SAT B

Answer Key

DIRECTIONS: For items answered <u>correctly</u>, circle the answer, then check any corresponding shaded box(es). Total the number of circled answers to determine the raw score for the test section. Total the number of checkmarks for each of the subscores and cross-test scores to determine each raw subscore and raw cross-test score.

Section 1: Reading

		Subscores		Cross-Test Scores	
		WC	CE	S	H/S
1.	D	▓			
2.	B	▓			
3.	C				
4.	D		▓		
5.	C				
6.	B		▓		
7.	A				
8.	B				
9.	C				
10.	D				
11.	B				▓
12.	B	▓			▓
13.	C				▓
14.	D		▓		▓
15.	B				▓
16.	A		▓		▓
17.	B	▓			▓
18.	A				▓

		Subscores		Cross-Test Scores	
		WC	CE	S	H/S
19.	B				▓
20.	B				▓
21.	D			▓	
22.	B			▓	
23.	A			▓	
24.	B			▓	
25.	C		▓	▓	
26.	D	▓		▓	
27.	A			▓	
28.	C	▓		▓	
29.	B			▓	
30.	C		▓	▓	
31.	A				▓
32.	A		▓		▓
33.	B	▓			▓
34.	A				▓
35.	D	▓			▓
36.	C				▓

		Subscores		Cross-Test Scores	
		WC	CE	S	H/S
37.	A				▓
38.	A				▓
39.	C		▓		▓
40.	A				▓
41.	B				▓
42.	D	▓		▓	
43.	A			▓	
44.	C		▓	▓	
45.	A			▓	
46.	D		▓	▓	
47.	B			▓	
48.	D			▓	
49.	C	▓		▓	
50.	B			▓	
51.	C			▓	
52.	C			▓	

Raw Score: _____ /52

Section 2: Writing and Language

#	Ans	Subscores WC	CE	Cross-Test Scores S	H/S	#	Ans	Subscores WC	CE	Cross-Test Scores S	H/S	#	Ans	Subscores WC	CE	Cross-Test Scores S	H/S
1.	D					16.	C	■				31.	A			■	
2.	A				■	17.	D					32.	B			■	
3.	B	■			■	18.	D		■	■		33.	A			■	
4.	D					19.	B					34.	C				
5.	D					20.	C					35.	C				
6.	A				■	21.	A		■			36.	A				
7.	A	■			■	22.	C					37.	D	■			
8.	A		■		■	23.	C					38.	D				
9.	B					24.	B		■	■		39.	A		■		
10.	D					25.	D	■		■		40.	B				
11.	D		■		■	26.	A		■	■		41.	C	■			
12.	A	■				27.	A					42.	D				
13.	B					28.	B	■		■		43.	A		■		
14.	D					29.	B					44.	C				
15.	A					30.	D										

Raw Score: _____ /44

Evidence-Based Reading and Writing Subscores

Words in Context (WC): _____ /18   Command of Evidence (CE): _____ /18

Section 3: Math—No Calculator

#	Ans	Cross-Test Scores S	H/S	#	Ans	Cross-Test Scores S	H/S	#	Ans	Cross-Test Scores S	H/S
1.	C			8.	C			15.	D		
2.	A			9.	D			16.	15.5, 31/2		
3.	D			10.	A		■	17.	4		
4.	C			11.	A			18.	29		
5.	B		■	12.	B			19.	1		
6.	C			13.	B			20.	9		
7.	A	■		14.	A						

Section 4: Math—Calculator

#	Ans	S	H/S	#	Ans	S	H/S	#	Ans	S	H/S
1.	B			14.	A			27.	B		
2.	A			15.	C			28.	C		
3.	C			16.	C			29.	C		
4.	A			17.	A			30.	B		
5.	C			18.	C			31.	11		
6.	D			19.	B	█		32.	2		█
7.	B	█		20.	D			33.	6000		█
8.	D			21.	B		█	34.	4		█
9.	B			22.	D		█	35.	80		
10.	C		█	23.	D	█		36.	9		
11.	C			24.	D	█		37.	53		
12.	B	█		25.	A	█		38.	7/24		
13.	A			26.	C	█					

Math Raw Score (total of calculator and no-calculator sections): _____ /58

Cross-Test Scores (All four test sections)

Science (S): _____ /35   History/Social Studies (H/S): _____ /35

Explanations

Section 1: Reading

Questions #1–10

1. (D) *Reading/Literary Fiction/Vocabulary.* SAT Topic: SUM.2; CC: ELA-Literacy.CCRA.R.4. Although "mean" has several different meanings, Robin's description of the place as a "low hovel" makes it clear that in this context the word means "shabby" or "run-down."

2. (B) *Reading/Literary Fiction/Vocabulary.* SAT Topic: SUM.2; CC: ELA-Literacy.CCRA.R.4. Robin is walking down the street and sees someone moving "in advance" of him. "In advance," in this context, means "up ahead" or simply "ahead."

