Regardless” (choice A) means in spite of something, “however” (choice B) indicates a contrast, and “furthermore” (choice C) means in addition. None of these transitions indicates that an example will follow.

### QUESTION 2

**Choice B is the best answer.** The verb “eliminate” means to remove, and it makes the most sense in the sentence because the object of the verb is “need.” “Eliminating the need” is an idiomatic expression for “removing the need.”

Choices A, C, and D are incorrect. Although all the choices mean “to get rid of,” their connotations are different. “Annihilating” (choice A) is usually used to refer to the act of completely destroying, which is too intense in this context. “Ousting” (choice C) is generally used when referring to the act of forcibly removing a person from a position. “Closing the door on” (choice D) is a colloquial expression that usually means shutting out the possibility of something happening or not being willing to consider an idea. This expression doesn’t fit the tone of the passage and is not idiomatic when used with “need.”

### QUESTION 3

**Choice C is the best answer.** The singular present tense verb “increases” agrees in number with the singular noun “compost” and maintains the parallel structure of the other two compound verbs in the sentence, “minimizes” and “helps.”

Choices A and D are incorrect because the use of the pronoun “it” (choice A) and “also it” (choice D) to begin new independent clauses creates comma splices. Choice B is incorrect because “savings increase” doesn’t maintain the parallel structure of the verbs in the sentence: “minimizes water waste and storm runoff” and “helps reduce erosion.”

### QUESTION 4

**Choice B is the best answer.** When setting off nonessential information, a pair of parentheses needs to be used. This choice provides the initial parenthesis that the parenthesis after “municipality” requires.

Choice A is incorrect because the initial parenthesis is missing and no comma is needed between the noun “quantities” and the modifying information. Choice C is incorrect because the initial parenthesis is missing. Choice D is incorrect because no semicolon is needed before the parenthetical information.

## QUESTION 5

**Choice D is the best answer.** According to the information from the graph, 33 million tons of food waste were discarded in US landfills in 2009, which is consistent with the discussion of food waste in the passage.

Choices A, B, and C are incorrect because the passage thus far has focused on compost. Metal, rubber, leather, and textiles are not materials that are composted.

## QUESTION 6

**Choice C is the best answer.** According to the graph, this is the only choice that makes the sentence true. More food waste was discarded in landfills in 2009 “than any other substance, including plastics or paper.”

Choices A, B, and D are incorrect because they are not true, according to the graph. The graph indicates that less glass, metal, and yard waste were discarded in the landfills than plastics and paper.

## QUESTION 7

**Choice B is the best answer.** No comma is needed between the comparative adjective “worse” and the comparative conjunction “than.”

Choices A, C, and D are incorrect because the word “then” indicates “when” and is not used in comparisons (choices A and C), and no comma is needed after worse (choice D).

## QUESTION 8

**Choice C is the best answer.** The present tense singular verb “contributes” agrees in number with the singular noun “material,” and the present tense verb is consistent with the other present tense verbs in the passage.

Choices A and B are incorrect because “contribute” (choice A) and “are contributing” (choice B) are plural present tense verbs. Choice D is incorrect because “have contributed” is a plural past tense verb.

## QUESTION 9

**Choice A is the best answer.** “Potent” means strong or powerful, which makes sense in the context of discussing greenhouse gas.

Choice B is incorrect because “sturdy” is usually used to refer to the physical strength or solidity of something. Choice C is incorrect because “influential” refers to the power of a person to affect or sway others or events without any apparent effort. Choice D is incorrect because “commanding” indicates that the inanimate greenhouse gas is actually commanding something.

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## QUESTION 10

**Choice C is the best answer.** “Armed with these facts” is the most effective transition from the previous paragraph, which discusses the amounts of various substances that end up in landfills and the resulting methane gas that is released from the organic matter. The paragraph that this transition introduces goes on to discuss laws that some cities have instituted to control the handling of compost in landfills to reduce the release of methane gas.

Choices A, B, and D are incorrect because they do not offer transitions that indicate a connection between the problem identified in the previous paragraph—the release of dangerous methane gas from the compost in landfills—and the concluding paragraph that identifies what some cities have done to help alleviate the problem.

## QUESTION 11

**Choice A is the best answer.** No change is needed because the correlative conjunctions “either” and “or” are used together to indicate that one choice or another should be considered. In this sentence, residents are encouraged to choose the option to create their own compost piles or to dispose of compostable materials in bins for collection.

Choices B, C, and D are incorrect because they do not provide the correlating conjunction for “either” used earlier in the sentence.

## QUESTION 12

**Choice A is the best answer.** The sentences are effectively combined by placing a comma after “red” and making the second sentence an appositive that explains the significance of the color red.

Choices B, C, and D are incorrect because they all contain excessive words that add no meaning to the resulting sentence.

## QUESTION 13

**Choice D is the best answer.** Punctuation is not necessary in the underlined portion of the sentence.

Choice A is incorrect because no commas are needed after “festive” and “red” because the adjectives don’t equally modify “banners.” No comma is needed after “banners” because there is no reason to put one between “banners” and “and garlands,” the two objects of the preposition “with.” Choice B is incorrect because placing commas around the prepositional phrase “with festive red banners” wrongly indicates that the information is nonessential and could be eliminated without changing the meaning of the sentence. Choice C is incorrect because there should not be a dash or any other kind of punctuation between “banners” and “and garlands.”

## QUESTION 14

**Choice C is the best answer.** This choice expands on the idea that the lion dance may have originated to ward off an evil spirit and that dressing in a lion costume was part of the effort to scare the spirit away.

Choice A is incorrect because it doesn't make a connection between the fierce quality of a lion and scaring away spirits. Choices B and D are incorrect because the name of the spirit (choice B) and the location of the village where the dance originated (choice D) are not as important as why a lion was incorporated into the dance.

## QUESTION 15

**Choice C is the best answer.** It ties the information about the possible origins and historical purpose of the lion dance to its present purpose as a New Year's celebration of hope.

Choices A, B, and D are incorrect because they don't effectively bring the paragraph to a conclusion. Each of these options is vague and calls for elaboration: choice A lacks specific information, choice B lacks proof for the idea of irrelevance, and choice D lacks a connection to the subject of the paragraph.

## QUESTION 16

**Choice A is the best answer.** The pronoun "both" and prepositional phrase "of whom" refer to "dancers" and are used correctly to introduce a clause that describes how the dancers are hidden by the lion costume. "Whom" is used correctly as the object of the preposition "of."

Choice B is incorrect because the word order doesn't make grammatical sense and the pronoun "which" can't be used to refer to people.

Choices C and D are incorrect because they create comma splices.

## QUESTION 17

**Choice D is the best answer.** The pronoun "those" correctly indicates that the moves in dance are being compared to the moves in martial arts. "Those" takes the place of the noun "moves" in the comparison.

Choices A, B, and C are incorrect because they do not compare similar things. "Moves" can't be compared to "martial arts," "acrobatics," "disciplines," "martial artists," or "acrobats."

## QUESTION 18

**Choice B is the best answer.** This choice indicates that the phoenix represents new beginnings, which is consistent in content with the information explaining that the tortoise represents longevity. Additionally, this choice is presented as a parenthetical prepositional phrase beginning with the preposition "for," which is consistent in structure with the parenthetical prepositional phrase "for longevity."

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Choice A is incorrect because the parenthetical information indicates what a phoenix is, not what it represents. Furthermore, the information is not presented in a prepositional phrase. Choice C is incorrect because this choice indicates the source of the phoenix, not what it represents. Choice D is incorrect because it is vague and doesn't identify what the phoenix symbolizes.

## QUESTION 19

**Choice D is the best answer.** Sentence 5 most logically should follow sentence 7. The pronoun “their” in sentence 5 refers to the “black lions” (which are the youngest lions and dance quickly) in sentence 7. Sentence 5 indicates that the “older counterparts” to the young lions don’t move as quickly.

Choices A, B, and C are incorrect because placing sentence 5 after any other sentence in the paragraph would not be logical and would interrupt the flow of the passage.

## QUESTION 20

**Choice B is the best answer.** The singular possessive pronoun “its” agrees in number with the singular antecedent “dance” and correctly indicates that the “climax” belongs to the dance.

Choice A is incorrect because “it’s” is the contraction for “it is” and doesn’t make sense in the sentence. Choice C is incorrect because “there” is not a possessive pronoun. Choice D is incorrect because “their” is a plural possessive pronoun that doesn’t agree with the singular antecedent “dance.”

## QUESTION 21

**Choice B is the best answer.** This choice correctly indicates that the lion is doing the approaching and the snaring, not the teeth.

Choices A and D are incorrect because the teeth don’t do the approaching or the snaring; only an animate object can do either. Choice C is incorrect because it is written in the passive voice, which changes the subject of the sentence from “lion” to “envelope.” Furthermore, an “envelope” cannot approach a doorway.

## QUESTION 22

**Choice D is the best answer.** The single word “envelope” is concise and clearly refers to the envelope that has been described earlier in the paragraph.

Choices A, B, and C are incorrect because they are wordy and contain information that has been given previously in the paragraph. Additionally, choice A contains inaccurate information because once the money has been chewed up, the envelope is no longer “money-filled.”

## QUESTION 23

**Choice A is the best answer.** No change is needed because “scrupulous” fits the formal tone of the passage. “Scrupulous” means exact and conscientious, and it is appropriate when discussing notes taken during a court proceeding.

Choices B and C are incorrect because they are too informal and therefore do not fit the tone of the passage. Choice D is incorrect because “intense” is an adjective that is used to describe something that is done to an extreme degree, such as putting forth effort or performing a physical act.

## QUESTION 24

**Choice C is the best answer.** Commas after “hearings” and “depositions” are correct because they separate the first two items in a series of three.

Choices A, B, and D are incorrect because they all contain semicolons either after “hearings,” “depositions,” or both of the words. Semicolons can be used to separate items in a series that already contains commas, but not to separate individual items in a simple series of words or phrases.

## QUESTION 25

**Choice C is the best answer.** The graph should not be added because it doesn’t support the information in the paragraph. The paragraph describes what a court reporter does. The graph provides information that compares the median salary of court reporters to that of other jobs.

Choices A and B are incorrect because the graph should not be added. It neither supports the claim that court reporting is an important part of a trial nor offers a relevant counterpoint to the argument that the use of digital recorders is on the rise. Choice D is incorrect because it doesn’t matter that there is no information provided in the graph about the pay scale for more experienced court reporters. The paragraph doesn’t deal with the subject of pay, so therefore the graph doesn’t support the paragraph.

## QUESTION 26

**Choice A is the best answer.** No change needs to be made because the word “to” is the idiomatic preposition to connect “subject” with the phrase “human errors” to show that technology such as a digital recorder doesn’t make the same mistakes that people make, such as “mishearing or mistyping.”

Choices B and C are incorrect because the verb “subjected” is a transitive verb that requires a direct object, which is not present in the sentence. Furthermore, “subjected from” is not idiomatic. Choice D is incorrect because “subject for human errors” doesn’t make sense.

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## QUESTION 27

**Choice C is the best answer.** The preposition “as” means “functioning in the same way” or “in the capacity of.” The plural noun “record keepers” agrees in number with the plural noun “court reporters.” The sentence indicates that court reporters are functioning as record keepers.

Choices A and D are incorrect because the singular “record keeper” can’t be used to refer to plural “court reporters.” Additionally, in choice D the infinitive verb phrase “to be” can’t be used in place of a preposition. Choice B is incorrect because the word “each” is unnecessary and makes the sentence confusing.

## QUESTION 28

**Choice C is the best answer.** To make the paragraph most logical, sentence 6 should be placed after sentence 3. Sentence 3 explains that the words the recorder types are “instantaneously” available to a judge to view on a computer screen. Sentence 6 explains, by using the transition “however,” that even though words are available instantly, recording technology continues to improve and therefore the need for court reporters is decreasing.

Choices A, B, and D are incorrect because placing sentence 6 after any other sentence would not be logical and would interrupt the flow of the paragraph.

## QUESTION 29

**Choice B is the best answer.** The dash most effectively combines the two sentences. It correctly indicates that what follows is explanatory information. In this case, the information after the dash could be inferred from what has already been stated because the opposite of making fewer mistakes is making more mistakes. The information after the dash in this sentence makes the conclusion overt.

Choice A is incorrect because the word “such” indicates incorrectly that an example of something will follow it. Choices C and D are incorrect because they are wordy and not as succinct as using a dash.

## QUESTION 30

**Choice B is the best answer.** The comma is used correctly to separate the introductory dependent clause from the main independent clause that follows it.

Choice A is incorrect because a semicolon can’t be used to separate a dependent and an independent clause. Choice C is incorrect because a period can’t be used at the end of a dependent clause. Choice D is incorrect because the adverb “therefore” doesn’t make sense in this context; what follows does not result from something said earlier in the sentence.

## QUESTION 31

**Choice B is the best answer.** “In other words” indicates correctly that what follows will be an elaboration of the idea that digital recorders can’t distinguish “important parts of the proceedings from other noises in the courtroom,” “such as a book dropping.”

Choices A, C, and D are incorrect because they don’t show the true relationship between the two sentences. “Despite this” means that in spite of something already said, what follows will be the case. “Therefore” and “consequently” indicate that what follows will be the result of something said earlier. None of these offers a further explanation of what was previously said.

## QUESTION 32

**Choice D is the best answer.** The prepositional phrase “between the words and the extrinsic noises” clearly and concisely identifies what a court reporter is able to distinguish. It is also the only parallel option, using two noun phrases after “between,” which are joined by “and.”

Choice A is incorrect because it needlessly repeats “distinguish between.” Choice B is incorrect because it is not parallel or grammatical. Choice C is incorrect because it is wordy and wrongly suggests that court reporters distinguish between words and a time period (when).

## QUESTION 33

**Choice D is the best answer.** The main idea of the paragraph is that court reporters can distinguish between words and extraneous noises in the courtroom, which digital recorders can’t always do. This choice offers an example of what can go wrong in a courtroom because digital recorders can’t always pick up “indistinct testimony”: the need for retrial because of indistinct testimony from witnesses.

Choices A, B, and C are incorrect because they don’t support the main idea of the paragraph. Making additional announcements at the beginning of a trial (choice A), monitoring to ensure equipment is functioning properly (choice B), and changing roles and duties of several members of the courtroom staff (choice C) are not examples of what can happen as a result of using digital recorders that can’t distinguish words from other courtroom noises.

## QUESTION 34

**Choice B is the best answer.** The adverb “however” indicates that regardless of the conditions that affect “combustion and the resulting fire” on Earth, their behavior in space is different.

Choices A, C, and D are incorrect because they do not show the true relationship between the information that comes before and what follows the linking adverb. “Moreover” means that additional information will follow; “accordingly” means that what follows corresponds to

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what has already been said or that what follows is a consequence; and “subsequently” means that what follows happens after what was previously stated. None of these choices indicates the difference between the behaviors of combustion and fire on Earth and in space.

### QUESTION 35

**Choice D is the best answer.** The past tense verb “sought” clearly and concisely conveys the idea that the students were trying to find a method to study combustion of biofuels. Additionally, the word “biofuels” is correctly placed immediately in front of the parenthetical information that defines it to prevent confusion.

Choices A and B are incorrect because they are wordy and the word “biofuel” is not placed immediately in front of the parenthetical information that defines it. Choice C is incorrect because it uses the verb “looked,” which is not preferable to “sought” in this science context.

### QUESTION 36

**Choice A is the best answer.** No change needs to be made because the word “deformation” provides the most precise description of what results when fuel droplets lose their symmetrical form while burning. A droplet that is deformed loses some good attribute due to the influence of some external condition.

Choices B and D are incorrect because “alteration” and “modification” imply that something is changed on purpose. Choice C is incorrect because “transformation” means that one thing is changed into another. None of these choices is accurate when discussing the effect of “gravitational influence” and the “movement of molecules” on droplets of fuel.

### QUESTION 37

**Choice B is the best answer.** The plural verbs “cause” and “limit” agree in number with the plural pronoun “both,” which refers to the plural noun “variations.”

Choices A and C are incorrect because “causes” and “limits” are singular verbs that don’t agree in number with the plural pronoun “both.” Choice D is incorrect because “has caused” and “has limited” are also singular verbs. Additionally, they are present perfect tense verbs that are used to describe a past event that has an influence on the present, which is not the case in this context.

### QUESTION 38

**Choice D is the best answer.** The underlined portion should be deleted because “built for this purpose” repeats the idea of being “specially designed” used previously in the sentence.

Choices A, B, and C are incorrect because they are redundant. There is no reason to repeat the idea of “specially designed.”

## QUESTION 39

**Choice B is the best answer.** This choice offers the most effective transition because it links the previously mentioned problems of conducting the biofuel experiment to the UCSD students' solution: participating in NASA's Microgravity University program.