3. (C) *Reading/Literary Fiction/Implied Idea.* SAT Topic: INFID.1b; CC: ELA-Literacy.CCRA.R.1. Throughout the passage, Robin asks a series of people (a stranger on the street, the innkeeper, the night watchman, and a man at the foot of the church building) how to find his relative, Major Molineux. Each of them either denies knowing him or evades the question. All the while, Robin believes that Major Molineux is an important person in the town. In the final paragraph, however, we learn that Major Molineux has been disgraced.

4. **(D)** *Reading/Literary Fiction/Textual Evidence.* SAT Topic: INFID.2; CC: ELA-Literacy.CCRA.R.1. The fact that Major Molineux has fallen into disgrace is supported in the final paragraph when Robin learns that his kinsman has been tarred and feathered by the townspeople.

5. **(C)** *Reading/Literary Fiction/Implied Idea.* SAT Topic: INFID.1b; CC: ELA-Literacy.CCRA.R.1. The man at the foot of the church building says that he is familiar with the name Molineux, that the Major will pass by where they are standing, and that he is curious to see Robin and Major Molineux. The fact that the man knows Molineux will pass by indicates that he is aware of Molineux's fate and knows the route that the mob of people will take. Also, it can be inferred that Major Molineux's fate will be a surprise to Robin since the man at the foot of the church building is interested in witnessing their meeting.

6. **(B)** *Reading/Literary Fiction/Textual Evidence.* SAT Topic: INFID.2; CC: ELA-Literacy.CCRA.R.1. The fact that the man at the foot of the church building is aware that Major Molineux has been tarred and feathered is best supported by his knowledge that the Major will pass by the place where he and Robin are sitting.

7. **(A)** *Reading/Literary Fiction/Development.* SAT Topic: RHET.2a; CC: ELA-Literacy.CCRA.R.5. The third paragraph from the end of the passage provides details of Robin's relationship to Major Molineux. Major Molineux and Robin's father are cousins. Molineux, who from his appearance during a visit a few years ago to Robin's family appeared to be a very prosperous person, had suggested that Robin could benefit from his oversight. So, a couple of years later Robin goes to town to meet his kinsman. Then, as already discussed in the explanation to item #3, Robin asks a series of people how to find his relative, and each of them either denies knowing the Major or is unclear. In fact, they even become hostile toward Robin; and at the end of the passage we learn that the reason for this hostility is that Major Molineux has done something that has caused him to be tarred and feathered by the townspeople.

8. **(B)** *Reading/Literary Fiction/Implied Idea.* SAT Topic: INFID.1b; CC: ELA-Literacy.CCRA.R.3. It's the name "Major Molineux" that disturbs both the innkeeper and the others in the inn. The animosity suddenly directed toward Robin is due to his mention of and association with that name.

9. **(C)** *Reading/Literary Fiction/Explicit Detail.* SAT Topic: INFID.1a; CC: ELA-Literacy.CCRA.R.1. According to the last sentence in the first paragraph, Robin headed into the town with a light step and an eager eye, so the best description of Robin's state of mind upon entering the town is one of "anticipation."

10. **(D)** *Reading/Literary Fiction/Development.* SAT Topic: SUM.1; CC: ELA-Literacy.CCRA.R.3. There is a wonderful irony in Robin's thinking, for he concludes that the stranger whom he has accosted is an out-of-towner who is unfamiliar with the town, its people, and its convention. Of course, this describes Robin, who has no idea where he is, how to find Major Molineux, or if it is good manners to grab the coat of a total stranger.

Questions #11–20

11. **(B)** *Reading/Social Studies/Implied Idea.* SAT Topic: RHET.5a; CC: ELA-Literacy.CCRA.R.8. In the fourth paragraph of Passage 1, the author states that there is no crisis of judicial activism. Based on that statement, it can be inferred that the author would find claims of judicial activism exaggerated.

12. **(B)** *Reading/Social Studies/Vocabulary.* SAT Topic: SUM.2; CC: ELA-Literacy.CCRA.R.4. In line 52, the author of Passage 2 states that the doctrine of judicial review does not mean that the courts have a monopoly on

the power to deem an act unconstitutional. The author then explains that both Congress and the president have a similar power. So, we can infer that "monopoly" in this context means "exclusive control."

13. **(C)** *Reading/Social Studies/Implied Idea.* SAT Topic: SYN.1 CC: ELA-Literacy.CCRA.R.9. In the second paragraph of Passage 1, the author describes the ways in which a law must be scrutinized by each branch of government. And in the second paragraph of Passage 2, the author states that not only the courts but also Congress and the president have an obligation to determine the constitutionality of a law.

14. **(D)** *Reading/Social Studies/Textual Evidence.* SAT Topic: INFID.2; CC: ELA-Literacy.CCRA.R.1. Both authors write that each branch has an obligation to test the constitutionality of laws: the Congress when it enacts them, the president when he or she either vetoes or enforces them, and the courts when they evaluate them.