Choices A, C, and D are incorrect because they don't link the previously identified problems with the specific solution: a program that could help the students overcome too little microgravity time and too small droplets.

## QUESTION 40

**Choice D is the best answer.** The commas after "weightlessness" and "space" are used correctly to set off the nonessential information between them. The information between the commas could be removed and the sentence would still make sense.

Choice A is incorrect because it is missing the comma after "weightlessness." In this context, choices B and C are incorrect because the commas are misplaced. In each of these choices, if the information between the commas were removed, the sentence would not make sense.

## QUESTION 41

**Choice A is the best answer.** The addition should be made because the information specifically identifies an advantage the students gained by working with NASA's Microgravity University program: not traveling to space.

Choice B is incorrect because it isn't accurate. The previous paragraph does suggest that the students didn't actually go into space by stating that researchers fly their experiments aboard aircraft that simulate the microgravity environment. Choices C and D are incorrect because the addition should be made. The addition neither shifts focus away from the students' experiences while on the flight nor restates what has already been said in the sentence.

## QUESTION 42

**Choice D is the best answer.** This choice, "were able to investigate," focuses on what the flights enabled the UCSD students to do that they were not able to do previously using the drop towers. It is consistent with the previous sentence, which states what the flights allowed the students to do.

Choices A, B, and C are incorrect because their focus is on "investigating" and not on allowing or enabling the students to investigate combustion in an environment that provided larger droplets and microgravity similar to that experienced in space.

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## QUESTION 43

**Choice A is the best answer.** No change is needed because the larger “spherically symmetric” droplets indicate that the flights remedied the problem of smaller deformed droplets mentioned earlier in the passage.

Choices B, C, and D are incorrect because none of these choices refers to the size or shape of the biofuel droplets, which is what made the investigation of combustion and fire on Earth problematic.

## QUESTION 44

**Choice C is the best answer.** No comma is needed in the underlined phrase, which clearly and concisely expresses the improved techniques for fighting fires in space or at future outposts on the Moon and Mars that may result from better combustion-rate models.

Choices A and B are incorrect because the commas are incorrectly separating the prepositional phrases from the noun “techniques.” Choice D is incorrect because the pair of commas indicate that the information contained between them is nonessential, which isn’t accurate.

# Section 3: Math Test – No Calculator

## QUESTION 1

**Choice D is correct.** Combining like terms on each side of the given equation yields  $6x - 5 = 7 + 2x$ . Adding 5 to both sides of  $6x - 5 = 7 + 2x$  and subtracting  $2x$  from both sides yields  $4x = 12$ . Dividing both sides of  $4x = 12$  by 4 yields  $x = 3$ .

Choices A, B, and C are incorrect because substituting those values into the equation  $3x + x + x + x - 3 - 2 = 7 + x + x$  will result in a false statement. For example, in choice B, substituting 1 for  $x$  in the equation would give  $3(1) + 1 + 1 + 1 - 3 - 2 = 7 + 1 + 1$ , which yields the false statement  $1 = 9$ ; therefore,  $x$  cannot equal 1.

## QUESTION 2

**Choice A is correct.** The line passes through the origin. Therefore, this is a relationship of the form  $d = km$ , where  $k$  is a constant representing the slope of the graph. To find the value of  $k$ , choose a point  $(m, d)$  on the graph of the line other than the origin and substitute the values of  $m$  and  $d$  into the equation. For example, if the point  $(2, 4)$  is chosen, then  $4 = k(2)$ , and  $k = 2$ . Therefore, the equation of the line is  $d = 2m$ .

Choice B is incorrect and may result from calculating the slope of the line as the change in time over the change in distance traveled instead of the change in distance traveled over the change in time. Choices C and D are incorrect because each of these equations represents a line with a  $d$ -intercept of 2. However, the graph shows a line with a  $d$ -intercept of 0.

## QUESTION 3

**Choice A is correct.** Multiplying both sides of the equation by 6 results in  $6E = O + 4M + P$ . Then, subtracting  $O + 4M$  from both sides of  $6E = O + 4M + P$  gives  $P = 6E - O - 4M$ .

Choice B is incorrect. This choice may result from solving for  $-P$  instead of for  $P$ . Choice C is incorrect and may result from transposing  $P$  with  $E$  in the given equation rather than solving for  $P$ . Choice D is incorrect and may result from transposing  $P$  with  $E$  and changing the sign of  $E$  rather than solving for  $P$ .

## QUESTION 4

**Choice C is correct.** Since  $RT = TU$ , it follows that  $\triangle RTU$  is an isosceles triangle with base  $RU$ . Therefore,  $\angle TRU$  and  $\angle TUR$  are the base angles of an isosceles triangle and are congruent. Let the measures of both  $\angle TRU$  and  $\angle TUR$  be  $t^\circ$ . According to the triangle sum theorem, the sum of the measures of the three angles of a triangle is  $180^\circ$ . Therefore,  $114^\circ + 2t^\circ = 180^\circ$ , so  $t = 33$ .

Note that  $\angle TUR$  is the same angle as  $\angle SUV$ . Thus, the measure of  $\angle SUV$  is  $33^\circ$ . According to the triangle exterior angle theorem, an external angle of a triangle is equal to the sum of the opposite interior angles. Therefore,  $x^\circ$  is equal to the sum of the measures of  $\angle VSU$  and  $\angle SUV$ ; that is,  $31^\circ + 33^\circ = 64^\circ$ . Thus, the value of  $x$  is 64.

Choice B is incorrect. This is the measure of  $\angle STR$ , but  $\angle STR$  is not congruent to  $\angle SVR$ . Choices A and D are incorrect and may result from a calculation error.

## QUESTION 5

**Choice B is correct.** It is given that the width of the dance floor is  $w$  feet. The length is 6 feet longer than the width; therefore, the length of the dance floor is  $w + 6$ . So the perimeter is  $w + w + (w + 6) + (w + 6) = 4w + 12$ .

Choice A is incorrect because it is the sum of one length and one width, which is only half the perimeter. Choice C is incorrect and may result from using the formula for the area instead of the formula for the perimeter and making a calculation error. Choice D is incorrect because this is the area, not the perimeter, of the dance floor.

## QUESTION 6

**Choice B is correct.** Subtracting the same number from each side of an inequality gives an equivalent inequality. Hence, subtracting 1 from each side of the inequality  $2x > 5$  gives  $2x - 1 > 4$ . So the given system of inequalities is equivalent to the system of inequalities  $y > 2x - 1$  and  $2x - 1 > 4$ , which can be rewritten as  $y > 2x - 1 > 4$ . Using the transitive property of inequalities, it follows that  $y > 4$ .

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Choice A is incorrect because there are points with a  $y$ -coordinate less than 6 that satisfy the given system of inequalities. For example,  $(3, 5.5)$  satisfies both inequalities. Choice C is incorrect. This may result from solving the inequality  $2x > 5$  for  $x$ , then replacing  $x$  with  $y$ . Choice D is incorrect because this inequality allows  $y$ -values that are not the  $y$ -coordinate of any point that satisfies both inequalities. For example,  $y = 2$  is contained in the set  $y > \frac{3}{2}$ ; however, if 2 is substituted into the first inequality for  $y$ , the result is  $x < \frac{3}{2}$ . This cannot be true because the second inequality gives  $x > \frac{5}{2}$ .

## QUESTION 7

**Choice B is correct.** Subtracting 4 from both sides of  $\sqrt{2x + 6} + 4 = x + 3$  isolates the radical expression on the left side of the equation as follows:  $\sqrt{2x + 6} = x - 1$ . Squaring both sides of  $\sqrt{2x + 6} = x - 1$  yields  $2x + 6 = x^2 - 2x + 1$ . This equation can be rewritten as a quadratic equation in standard form:  $x^2 - 4x - 5 = 0$ . One way to solve this quadratic equation is to factor the expression  $x^2 - 4x - 5$  by identifying two numbers with a sum of  $-4$  and a product of  $-5$ . These numbers are  $-5$  and  $1$ . So the quadratic equation can be factored as  $(x - 5)(x + 1) = 0$ . It follows that  $5$  and  $-1$  are the solutions to the quadratic equation. However, the solutions must be verified by checking whether  $5$  and  $-1$  satisfy the original equation,  $\sqrt{2x + 6} + 4 = x + 3$ . When  $x = -1$ , the original equation gives  $\sqrt{2(-1) + 6} + 4 = (-1) + 3$ , or  $6 = 2$ , which is false. Therefore,  $-1$  does not satisfy the original equation. When  $x = 5$ , the original equation gives  $\sqrt{2(5) + 6} + 4 = 5 + 3$ , or  $8 = 8$ , which is true. Therefore,  $x = 5$  is the only solution to the original equation, and so the solution set is  $\{5\}$ .

Choices A, C, and D are incorrect because each of these sets contains at least one value that results in a false statement when substituted into the given equation. For instance, in choice D, when  $0$  is substituted for  $x$  into the given equation, the result is  $\sqrt{2(0) + 6} + 4 = (0) + 3$ , or  $\sqrt{6} + 4 = 3$ . This is not a true statement, so  $0$  is not a solution to the given equation.

## QUESTION 8

**Choice D is correct.** Since  $x^3 - 9x = x(x + 3)(x - 3)$  and  $x^2 - 2x - 3 = (x + 1)(x - 3)$ , the fraction  $\frac{f(x)}{g(x)}$  can be written as  $\frac{x(x + 3)(x - 3)}{(x + 1)(x - 3)}$ . It is given that  $x > 3$ , so the common factor  $x - 3$  is not equal to 0. Therefore, the fraction can be further simplified to  $\frac{x(x + 3)}{x + 1}$ .

Choice A is incorrect. The expression  $\frac{1}{x+1}$  is not equivalent to  $\frac{f(x)}{g(x)}$  because at  $x = 0$ ,  $\frac{1}{x+1}$  has a value of 1 and  $\frac{f(x)}{g(x)}$  has a value of 0.

Choice B is incorrect and results from omitting the factor  $x$  in the factorization of  $f(x)$ . Choice C is incorrect and may result from incorrectly factoring  $g(x)$  as  $(x + 1)(x + 3)$  instead of  $(x + 1)(x - 3)$ .

## QUESTION 9

**Choice A is correct.** The standard form for the equation of a circle is  $(x - h)^2 + (y - k)^2 = r^2$ , where  $(h, k)$  are the coordinates of the center and  $r$  is the length of the radius. According to the given equation, the center of the circle is  $(6, -5)$ . Let  $(x_1, y_1)$  represent the coordinates of point Q. Since point P  $(10, -5)$  and point Q  $(x_1, y_1)$  are the endpoints of a diameter of the circle, the center  $(6, -5)$  lies on the diameter, halfway between P and Q. Therefore, the following relationships hold:

$\frac{x_1 + 10}{2} = 6$  and  $\frac{y_1 + (-5)}{2} = -5$ . Solving the equations for  $x_1$  and  $y_1$ , respectively, yields  $x_1 = 2$  and  $y_1 = -5$ . Therefore, the coordinates of point Q are  $(2, -5)$ .

Alternate approach: Since point P  $(10, -5)$  on the circle and the center of the circle  $(6, -5)$  have the same y-coordinate, it follows that the radius of the circle is  $10 - 6 = 4$ . In addition, the opposite end of the diameter  $\overline{PQ}$  must have the same y-coordinate as P and be 4 units away from the center. Hence, the coordinates of point Q must be  $(2, -5)$ .

Choices B and D are incorrect because the points given in these choices lie on a diameter that is perpendicular to the diameter  $\overline{PQ}$ . If either of these points were point Q, then  $\overline{PQ}$  would not be the diameter of the circle. Choice C is incorrect because  $(6, -5)$  is the center of the circle and does not lie on the circle.

## QUESTION 10

**Choice C is correct.** Let  $x$  represent the number of 2-person tents and let  $y$  represent the number of 4-person tents. It is given that the total number of tents was 60 and the total number of people in the group was 202. This situation can be expressed as a system of two equations,  $x + y = 60$  and  $2x + 4y = 202$ . The first equation can be rewritten as  $y = -x + 60$ . Substituting  $-x + 60$  for  $y$  in the equation  $2x + 4y = 202$  yields  $2x + 4(-x + 60) = 202$ . Distributing and combining like terms gives  $-2x + 240 = 202$ . Subtracting 240 from both sides of  $-2x + 240 = 202$  and then dividing both sides by  $-2$  gives  $x = 19$ . Therefore, the number of 2-person tents is 19.

Alternate approach: If each of the 60 tents held 4 people, the total number of people that could be accommodated in tents would be 240. However, the actual number of people who slept in tents was 202. The difference of 38 accounts for the 2-person tents. Since each of these tents holds 2 people fewer than a 4-person tent,  $\frac{38}{2} = 19$  gives the number of 2-person tents.

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Choice A is incorrect. This choice may result from assuming exactly half of the tents hold 2 people. If that were true, then the total number of people who slept in tents would be  $2(30) + 4(30) = 180$ ; however, the total number of people who slept in tents was 202, not 180.

Choice B is incorrect. If 20 tents were 2-person tents, then the remaining 40 tents would be 4-person tents. Since all the tents were filled to capacity, the total number of people who slept in tents would be  $2(20) + 4(40) = 40 + 160 = 200$ ; however, the total number of people who slept in tents was 202, not 200. Choice D is incorrect. If 18 tents were 2-person tents, then the remaining 42 tents would be 4-person tents. Since all the tents were filled to capacity, the total number of people who slept in tents would be  $2(18) + 4(42) = 36 + 168 = 204$ ; however, the total number of people who slept in tents was 202, not 204.

## QUESTION 11

**Choice B is correct.** The  $x$ -coordinates of the  $x$ -intercepts of the graph are  $-3$ ,  $0$ , and  $2$ . This means that if  $y = f(x)$  is the equation of the graph, where  $f$  is a polynomial function, then  $(x + 3)$ ,  $x$ , and  $(x - 2)$  are factors of  $f$ . Of the choices given, A and B have the correct factors. However, in choice A,  $x$  is raised to the first power, and in choice B,  $x$  is raised to the second power. At  $x = 0$ , the graph touches the  $x$ -axis but doesn't cross it. This means that  $x$ , as a factor of  $f$ , is raised to an even power. If  $x$  were raised to an odd power, then the graph would cross the  $x$ -axis. Alternatively, in choice A,  $f$  is a third-degree polynomial, and in choice B,  $f$  is a fourth-degree polynomial. The  $y$ -coordinates of points on the graph become large and positive as  $x$  becomes large and negative; this is consistent with a fourth-degree polynomial, but not with a third-degree polynomial. Therefore, of the choices given, only choice B could be the equation of the graph.

Choice A is incorrect. The graph of the equation in this answer choice has the correct factors. However, at  $x = 0$  the graph of the equation in this choice crosses the  $x$ -axis; the graph shown touches the  $x$ -axis but doesn't cross it. Choices C and D are incorrect and are likely the result of misinterpreting the relationship between the  $x$ -intercepts of a graph of a polynomial function and the factors of the polynomial expression.

## QUESTION 12

**Choice D is correct.** Dividing both sides of equation  $\frac{2a}{b} = \frac{1}{2}$  by 2 gives  $\frac{a}{b} = \frac{1}{4}$ . Taking the reciprocal of both sides yields  $\frac{b}{a} = 4$ .

Choice A is incorrect. This is the value of  $\frac{a}{2b}$ , not  $\frac{b}{a}$ . Choice B is incorrect. This is the value of  $\frac{a}{b}$ , not  $\frac{b}{a}$ . Choice C is incorrect. This is the value of  $\frac{b}{2a}$ , not  $\frac{b}{a}$ .

## QUESTION 13

**Choice C is correct.** It is assumed that the oil and gas production decreased at a constant rate. Therefore, the function  $f$  that best models the production  $t$  years after the year 2000 can be written as a linear function,  $f(t) = mt + b$ , where  $m$  is the rate of change of the oil and gas production and  $b$  is the oil and gas production, in millions of barrels, in the year 2000. Since there were 4 million barrels of oil and gas produced in 2000,  $b = 4$ . The rate of change,  $m$ , can be calculated as  $\frac{4 - 1.9}{0 - 13} = -\frac{2.1}{13}$ , which is equivalent to  $-\frac{21}{130}$ , the rate of change in choice C.

Choices A and B are incorrect because each of these functions has a positive rate of change. Since the oil and gas production decreased over time, the rate of change must be negative. Choice D is incorrect. This model may result from misinterpreting 1.9 million barrels as the amount by which the production decreased.