15. **(B)** *Reading/Social Studies/Implied Idea.* SAT Topic: RHET.5a: ELA-Literacy.CCRA.R.8. The author of Passage 1 seems to find the basis for judicial review in the oath taken by all members of the government to uphold the Constitution. This interpretation seems to make the three branches equal, giving a final say to the Supreme Court since it is the last to decide on the issue. The author of Passage 2, on the other hand, starts out by saying that this is not an adequate foundation for the doctrine and goes on to cite both Marshall and Hamilton as authorities.

16. **(A)** *Reading/Social Studies/Textual Evidence.* SAT Topic: INFID.2; CC: ELA-Literacy.CCRA.R.1. The author of Passage 2 believes that the basis for judicial review goes beyond the obligation of the judges to support the Constitution. This doctrine is explicitly stated in lines 42–45.

17. **(B)** *Reading/Social Studies/Vocabulary.* SAT Topic: SUM.2; CC: ELA-Literacy.CCRA.R.4. In most contexts, the word "vex" means "to annoy" or "to irritate." The author here does not intend the usual meaning. In this context, "vexing" takes on a shade of that meaning: "difficult." The question posed in the passage is a difficult one because it is not easy to say whose view should prevail in case of conflict.

18. **(A)** *Reading/Social Studies/Implied Idea.* SAT Topic: RHET.5a; CC: ELA-Literacy.CCRA.R.8. The author cites Marshall and Hamilton as authorities on the Constitution (Marshall being the first Chief Justice of the Supreme Court and Hamilton being one of the authors of *The Federalist Papers*) and does so to support the contention that judicial review is not just the courts' obeying of the Constitution, but is a more expansive doctrine that requires them to assess the constitutionality of laws.

19. **(B)** *Reading/Social Studies/Implied Idea.* SAT Topic: RHET.5a; CC: ELA-Literacy.CCRA.R.8. In the fifth paragraph of Passage 2, the author states that Jefferson pardoned those convicted under the Sedition Act on grounds that courts had already rejected. In other words, the people convicted had already argued to the courts that the Act was unconstitutional, and those courts rejected the argument. The author explains that Jefferson, however, was exercising an inherent power of the executive branch: granting pardons. The author's reasoning is that since the executive had won the convictions in the first place, it was later free to undo that result since it was giving up only what it had won.

20. **(B)** *Reading/Social Studies/Main Idea.* SAT Topic: SYN.1; CC: ELA-Literacy.CCRA.R.9. In paragraph three of Passage 1, the author states that losing the doctrine of judicial review would be "unfortunate," and in the last paragraph of Passage 2, that author cites Jefferson and Jackson to emphasize the value of judicial review.

Questions #21–30

21. (D) *Reading/Natural Sciences/Explicit Detail.* SAT Topic: INFID.1a; CC: ELA-Literacy.CCRA.R.1. According to the last paragraph, lower frequency radiation is able to penetrate more deeply and so would likely deposit its energy in muscle tissue.

22. (B) *Reading/Natural Sciences/Main Idea.* SAT Topic: RHET.4; CC: ELA-Literacy.CCRA.R.6. The main point of the passage is to demonstrate that the effects of microwave radiation on human tissue are different from those of other forms of radiation, (B). As for (A), while the author does explain the importance of behavior response in humans for the regulation of body temperature, this point is made to introduce the outdated theory based on the assumption that organisms respond to microwave radiation in the same way that they do to other forms of radiation. As for (C) and (D), the author's main point does not involve either the analysis of a *particular* mechanism or the discussion of the *specific* importance of thermoreceptors, respectively.

23. (A) *Reading/Natural Sciences/Explicit Detail.* SAT Topic: INFID.1a; CC: ELA-Literacy.CCRA.R.1. In the opening sentence, the author establishes that there are two general responses available to warm-blooded animals for regulating body temperature: behavior and innate mechanisms. The author goes on to state that when the organism responds to changes in temperature in the core of the body (the second type of response), these changes are triggered by thermoreceptors that are distributed throughout the central nervous system (inside the body of the organism).

24. (B) *Reading/Natural Sciences/Implied Idea.* SAT Topic: RHET.5a; CC: ELA-Literacy.CCRA.R.8. In the first sentence of the second paragraph, the author remarks that proponents of the generally accepted theory (which treats microwave radiation like other forms of radiation) simply *assumed* that one type of radiation would have the same thermal effect as other types of radiation would.

25. (C) *Reading/Natural Sciences/Textual Evidence.* SAT Topic: INFID.2; CC: ELA-Literacy.CCRA.R.1. The outdated theory took it for granted that microwaves behave like other forms of radiation. The passage goes on to explain that this idea is wrong. In lines 23–27, the author specifically states that the only support for this erroneous belief was assumption.

26. (D) Reading/*Natural Sciences/Vocabulary.* SAT Topic: SUM.2; CC: ELA-Literacy.CCRA.R.4. The word "appreciate" often means "to like" or "to be pleased by," but that meaning is out of place here. Rather, the author uses the word to mean "notice."