## QUESTION 14

**Choice C is correct.** The second equation of the system can be rewritten as  $y = 5x - 8$ . Substituting  $5x - 8$  for  $y$  in the first equation gives  $5x - 8 = x^2 + 3x - 7$ . This equation can be solved as shown below:

$$x^2 + 3x - 7 - 5x + 8 = 0$$

$$x^2 - 2x + 1 = 0$$

$$(x - 1)^2 = 0$$

$$x = 1$$

Substituting 1 for  $x$  in the equation  $y = 5x - 8$  gives  $y = -3$ . Therefore,  $(1, -3)$  is the only solution to the system of equations.

Choice A is incorrect. In the  $xy$ -plane, a parabola and a line can intersect at no more than two points. Since the graph of the first equation is a parabola and the graph of the second equation is a line, the system cannot have more than 2 solutions. Choice B is incorrect. There is a single ordered pair  $(x, y)$  that satisfies both equations of the system. Choice D is incorrect because the ordered pair  $(1, -3)$  satisfies both equations of the system.

## QUESTION 15

**Choice D is correct.** Since  $h(x) = 1 - g(x)$ , substituting 0 for  $x$  yields  $h(0) = 1 - g(0)$ . Evaluating  $g(0)$  gives  $g(0) = 2(0) - 1 = -1$ . Therefore,  $h(0) = 1 - (-1) = 2$ .

Choice A is incorrect. This choice may result from an arithmetic error. Choice B is incorrect. This choice may result from incorrectly evaluating  $g(0)$  to be 1. Choice C is incorrect. This choice may result from evaluating  $1 - 0$  instead of  $1 - g(0)$ .

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## QUESTION 16

**The correct answer is 3.** The solution to the given equation can be found by factoring the quadratic expression. The factors can be determined by finding two numbers with a sum of 1 and a product of  $-12$ . The two numbers that meet these constraints are 4 and  $-3$ . Therefore, the given equation can be rewritten as  $(x + 4)(x - 3) = 0$ . It follows that the solutions to the equation are  $x = -4$  or  $x = 3$ . Since it is given that  $a > 0$ ,  $a$  must equal 3.

## QUESTION 17

**The correct answer is 32.** The sum of the given expressions is  $(-2x^2 + x + 31) + (3x^2 + 7x - 8)$ . Combining like terms yields  $x^2 + 8x + 23$ . Based on the form of the given equation,  $a = 1$ ,  $b = 8$ , and  $c = 23$ . Therefore,  $a + b + c = 32$ .

Alternate approach: Because  $a + b + c$  is the value of  $ax^2 + bx + c$  when  $x = 1$ , it is possible to first make that substitution into each polynomial before adding them. When  $x = 1$ , the first polynomial is equal to  $-2 + 1 + 31 = 30$  and the second polynomial is equal to  $3 + 7 - 8 = 2$ . The sum of 30 and 2 is 32.

## QUESTION 18

**The correct answer is  $\frac{3}{2}$ .** One method for solving the system of equations for  $y$  is to add corresponding sides of the two equations. Adding the left-hand sides gives  $(-x + y) + (x + 3y)$ , or  $4y$ . Adding the right-hand sides yields  $-3.5 + 9.5 = 6$ . It follows that  $4y = 6$ . Finally, dividing both sides of  $4y = 6$  by 4 yields  $y = \frac{6}{4}$  or  $\frac{3}{2}$ . Any of  $3/2$ ,  $6/4$ ,  $9/6$ ,  $12/8$  or the decimal equivalent 1.5 will be scored as correct.

## QUESTION 19

**The correct answer is 8.** The number of employees,  $y$ , expected to be employed by the company  $x$  quarters after the company opened can be modeled by the equation  $y = ax + b$ , where  $a$  represents the constant rate of change in the number of employees each quarter and  $b$  represents the number of employees with which the company opened. The company's growth plan assumes that 2 employees will be hired each quarter, so  $a = 2$ . The number of employees the company opened with was 8, so  $b = 8$ .

## QUESTION 20

**The correct answer is 144.** In a circle, the ratio of the length of a given arc to the circle's circumference is equal to the ratio of the measure of the arc, in degrees, to  $360^\circ$ . The ratio between the arc length and the circle's circumference is given as  $\frac{2}{5}$ . It follows that  $\frac{2}{5} = \frac{x}{360}$ . Solving this proportion for  $x$  gives  $x = 144$ .

## Section 4: Math Test – Calculator

### QUESTION 1

**Choice A is correct.** If one pound of grapes costs \$2, two pounds of grapes will cost 2 times \$2, three pounds of grapes will cost 3 times \$2, and so on. Therefore,  $c$  pounds of grapes will cost  $c$  times \$2, which is  $2c$  dollars.

Choice B is incorrect and may result from incorrectly adding instead of multiplying. Choice C is incorrect and may result from assuming that  $c$  pounds cost \$2, and then finding the cost per pound. Choice D is incorrect and could result from incorrectly assuming that 2 pounds cost  $\$c$ , and then finding the cost per pound.

### QUESTION 2

**Choice C is correct.** According to the graph, the number of figurines decreased between 1 and 2 months and between 3 and 4 months. Because the line segment between 3 and 4 months is steeper than the line segment between 1 and 2 months, it follows that the number of figurines decreased the fastest between 3 and 4 months.

Choice A is incorrect. Between 1 and 2 months, the number of figurines decreased. However, the number of figurines decreased faster during the interval between 3 and 4 months. Choices B and D are incorrect. The number of figurines during these intervals was increasing, not decreasing.

### QUESTION 3

**Choice A is correct.** The fraction of the cars in the random sample that have a manufacturing defect is  $\frac{3}{200} = 0.015$ . At this rate, out of 10,000 cars there would be  $0.015 \times 10,000 = 150$  cars that have a manufacturing defect.

Choices B, C, and D are incorrect because the fractions of cars in the population that have a defect,  $\frac{200}{10,000} = 0.02$  in choice B,  $\frac{250}{10,000} = 0.025$  in choice C, and  $\frac{300}{10,000} = 0.03$  in choice D, are all different from the fraction of cars in the sample with a manufacturing defect, which is 0.015.

### QUESTION 4

**Choice C is correct.** The given line of best fit can be used to predict the length when the width is known. The equation of the line of best fit is given as  $y = 1.67x + 21.1$ , where  $x$  is the width in millimeters and  $y$  is the predicted length in millimeters. If the width of the petal is 19 millimeters, then  $x = 19$  and  $y = 1.67(19) + 21.1 = 52.83$ .

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Choice A is incorrect and may result from incorrectly using  $x = 0$  in the equation. Choice B is incorrect and may result from neglecting to add 21.1 in the computation. Choice D is incorrect and may result from an arithmetic error.

## QUESTION 5

**Choice B is correct.** Let the measure of the third angle in the smaller triangle be  $\alpha^\circ$ . Since lines  $\ell$  and  $m$  are parallel and cut by transversals, it follows that the corresponding angles formed are congruent.

So  $\alpha^\circ = y^\circ = 20^\circ$ . The sum of the measures of the interior angles of a triangle is  $180^\circ$ , which for the interior angles in the smaller triangle yields  $\alpha + x + z = 180$ . Given that  $z = 60$  and  $\alpha = 20$ , it follows that  $20 + x + 60 = 180$ . Solving for  $x$  gives  $x = 180 - 60 - 20$ , or  $x = 100$ .

Choice A is incorrect and may result from incorrectly assuming that angles  $x + z = 180$ . Choice C is incorrect and may result from incorrectly assuming that the smaller triangle is a right triangle, with  $x$  as the right angle. Choice D is incorrect and may result from a misunderstanding of the exterior angle theorem and incorrectly assuming that  $x = y + z$ .

## QUESTION 6

**Choice D is correct.** Since only two types of tickets were sold and a total of 350 tickets were sold, the sum of the numbers of both types of ticket sold must be 350. Therefore,  $B + L = 350$ . Since the bench tickets were \$75 each, the income from  $B$  bench tickets was  $75B$ . Similarly, since the lawn tickets were \$40 each, the income from  $L$  lawn tickets sold was  $40L$ . The total income from all tickets was \$19,250. So the sum of the income from bench tickets and lawn tickets sold must equal 19,250. Therefore,  $75B + 40L = 19,250$ . Only choice D has both correct equations.

Choice A is incorrect and may result from incorrectly multiplying the income from each type of ticket instead of adding them. It also incorrectly uses 1,950 instead of 19,250. Choice B is incorrect and may result from confusing the cost of bench tickets with the cost of lawn tickets. Choice C is incorrect and may result from confusing the total number of tickets sold with the total amount raised.

## QUESTION 7

**Choice C is correct.** The graph of an equation given in the form  $y = mx + b$  has slope  $m$ . The equation in choice C is  $y = 3x + 2$ , so the slope of its graph is 3.

Choices A, B, and D are incorrect. They are all given in the form  $y = mx + b$ , where  $m$  is the slope. Therefore, choice A has a graph with a slope of  $\frac{1}{3}$ , choice B has a graph with a slope of 1 (because  $x = 1 \cdot x$ ), and choice D has a graph with a slope of 6.

## QUESTION 8

**Choice B is correct.** Multiplying both sides of the equation by  $x + 1$  gives  $(x + 1)^2 = 2$ . This means  $x + 1$  is a number whose square is 2, so  $(x + 1)$  is either  $\sqrt{2}$  or  $-\sqrt{2}$ . Therefore,  $\sqrt{2}$  is a possible value for  $x + 1$ .

Choice A is incorrect and may result from trying to find the value of  $x$  instead of  $x + 1$  and making a sign error. Choice C is incorrect and may result from solving for  $(x + 1)^2$  instead of  $x + 1$ . Choice D is incorrect and may result from squaring instead of taking the square root to find the value of  $x + 1$ .

## QUESTION 9

**Choice D is correct.** Using the volume formula  $V = \frac{7\pi k^3}{48}$  and the given information that the volume of the glass is 473 cubic centimeters, the value of  $k$  can be found as follows:

$$473 = \frac{7\pi k^3}{48}$$

$$k^3 = \frac{473(48)}{7\pi}$$

$$k = \sqrt[3]{\frac{473(48)}{7\pi}} \approx 10.10690$$

Therefore, the value of  $k$  is approximately 10.11 centimeters.

Choices A, B, and C are incorrect. Substituting the values of  $k$  from these choices in the formula results in volumes of approximately 7 cubic centimeters, 207 cubic centimeters, and 217 cubic centimeters, respectively, all of which contradict the given information that the volume of the glass is 473 cubic centimeters.

## QUESTION 10

**Choice C is correct.** Due to the shape of the glass, if the water is poured at a constant rate, the height of the water level will increase faster initially, where the diameter of the glass is smaller, and increase more slowly later, as the diameter of the glass increases. Choice C is the only graph that shows this behavior: it is steeper initially and then gets less steep.

Choice A is incorrect since it shows the height of the water level increasing at a constant rate over time. Choice B is incorrect since it shows the height of the water level increasing slowly at first and faster later. Choice D is incorrect since it shows the height of the water level staying constant even as water is being poured into the glass.

## QUESTION 11

**Choice B is correct.** It is given that the volume of the glass is approximately 16 fluid ounces. If Jenny has 1 gallon of water, which is 128 fluid ounces, she could fill the glass  $\frac{128}{16} = 8$  times.

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Choice A is incorrect because Jenny would need  $16 \times 16$  fluid ounces = 256 fluid ounces, or 2 gallons, of water to fill the glass 16 times. Choice C is incorrect because Jenny would need only  $4 \times 16$  fluid ounces = 64 fluid ounces of water to fill the glass 4 times. Choice D is incorrect because Jenny would need only  $3 \times 16$  fluid ounces = 48 fluid ounces to fill the glass 3 times.

## QUESTION 12

**Choice C is correct.** Since Roberto sells only two types of policies and he didn't meet his goal of selling at least 57 policies, the sum of  $x$ , the number of \$50,000 policies, and  $y$ , the number of \$100,000 policies, must be less than 57. Symbolically, that is  $x + y < 57$ . The total value, in dollars, from selling  $x$  number of \$50,000 policies is  $50,000x$ . The total value, in dollars, from selling  $y$  number of \$100,000 policies is  $100,000y$ . Since the total value of the policies he sold was over \$3,000,000, it follows that  $50,000x + 100,000y > 3,000,000$ . Only choice C has both correct inequalities.

Choice A is incorrect because the total value, in dollars, of the policies Roberto sold was greater than, not less than, 3,000,000. Choice B is incorrect because Roberto didn't meet his goal, so  $x + y$  should be less than, not greater than, 57. Choice D is incorrect because both inequalities misrepresent the situation.

## QUESTION 13

**Choice C is correct.** Since  $a$  has the exponent  $-\frac{1}{2}$ ,  $a$  can be isolated by raising both sides of the equation to the  $-2$  power.

$$a^{(-\frac{1}{2})(-2)} = x^{-2}$$

$$a = x^{-2}$$

$$a = \frac{1}{x^2}$$

Alternate method:

$$a^{-\frac{1}{2}} = \frac{1}{a^{\frac{1}{2}}} = \frac{1}{\sqrt{a}}$$

So,

$$\frac{1}{\sqrt{a}} = x$$

Square both sides of the equation:

$$\frac{1}{a} = x^2$$

Then take the reciprocal of both sides:

$$a = \frac{1}{x^2}$$

Choice A is incorrect and may result from incorrectly taking the square root of both sides to eliminate the exponent of  $a$ . Choice B is incorrect and may result from incorrectly taking the square root of both sides to eliminate the exponent of  $a$ , and incorrectly multiplying by  $-1$  to make the exponent positive. Choice D is incorrect and may result from incorrectly multiplying by  $-1$  to make the exponent positive.

**QUESTION 14**

**Choice D is correct.** A rational expression is undefined when the denominator is 0. To determine the values of  $x$  that result in a denominator of 0, set the denominator equal to 0 and solve for  $x$ :

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

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

$$x + 5 = 0 \text{ or } x - 2 = 0$$

$$x = -5 \text{ or } x = 2$$

Among the answer choices, only the value  $x = 2$  is listed, so choice D is correct.

Choice A is incorrect. When  $x = -3$ , the denominator is  $(-3)^2 + 3(-3) - 10 = -10$ , so the given expression is not undefined. Choice B is incorrect and may result from incorrectly factoring the denominator or incorrectly assuming that if  $(x - 2)$  is a factor, then  $x = -2$  is a solution. Choice C is incorrect and may result from giving the value of the denominator that makes the given expression undefined rather than the value of  $x$  that makes the denominator equal to 0.

**QUESTION 15**

**Choice D is correct.** Since density is mass per unit volume, the mass is the density times volume. The volume of a right rectangular prism is the product of the lengths of the sides. Therefore:

$$\begin{aligned} \text{mass} &= (\text{2.8 grams per cubic centimeter}) \times \\ &(30 \text{ centimeters} \times 40 \text{ centimeters} \times 50 \text{ centimeters}) \end{aligned}$$

$$\text{mass} = (\text{2.8 grams per cubic centimeter}) \times (60,000 \text{ cubic centimeters})$$

$$\text{mass} = 168,000 \text{ grams}$$

Choice A is incorrect and may result from adding, instead of multiplying, the lengths of the sides to find the volume. Choice B is incorrect and may result from the same error as in choice A, as well as a place value error. Choice C is incorrect and may result from a place value error when finding the volume.

**QUESTION 16**

**Choice B is correct.** A total of 150 adults received the sugar pill.

Of those, 33 reported contracting a cold. Therefore,  $\frac{33}{150}$ , or the equivalent  $\frac{11}{50}$ , is the proportion of adults receiving a sugar pill who reported contracting a cold.

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Choice A is incorrect. This is the proportion of adults receiving a sugar pill and contracting a cold to all adults contracting a cold ( $\frac{33}{54}$ ).

Choice C is incorrect. This is the proportion of adults who reported contracting a cold to all the participants in the study ( $\frac{54}{300} = \frac{9}{50}$ ).

Choice D is incorrect. This is the proportion of adults who received a sugar pill and reported contracting a cold to all the participants in the study ( $\frac{33}{300} = \frac{11}{100}$ ).

## QUESTION 17

**Choice A is correct.** The mode is the data value with the highest frequency. So for the data shown, the mode is 18. The median is the middle data value when the data values are sorted from least to greatest. Since there are 20 ages ordered, the median is the average of the two middle values, the 10th and 11th, which for these data are both 19. Therefore, the median is 19. The mean is the sum of the data values divided by the number of the data values. So for these data, the mean is 
$$\frac{(18 \times 6) + (19 \times 5) + (20 \times 4) + (21 \times 2) + (22 \times 1) + (23 \times 1) + (30 \times 1)}{20} = 20.$$

Since the mode is 18, the median is 19, and the mean is 20,  
mode < median < mean.

Choice B and D are incorrect because the mean is greater than the median. Choice C is incorrect because the median is greater than the mode.