27. (A) *Reading/Natural Sciences/Development.* SAT Topic: RHET.2b; CC: ELA-Literacy.CCRA.R.5. In the lines indicated, the author states that it is possible that an organism could be cooked by microwave radiation (because the radiation penetrates into the core) before it even realizes its temperature is rising. The verb tense here ("could") clearly indicates that the author is introducing a hypothetical possibility; additionally, the author uses the phrase "in theory." Given the shocking nature of the example, we should conclude that the author has introduced it to dramatize a point.

28. (C) *Reading/Natural Sciences/Vocabulary.* SAT Topic: SUM.2; CC: ELA-Literacy.CCRA.R.4. The most common meaning of the word "compromise" is "reach an agreement in which each side gives up something," but that meaning is not appropriate here. Rather, the author intends a less common meaning: "endanger."

29. (B) *Reading/Natural Sciences/Implied Idea.* SAT Topic: INFID.1b; CC: ELA-Literacy.CCRA.R.1. In the fourth paragraph, the author begins by stating that microwaves at lower frequencies and high power pose a

"significant risk." In this paragraph, the author notes that the resulting temperature profile may be a reverse thermal gradient in which the inside is warmer than the surface. But you also need information to explain why the low frequency microwaves heat the inside, and you can find that information in the final paragraph: lower frequencies penetrate to the deep muscle tissue, which absorbs more efficiently than does fat so most energy is found at that level.

30. (C) *Reading/Natural Sciences/Textual Evidence.* SAT Topic: INFID.2; CC: ELA-Literacy.CCRA.R.1. A complete explanation of the phenomenon requires a couple of facts, both of which are provided in the explanation to the previous item: that there is a reverse thermal gradient in which the inside is warmer than the surface and that the lower frequency microwaves penetrate the body and heat the muscle tissue, which absorbs energy more efficiently than fat.

Questions #31–41

31. (A) *Reading/Social Studies/Voice.* SAT Topic: RHET.3; CC: ELA-Literacy.CCRA.R.6. In the first sentence, Susan B. Anthony says, "I stand before you tonight under indictment for the alleged crime." A person under indictment for a supposed crime is a defendant on trial.

32. (A) *Reading/Social Studies/Textual Evidence.* SAT Topic: INFID.2; CC: ELA-Literacy.CCRA.R.1. Anthony opens her speech by stating that she is under indictment for fraudulently voting in the most recent federal election and is, therefore, a criminal defendant. After the opening statement, she goes on to say that she will prove that she has committed no crime and is in fact well within her rights as a citizen.

33. (B) *Reading/Social Studies/Vocabulary.* SAT Topic: SUM.2; CC: ELA-Literacy.CCRA.R.4. An oligarchy is a form of government in which those few who hold power share and are made eligible to govern by a common characteristic such as wealth or lineage. Anthony here refers to the United States as an oligarchy of sex, meaning that the qualifying characteristic for holding office is that one is male.

34. (A) *Reading/Social Studies/Development.* SAT Topic: RHET.2b; CC: ELA-Literacy.CCRA.R.5. Anthony has a small problem with the presentation of the argument (see #38). The original Constitution was not always clear about terms like "person" and "citizen." She handles this problem by acknowledging the ambiguity and then goes on to say the ambiguity was resolved by the fourteenth amendment. The two terms that appear in the excerpt from the original Constitution are "person" and "citizen."

35. (D) *Reading/Social Studies/Vocabulary.* SAT Topic: SUM.2; CC: ELA-Literacy.CCRA.R.4. "Regime" could mean any of the four things offered by the choices, but in this particular case, Anthony uses "regime" to mean "the old way of thinking," that is, before the fourteenth amendment. So "system" is the best choice.

36. (C) *Reading/Social Studies/Development.* SAT Topic: RHET.5a; CC: ELA-Literacy.CCRA.R.8. The fourth paragraph begins with "but, it is urged," referring to objections that Anthony's opponents might raise. Then she proceeds to answer the possible objection by pointing out that the argument places the opponents in a dilemma.

37. (A) *Reading/Social Studies/Development.* SAT Topic: RHET.5a; CC: ELA-Literacy.CCRA.R.8. Anthony anticipates a possible objection to her position: the Constitution and other laws use masculine pronouns, which means that the provisions of the documents were meant to apply only to men. Anthony's response is that women should therefore not have to pay taxes or otherwise be subject to the constraints of laws since such laws are described using masculine pronouns.

38. (A) *Reading/Social Studies/Development.* SAT Topic: SUM.1; CC: ELA-Literacy.CCRA.R.3. This question requires you to abstract from the passage and summarize the formal or logical structure of Anthony's argument. In lines 71–74, Anthony quotes the Fourteenth Amendment to establish the first premise of the argument that all persons born or naturalized in the United States are citizens. Then in lines 77–79, she further quotes the Amendment to establish the premise that all citizens have the right to vote (no law shall abridge the privileges or immunities of citizens). Once she has established that all persons who are citizens have the right to vote, she needs only answer the question "Are women persons?" And the answer to that question, she believes, is obvious.

39. (C) *Reading/Social Studies/Textual Evidence.* SAT Topic: INFID.2; CC: ELA-Literacy.CCRA.R.1. The language of the first sentence of the Fourteenth Amendment clearly states that all persons born or naturalized in the United States are citizens both of the United States and of the state where they live.

40. (A) *Reading/Social Studies/Main Idea.* SAT Topic: RHET.4; CC: ELA-Literacy.CCRA.R.6. The third paragraph is an independent argument that is quite persuasive, even though it technically does not belong in Anthony's criminal defense. In this paragraph, she argues that a government restricted in its participation to men can only introduce instability because women, excluded from the vote, perceive the government and its laws as oppressive.

41. (B) *Reading/Social Studies/Data Presentations.* SAT Topic: SYN.2; CC: ELA-Literacy.CCRA.R.7. The map shows several interesting things. Note that the western states generally granted full voting rights to women prior to the 19th amendment. In four of those states, women had full voting rights not only before the passage of the 19th Amendment but also before these territories were granted statehood. These four states, however, do not represent the southwestern region, so (A) can be eliminated. Notice that states in the south and along the eastern seaboard granted women the right to vote only after the 19th Amendment was ratified. So (B) is the correct choice.

Questions #42–52

42. (D) *Reading/Natural Sciences/Vocabulary.* SAT Topic: SUM.2; CC: ELA-Literacy.CCRA.R.4. According to the passage, the vernal mixing takes place in the spring. So, "vernal" must mean "spring."

43. (A) *Reading/Natural Sciences/Implied Idea.* SAT Topic: INFID.1b; CC: ELA-Literacy.CCRA.R.1. In paragraph five, the passage explains that freshwater is densest at a temperature of 4°C. Thus, water between 0°C and 4°C is colder but less dense. Since denser water sinks, the warmer layer is beneath the colder layer, an inversion of the usual order.

44. (C) *Reading/Natural Sciences/Textual Evidence.* SAT Topic: INFID.2; CC: ELA-Literacy.CCRA.R.1. Lines 44–47 provide the description for inverse stratification that is laid out in the explanation to the previous item.

45. (A) *Reading/Natural Sciences/Explicit Detail.* SAT Topic: INFID.1a; CC: ELA-Literacy.CCRA.R.1. In the final paragraph, the author explains how stratification can reduce the nutrients needed in the epilimnion. Photosynthesis occurs in the epilimnion so organisms are consuming nutrients. While the organisms live, the nutrients are bound up in the organisms. When the organisms die, they sink to the bottom of the lake and decompose, so the nutrients are released. If the water circulates from bottom to top, the nutrients are carried back to the epilimnion for reuse. But when the lake is stratified, there is no movement across the thermocline, so the nutrients are trapped in the hypolimnion. Eventually, organisms use up the nutrients in the epilimnion because there is no resupply from the bottom.

46. (D) *Reading/Natural Sciences/Textual Evidence.* SAT Topic: INFID.2; CC: ELA-Literacy.CCRA.R.1. When the lake is stratified, there is no movement across the thermocline, so the nutrients are trapped in the hypolimnion. This process is stated explicitly in lines 88–92.

47. (B) *Reading/Natural Sciences/Explicit Detail.* SAT Topic: INFID.1a; CC: ELA-Literacy.CCRA.R.1. According to the last two paragraphs, stratification poses a threat to lake life because the dissolved oxygen in the upper layer cannot cross the thermocline to the bottom so life on the bottom cannot carry on respiration. Additionally, after an organism dies, sinks to the bottom, and decomposes, the released nutrients cannot rise to the top, so life there has nothing to eat.

48. (D) *Reading/Natural Sciences/Explicit Detail.* SAT Topic: INFID.1a; CC: ELA-Literacy.CCRA.R.1. In the very first sentence of the passage, the author states that the lake stratification is explained by changes in temperature.

49. (C) *Reading/Natural Sciences/Vocabulary.* SAT Topic: SUM.2; CC: ELA-Literacy.CCRA.R.4. In the sentence in which "gradient" is used, the author notes that the difference in density is very small so the gradient is minor. "Gradient," therefore, must mean "difference."

50. (B) *Reading/Natural Sciences/Main Idea.* SAT Topic: RHET.4; CC: ELA-Literacy.CCRA.R.6. The last two paragraphs discuss how stratification poses a threat to lake life: the thermocline barrier disrupts the vertical transport of both dissolved oxygen and the nutrients released from dead organisms.

51. (C) *Reading/Natural Sciences/Data Presentations.* SAT Topic: SYN.2; CC: ELA-Literacy.CCRA.R.7. For this item, use the process of elimination. (A) and (D) can be eliminated because the passage states that the thermocline is located within the metalimnion layer. (B) can be eliminated because the passage distinguishes the thermocline from the metalimnion. (Theoretically, the two could coincide, in which case the graph would show a line of constant slope between the top and bottom of the metalimnion.) So, by the process of elimination, (C) must be the correct choice. The author defines the thermocline as the "plane of maximum rate of decrease." From 20 to 25 meters, this change of depth of 5 meters is associated with a temperature change from just under 20°C to approximately 7.5°C, or a little greater than 10°C.