Alternate approach: After determining the mode, 18, and the median, 19, it remains to determine whether the mean is less than 19 or more than 19. Because the mean is a balancing point, there is as much deviation below the mean as above the mean. It is possible to compare the data to 19 to determine the balance of deviation above and below the mean. There is a total deviation of only 6 below 19 (the 6 values of 18); however, the data value 30 alone deviates by 11 above 19. Thus the mean must be greater than 19.

## QUESTION 18

**Choice C is correct.** Based on the line of best fit shown, the predicted percent of leaf litter mass remaining for a forest with a mean annual temperature of  $-2^{\circ}\text{C}$  is about 70%.

Choice A is incorrect; it is the predicted percent of leaf litter mass remaining at about  $6.5^{\circ}\text{C}$ . Choice B is incorrect; it is the predicted percent of leaf litter mass remaining at  $2^{\circ}\text{C}$  instead of at  $-2^{\circ}\text{C}$ .

Choice D is incorrect; it is the predicted percent of leaf litter mass remaining at about  $-7^{\circ}\text{C}$ .

## QUESTION 19

**Choice A is correct.** Since zeros of  $f$  correspond to the  $x$ -intercepts of the graph of  $f$ , and the range of  $f$  gives all the possible  $y$ -values on the graph of the function, the correct graph of the function has only points with  $y$ -values less than or equal to 4, and crosses the  $x$ -axis at only  $(-3, 0)$  and  $(1, 0)$ . The graph in choice A satisfies both of these conditions.

Choice B is incorrect. The graph of the function matches the range given, but the zeros are at  $-1$  and  $3$ , not  $-3$  and  $1$ . Choice C is incorrect. The graph has  $y$ -values greater than  $4$ . Choice D is incorrect. Even though the graph has zeros at  $-3$  and  $1$ , it has an additional zero at  $0$ , and the range of the graph is the set of all real numbers.

## QUESTION 20

**Choice B is correct.** The savings each year from installing the geothermal heating system will be the average annual energy cost for the home before the geothermal heating system installation minus the average annual energy cost after the geothermal heating system installation, which is  $(4,334 - 2,712)$  dollars. In  $t$  years, the savings will be  $(4,334 - 2,712)t$  dollars. Therefore, the inequality that can be solved to find the number of years after installation at which the total amount of energy cost savings will exceed (be greater than) the installation cost,  $\$25,000$ , is  $25,000 < (4,334 - 2,712)t$ .

Choice A is incorrect. It gives the number of years after installation at which the total amount of energy cost savings will be less than the installation cost. Choice C is incorrect and may result from subtracting the average annual energy cost for the home from the onetime cost of the geothermal heating system installation. To find the predicted total savings, the predicted average cost should be subtracted from the average annual energy cost before the installation, and the result should be multiplied by the number of years,  $t$ . Choice D is incorrect and may result from misunderstanding the context. The ratio  $\frac{4,332}{2,712}$  compares the average energy cost before installation and the average energy cost after installation; it does not represent the savings.

## QUESTION 21

**Choice D is correct.** The number  $3.39$  in the equation  $y = 3.39x + 46.89$  is the slope, which is the change in  $y$  per unit change in  $x$ . Because  $y$  represents the amount of plastic produced annually, in billions of pounds, and  $x$  represents the number of years since 1985, the number  $3.39$  represents the rate of change of the amount of plastic produced with respect to time, in units of billions of pounds per year. The change is an increase since  $3.39$  is positive, and it is described as an average change because the data show increases that are sometimes more and sometimes less than  $3.39$ .

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Choice A is incorrect. It is the interpretation of the number 46.89 in the line of best fit equation,  $y = 3.39x + 46.89$ . Choices B and C are incorrect because they are expressed in the wrong units. The number 3.39 has units of billions of pounds per year, but choice B has units of years and choice C has units of billions of pounds.

## QUESTION 22

**Choice A is correct.** Since  $x$  is the number of years since 1985, the year 2000 corresponds to  $x = 15$  and the year 2003 corresponds to  $x = 18$ . The corresponding points on the line of best fit are approximately (15, 98) and (18, 107). This means that approximately 98 billion pounds of plastic were produced in 2000 and approximately 107 billion pounds of plastic were produced in 2003. To calculate the percent increase, subtract the amount of plastic produced in 2000 from the amount of plastic produced in 2003 and then divide the result by the amount of plastic produced in 2000 and multiply by 100. This yields  $\left(\frac{107 - 98}{98}\right) \cdot 100 = 9.2$ , or approximately 10%.

Choices B and C are incorrect and may be the result of misreading the graph or making an arithmetic error. Choice D is incorrect and may be the result of approximating the amount of plastic produced, in billions of pounds, in the year 2003 ( $x = 18$ ).

## QUESTION 23

**Choice A is correct.** In 1 year, there are 4 quarter years, so the number of quarter years,  $q$ , is 4 times the number of years,  $t$ ; that is,  $q = 4t$ . This is equivalent to  $t = \frac{q}{4}$ , and substituting this into the expression for  $M$  in terms of  $t$  gives  $M = 1,800(1.02)^{\frac{q}{4}}$ .

Choices B and D are incorrect and may be the result of incorrectly using  $t = 4q$ . In choice D,  $1.02^{4q} = 1.02^{4(q)}$ , which is approximately 1.082<sup>q</sup>. Choice C is incorrect and may be the result of incorrectly using  $t = 4q$  and unnecessarily dividing 0.02 by 4.

## QUESTION 24

**Choice D is correct.** It is given that Contestant 2 earned 70% of the votes cast using social media and 40% of the votes cast using a text message. Based on this information, viewers voting by social media were more likely to prefer Contestant 2 than were viewers voting by text message.

Choices A, B, and C are incorrect. There is not enough information about the viewers to reach these conclusions.

## QUESTION 25

**Choice A is correct.** It is given that the relationship between population and year is linear; therefore, the function that models the population  $t$  years after 2000 is of the form  $P(t) = mt + b$ , where  $m$  is the slope and  $b$  is the population when  $t = 0$ .

In the year 2000,  $t = 0$ . Therefore,  $b = 862$ . The slope is given by

$$m = \frac{P(10) - P(0)}{10 - 0} = \frac{846 - 862}{10 - 0} = \frac{-16}{10} = -1.6. \text{ Therefore, } P(t) = -1.6t + 862,$$

which is equivalent to the equation in choice A.

Choice B is incorrect and may be the result of incorrectly calculating the slope as just the change in the value of  $P$ . Choice C is incorrect and may be the result of the same error as in choice B, in addition to incorrectly using  $t$  to represent the year, instead of the number of years after 2000. Choice D is incorrect and may be the result of incorrectly using  $t$  to represent the year instead of the number of years after 2000.

## QUESTION 26

**Choice C is correct.** In order to use a sample mean to estimate the mean for a population, the sample must be representative of the population (for example, a simple random sample). In this case, Tabitha surveyed 20 families in a playground. Families in the playground are more likely to have children than other households in the community. Therefore, the sample isn't representative of the population. Hence, the sampling method is flawed and may produce a biased estimate.

Choices A and D are incorrect because they incorrectly assume the sampling method is unbiased. Choice B is incorrect because a sample of size 20 could be large enough to make an estimate if the sample had been representative of all the families in the community.

## QUESTION 27

**Choice B is correct.** Since the point  $(p, r)$  lies on the line with equation  $y = x + b$ , the point must satisfy the equation. Substituting  $p$  for  $x$  and  $r$  for  $y$  in the equation  $y = x + b$  gives  $r = p + b$ . Similarly, since the point  $(2p, 5r)$  lies on the line with the equation  $y = 2x + b$ , the point must satisfy the equation. Substituting  $2p$  for  $x$  and  $5r$  for  $y$  in the equation  $y = 2x + b$  gives  $5r = 2(2p) + b$ , or  $5r = 4p + b$ . Solving each equation for  $b$  gives  $b = r - p$  and  $b = 5r - 4p$ , respectively. Substituting  $r - p$  for  $b$  in the equation  $b = 5r - 4p$  gives  $r - p = 5r - 4p$ . Subtracting  $r$  from each side of the equation and adding  $4p$  to each side of the equation gives  $3p = 4r$ . Dividing each side of the equation by  $p$  and dividing each side of the equation by 4 gives  $\frac{3}{4} = \frac{r}{p}$ .

Choices A, C, and D are incorrect. Choices A and D may be the result of incorrectly forming the answer out of the coefficients in the point  $(2p, 5r)$ . Choice C may be the result of confusing  $r$  and  $p$ .