52. (C) *Reading/Natural Sciences/Main Idea.* SAT Topic: INFID.3; CC: ELA-Literacy.CCRA.R.2. According to paragraph one, after the spring mixing, warm summer temperatures cause the lake to stratify, and as temperatures continue to warm and remain warm, the stratification becomes increasingly stable. Then, according to paragraph four, cool fall temperatures disrupt the stratification and cause mixing. In the winter, the lake will either remain mixed or stratify inversely.

Section 2: Writing and Language

Passage 1

1. (D) *Writing and Language/Standard English Conventions/Sentence Structure/Faulty Parallelism.* SAT Topic: SEC.1a.iii; CC: ELA-Literacy.L.8.1. This item tests sentence structure. The problem with the original is that the lack of a "most" before "imaginative" disrupts the parallelism of the series. The problem can be solved by inserting another "most." Yes, you would have the repetition of "most," but it would not necessarily be needless repetition. A writer may choose that route in order to provide emphasis to each element in the series. Or, as the correct answer does, the "most" can be position in front of the entire series so that it

modifies each of the four elements—more concise, less dramatic. Remember, the test would never ask students to choose between two good alternatives, so only one or the other of those would be used as a choice.

2. (A) *Writing and Language/Expression of Ideas/Strategy/Appropriate Supporting Material.* SAT Topic: EXPID.1b; CC: ELA-Literacy.L.9-10.3. The author is looking for a quotation that will echo the pre-modern attitude toward war that is described in the immediately preceding sentence. According to that sentence, war in pre-modernized times was considered "unavoidable" and even "noble." The idea that dying for one's country ("war") is sweet ("noble") and fitting ("unavoidable") best meets the author's goal.

3. (B) *Writing and Language/Expression of Ideas/Style/Tone.* SAT Topic: EXPID.3c; CC: ELA-Literacy.L.9-10.3. The author places the word "civilized" in quotes in order to alert the reader that something unusual is taking place. In this case, the author is using the word ironically to call attention to the fact that the so-called "civilized" humanity who settled into cities 8,000 years ago has been consistently at war all that time.

4. (D) *Writing and Language/Standard English Conventions/Punctuation/Colons.* SAT Topic: SEC.3b; CC: ELA-Literacy.L.11-12.2. In this case, it is used to introduce a series. The original is wrong, however, because the phrase "such as," which may also be used to introduce a series, is superfluous. So, (D) is the correct choice. Note that using the phrase "such as" without the colon would also result in a correct construction, but this is not one of the options.

5. (D) *Writing and Language/Standard English Conventions/Sentence Structure/Faulty Parallelism.* SAT Topic: SEC.1a.iii; CC: ELA-Literacy.L.9-10.1. The original is wrong because it is not parallel to the other elements in the series. As written, the elements are presented as "enemy," "having…slaves," "natural resources," and "land." In order to correct this problem, "having human slaves to do labor" should be changed to "human slave labor."

6. (A) *Writing and Language/Expression of Ideas/Strategy/Effective Transitional Sentence.* SAT Topic: EXPID.2b; CC: ELA-Literacy.L.9-10.3. In this sentence, "nevertheless," which means "in spite of that," is a conjunctive adverb. It is used to signal a relationship of opposition or contrast between the preceding sentence and the sentence in which it appears. In this case, it effectively sets up an idea against the idea that precedes it: a major war is unthinkable; "nevertheless," we must think about it.

7. (A) *Writing and Language/Expression of Ideas/Style/Precision.* SAT Topic: EXPID.3a; CC: ELA-Literacy.L.11-12.6. A paradox is a statement that contradicts itself. Our need to maintain the capacity for war as a means to preserving peace is certainly a self-contradictory idea.

8. (A) *Writing and Language/Expression of Ideas/Style/Appropriate Supporting Material.* SAT Topic: EXPID.1b; CC: ELA-Literacy.L.9-10.3. The author effectively wants to make his or her point by providing an example that is analogous to the changing effects of warfare. As described in the paragraph, with advances in warfare (nuclear weapons that make traditional war unthinkable) come side effects (the mass destruction that can come from a nuclear war brought on by accident or miscalculation). So, the advance of techniques in warfare has created a situation in which war becomes more dangerous. Analogously, while the abundance of food has reduced hunger, it has been accompanied by a rise in diet-related illnesses.

9. **(B)** *Writing and Language/Standard English Conventions/Grammar and Usage/Subject-Verb Agreement.* SAT Topic: SEC.2c.ii; CC: ELA-Literacy.L.9-10.1. The original is wrong because the singular verb "has been" does not agree with the plural subject of the sentence ("reasons"). Instead, the plural verb "have been" is required.

10. **(D)** *Writing and Language/Standard English Conventions/Grammar and Usage/Pronoun Usage.* SAT Topic: SEC.2b; CC: ELA-Literacy.L.9-10.1. The original is wrong because the contraction "it's" is inappropriate in this context. The author intends to show possession (of "wealth"), so the singular possessive pronoun "its" is required.

11. **(D)** *Writing and Language/Expression of Ideas/Strategy/Effective Concluding Sentence.* SAT Topic: EXPID.2b; CC: ELA-Literacy.L.9-10.3. In the final paragraph, the author discusses several disadvantages to controlling a conquered territory, such as the cost of providing and administering government services to a conquered enemy. In summary, it no longer makes financial sense to conquer and rule because the costs outweigh the benefits.

Passage 2

12. **(A)** *Writing and Language/Expression of Ideas/Style/Precision.* SAT Topic: EXPID.3a; CC: ELA-Literacy.L.11-12.6. An epithet is a descriptive phrase so closely associated with a person's nature or character that it becomes a part of one of the names by which that person is called (e.g., Philip the Tall or Henry the Navigator). In this context, "epithet" not only provides the author's intended meaning, but it also expresses the appropriately formal tone of the passage.

13. **(B)** *Writing and Language/Expression of Ideas/Style/Clarity of Meaning.* SAT Topic: EXPID.3d; CC: ELA-Literacy.L.9-10.3. The original is wrong because it is awkward and imprecise. As written, it seems to say that a snake-entwined staff used to have a different name and symbolic meaning than what it does today. Instead, the author means to suggest that the rod was associated with health and medicine in ancient times and express that it remains a symbol of medicine today. (B) best captures this idea, making the description of the rod itself a non-essential element of the sentence.

14. **(D)** *Writing and Language/Standard English Conventions/Sentence Structure/Unintended Meanings.* SAT Topic: SEC.1b.i; CC: ELA-Literacy.L.9-10.1. The original is wrong because it suggests that the objective of preventive medicine has already been met. What the author intends to say is that the maintenance and promotion of health is an ongoing concern. So, "to accomplish" this objective, preventive medicine takes certain actions and measures.

15. **(A)** *Writing and Language/Standard English Conventions/Grammar and Usage/Pronoun Usage.* SAT Topic: SEC.2c.i; CC: ELA-Literacy.L.9-10.1. This item tests pronoun reference. The referent (antecedent" of "it") is found in an earlier sentence, making the item a bit more difficult than a similar item in which both the pronoun and the referent are contained in the same sentence. Students must search the previous sentence to learn that "it" refers "preventive medicine," so the sentence is correct as written.

16. **(C)** *Writing and Language/Expression of Ideas/Style/Precision.* SAT Topic: EXPID.3a; CC: ELA-Literacy.L.9-10.3. The original is wrong because it inappropriately uses the concept of size to refer to something that cannot be measured in that way (an objective). "Major," which means "important," is the correct word choice.

17. (D) *Writing and Language/Expression of Ideas/Strategy/Effective Concluding Sentence.* SAT Topic: EXPID.2b; CC: ELA-Literacy.L.9-10.3. The logical structure of the paragraph consists of a general statement followed by five supporting points. Since the five points do not necessarily require any sequential arrangement, "initially" is inappropriate in this context. However, since the related sentence is the fifth and final point, "finally" is certainly acceptable and is in fact the best of the remaining answer choices. "Instead" and "for once" result in meanings that are not intended by the author.

18. (D) *Writing and Language/Expression of Ideas/Strategy/Effective Opening Sentence.* SAT Topic: EXPID.2b; CC: ELA-Literacy.L.11-12.3. In the fourth paragraph, the author explains that curative medicine requires clinically trained practitioners (presumably doctors, nurses, physician assistants, etc.) while preventive medicine requires people who deal with environmental factors and communities (presumably engineers and specialized technicians who work in areas such as water supply, pollution, etc.). (D) neatly introduces this explanation.

19. (B) *Writing and Language/Standard English Conventions/Grammar and Usage/Pronoun Usage.* SAT Topic: SEC.2b; CC: ELA-Literacy.L.9-10.1. "Who's" is a contraction for "who is" and is inappropriate in this context. Instead, the possessive pronoun "whose" is required to refer to the plural noun "individuals" and indicate that they possess "training."

20. (C) *Writing and Language/Standard English Conventions/Punctuation/Apostrophes.* SAT Topic: SEC.3c; CC: ELA-Literacy.L.9-10.2. Just as with the previous item, this item deals with possession; in this case, however, the issue is one of correct apostrophe use when creating a possessive noun. Since the author intends to refer to the health and disease status of an individual, the singular possessive of "individual" ("individual's") is required.

21. (A) *Writing and Language/Expression of Ideas/Organization/Paragraph-Level Structure.* SAT Topic: EXPID.2a; CC: ELA-Literacy.L.11-12.3. The underlined sentence states that there are economic differences between preventive and curative medicine. The remainder of the paragraph develops this point: sickness is nonproductive but health has a high value; a sick population is a greater economic burden than is a healthy population; and the cost of prevention is lower than the cost of curing. So, the underlined sentence makes an effective opening sentence for the paragraph and should remain where it is.