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## QUESTION 28

**Choice D is correct.** The two data sets have the same range. The first data set has a range of  $88 - 56 = 32$ , and the second data set has a range of  $112 - 80 = 32$ . Alternatively, it can be seen visually that the ranges are the same because the two dot plots are aligned, the scales of the graphs are the same, and the graphs have the same width. The two data sets have different standard deviations. Both dot plots show distributions that have a mean near the center value of the dot plot. The first dot plot shows most values clustered near the mean, while the second dot plot shows most values farther from the mean. Therefore, the standard deviations of the two data sets are not equal—the data represented by the second dot plot has a greater standard deviation.

Choices A, B, and C are incorrect because they incorrectly assert either that the standard deviations are the same or that the ranges are different.

## QUESTION 29

**Choice B is correct.** Since the machine copies at a constant rate, the relationship between  $p$ , the number of sheets of paper remaining, and  $m$ , the time in minutes since the machine started printing, is modeled by a linear equation. The initial number of sheets of paper is given as 5,000. It is also given that the machine used 30% of those 5,000 sheets in 20 minutes, so it used  $0.30 \times 5,000 = 1,500$  sheets in 20 minutes. Therefore, the number of sheets used per minute is  $\frac{1,500}{20} = 75$ . To determine the number of sheets of paper used  $m$  minutes after the machine started printing, multiply 75 by  $m$ , which gives  $75m$ . Therefore, a linear equation modeling this relationship is the number of sheets remaining equals the initial number of sheets of paper minus the number of sheets of paper used  $m$  minutes after the machine started printing, which is  $p = 5,000 - 75m$ .

Choice A is incorrect and may be the result of using the given number of minutes, 20, as the rate at which the copy machine uses paper. However, the rate is 75, not 20, sheets per minute. Choices C and D are incorrect because they aren't linear equations; they assume that the copy machine prints at a nonconstant rate.

## QUESTION 30

**Choice B is correct.** The maximum value of the function  $f$  occurs at the highest point on the graph of  $y = f(x)$ ; the highest point on the graph is  $(4, 3)$ . For any point on the graph of  $f$ , the  $y$ -coordinate gives the value of the function at the  $x$ -coordinate; therefore, the maximum value of the function  $f$  is 3. It is stated that  $k$  is the maximum value of  $f$ , so  $k = 3$ . Thus,  $g(k) = g(3)$ . From the table of values for  $g$ , it can be seen that when  $x = 3$ ,  $g(3) = 6$ .

Choice A is incorrect and may result from using the  $x$ -coordinate of the maximum point as the value of  $k$ . Choice C is incorrect; it is the value of  $k$ , not of  $g(k)$ . Choice D is incorrect and may be the result of giving the value of  $x$  that makes  $g(x) = 3$  instead of finding the value of  $g(x)$  when  $x = 3$ .

### QUESTION 31

**The correct answer is 102.** Since each molecule of water has 2 atoms of hydrogen, 51 molecules of water have a total of  $(51)(2) = 102$  atoms of hydrogen.

### QUESTION 32

**The correct answer is 2.** Substituting  $x = 1$  in the equation  $x - \frac{1}{2}a = 0$  gives  $1 - \frac{1}{2}a = 0$ . Adding  $\frac{1}{2}a$  to both sides of this equation gives  $1 = \frac{1}{2}a$ . Multiplying both sides of this last equation by 2 gives  $2 = a$ .

### QUESTION 33

**The correct answer is 30.** Since the equations  $x + 2y = 10$  and  $3x + 6y = c$  represent the same line in the  $xy$ -plane, they must be equivalent equations. The expression  $3x + 6y$  on the left-hand side of the second equation is equivalent to  $3(x + 2y)$ , which is 3 times the left-hand side of the first equation. Thus, to be equivalent, the right-hand side of the second equation,  $c$ , must be 3 times the right-hand side of the first equation, 10. Therefore,  $c = 30$ .

### QUESTION 34

**The correct answer is 25.4.** The average speed is the total distance divided by the total time. The total distance is 11 miles and the total time is 26 minutes. Thus, the average speed is  $\frac{11}{26}$  miles per minute.

The question asks for the average speed in miles per hour, and there are 60 minutes in an hour; converting miles per minute to miles per hour gives the following:

$$\begin{aligned}\text{Average speed} &= \frac{11 \text{ miles}}{26 \text{ minutes}} \times \frac{60 \text{ minutes}}{1 \text{ hour}} \\ &= \frac{660}{26} \text{ miles per hour} \\ &\approx 25.38 \text{ miles per hour}\end{aligned}$$

Therefore, to the nearest tenth of a mile per hour, the average speed of Paul Revere's ride would have been 25.4 miles per hour.

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## QUESTION 35

**The correct answers are 2 and 8.** Substituting  $x = a$  in the definitions for  $f$  and  $g$  gives  $f(a) = -\frac{1}{2}(a - 4)^2 + 10$  and  $g(a) = -a + 10$ , respectively. If  $f(a) = g(a)$ , then  $-\frac{1}{2}(a - 4)^2 + 10 = -a + 10$ . Subtracting 10 from both sides of this equation gives  $-\frac{1}{2}(a - 4)^2 = -a$ . Multiplying both sides by  $-2$  gives  $(a - 4)^2 = 2a$ . Expanding  $(a - 4)^2$  gives  $a^2 - 8a + 16 = 2a$ . Combining the like terms on one side of the equation gives  $a^2 - 10a + 16 = 0$ . One way to solve this equation is to factor  $a^2 - 10a + 16$  by identifying two numbers with a sum of  $-10$  and a product of  $16$ . These numbers are  $-2$  and  $-8$ , so the quadratic equation can be factored as  $(a - 2)(a - 8) = 0$ . Therefore, the possible values of  $a$  are either  $2$  or  $8$ . Either  $2$  or  $8$  will be scored as a correct answer.

Alternate approach: Graphically, the condition  $f(a) = g(a)$  implies the graphs of the functions  $y = f(x)$  and  $y = g(x)$  intersect at  $x = a$ . The graph  $y = f(x)$  is given, and the graph of  $y = g(x)$  may be sketched as a line with  $y$ -intercept  $10$  and a slope of  $-1$  (taking care to note the different scales on each axis). These two graphs intersect at  $x = 2$  and  $x = 8$ .

## QUESTION 36

**The correct answer is 0.** Note that no matter where point  $W$  is on  $\overline{RT}$ , the sum of the measures of  $\angle RSW$  and  $\angle WST$  is equal to the measure of  $\angle RST$ , which is  $90^\circ$ . Thus,  $\angle RSW$  and  $\angle WST$  are complementary angles. Since the cosine of an angle is equal to the sine of its complementary angle,  $\cos(\angle RSW) = \sin(\angle WST)$ . Therefore,  $\cos(\angle RSW) - \sin(\angle WST) = 0$ .

## QUESTION 37

**The correct answer is 576.** According to the table, 5 minutes after the injection, the penicillin in the patient's bloodstream is 152 micrograms per milliliter. Thus, there are  $10 \times 152 = 1520$  micrograms of penicillin in 10 milliliters of blood drawn 5 minutes after the injection. Similarly, 10 minutes after the injection, the penicillin concentration is 118 micrograms per milliliter. Thus, there are  $8 \times 118 = 944$  micrograms of penicillin in 8 milliliters of blood drawn 10 minutes after the injection. Therefore, there are  $1520 - 944 = 576$  more micrograms of penicillin in 10 milliliters of blood drawn 5 minutes after the injection than in 8 milliliters of blood drawn 10 minutes after the injection.

**QUESTION 38**

**The correct answer is 0.8.** The value of  $b$  in the equation  $P(t) = 200b^{\frac{t}{5}}$  can be estimated using any row of the table other than the first one. Substituting  $t = 5$  and  $P(5) = 152$  from the second row of the table into the definition of  $P$  yields  $152 = 200b^{\frac{5}{5}}$ , or  $152 = 200b$ . Dividing both sides of this equation by 200 yields  $b = \frac{152}{200}$ . The fraction can be rewritten as  $\frac{76}{100}$ , or its decimal equivalent .76. Rounded to the nearest tenth, this value is .8. Other rows of the table also give a value of  $b$  that rounds to .8. Therefore, the value of  $b$ , rounded to the nearest tenth, is .8. Either .8, or its fractional equivalents,  $4/5$  or  $8/10$ , can be gridded as the correct answer.