22. (C) *Writing and Language/Standard English Conventions/Sentence Structure/Comma Splices.* SAT Topic: SEC.1a.i; CC: ELA-Literacy.L.9-10.1. The problem with the original is that it results in a commas splice (two independent clauses joined with only a comma). The different ways to solve this problem are to insert a coordinating conjunction immediately after the comma, replace the comma with a semicolon, or create two sentences by using the appropriate end-stop punctuation. (C) uses the third of these approaches to address the comma splice.

Passage 3

23. (C) *Writing and Language/Standard English Conventions/Sentence Structure/Misplaced Modifiers.* SAT Topic: SEC.1a.iv; CC: ELA-Literacy.L.11-12.1. The original is wrong because the misplacement of the modifier "with a speed of 1.6 million miles per hour" changes the author's intended meaning. As written, the sentence seems illogically to say that the speed was used to detect the star or that the star is one of the fastest of those stars detected that have a speed of 1.6 million miles per hour. (C) solves the problem by placing the modifier close to what it is intended to modify: "it" (the star).

24. **(B)** *Writing and Language/Expression of Ideas/Strategy/Appropriate Supporting Material.* SAT Topic: EXPID.1b; CC: ELA-Literacy.L.9-10.3. What do the observations made by Hubble prove? The answer to this question is contained in the second paragraph. At first, astronomers thought that the star originated in the Large Magellanic Cloud, but the Hubble evidence has proven this wrong; the star actually originated in the Milky Way.

25. **(D)** *Writing and Language/Expression of Ideas/Style/Precision.* SAT Topic: EXPID.3a; CC: ELA-Literacy.L.9-10.5. The original is wrong because the word "evicted" does not have the meaning required in this context. "Ejected," which means "violently thrown out," is the correct word choice.

26. **(A)** *Writing and Language/Expression of Ideas/Strategy/Effective Opening Sentence.* SAT Topic: EXPID.2b; CC: ELA-Literacy.L.11-12.3. The second paragraph states how the astronomers' original theory of the star's origin in the Large Magellanic Cloud was disproven by the Hubble evidence. The original theory precedes the location in the paragraph designated by this item, and the description of the Hubble findings immediately follows this location. So, (A) is the correct choice. The remaining answer choices suggest that the original theory was correct.

27. **(A)** *Writing and Language/Standard English Conventions/Grammar and Usage/Pronoun Usage.* SAT Topic: SEC.2c.i; CC: ELA-Literacy.L.9-10.1. This item asks whether the underlined pronoun is used unambiguously. The original is correct. "It" clearly refers to "star." Each of the other choices disrupts that clear, unambiguous connection.

28. **(B)** *Writing and Language/Expression of Ideas/Style/Conciseness.* SAT Topic: EXPID.3b; CC: ELA-Literacy.L.9-10.3. The problem with the original is that it is needlessly wordy. The phrase "traveled the journey" is essentially redundant, so either "traveled" or "journeyed" will suffice.

29. **(B)** *Writing and Language/Standard English Conventions/Grammar and Usage/Faulty or Illogical Comparisons.* SAT Topic: SEC.2e; CC: ELA-Literacy.L.9-10.1. The original suffers from a faulty comparison. The underlined portion tries to compare the star's mass with nine of our suns. By inserting the pronoun "that," which refers to "mass," (B) corrects the mistake: the star's mass is nine times that (the mass) of our sun.

30. **(D)** *Writing and Language/Standard English Conventions/Grammar and Usage/Subject-Verb Agreement.* SAT Topic: SEC.2c.ii; CC: ELA-Literacy.L.9-10.1. The subject of the sentence is the compound "mass...and blue color," so a plural verb is required.

31. **(A)** *Writing and Language/Standard English Conventions/Punctuation/Commas.* SAT Topic: SEC.3f; CC: ELA-Literacy.L.11-12.2. This question turns on a subtle point of punctuation. In this sentence, the adjectives "young" and "massive" both modify the noun "star." Two such adjectives are referred to as coordinate adjectives and need to be separated by either a comma or a coordinating conjunction. The original is correct because the two adjectives are separated by a comma. Without the comma, "young" would seem to modify "massive." Note that using the coordinating conjunction "and" in this context would also be correct ("young and massive star").

32. **(B)** *Writing and Language/Expression of Ideas/Strategy/Data Presentations.* SAT Topic: EXPID.1d; CC: ELA-Literacy.L.11-12.3. The sequence of events depicted in the graphic is: triple-star system travels through

Milky Way galaxy (sentence 2), black hole captures one star and the other two stars are expelled (sentence 4), and two expelled stars continue to evolve into a blue straggler (sentence 3).

33. (A) *Writing and Language/Expression of Ideas/Strategy/Precision.* SAT Topic: EXPID.3a; CC: ELA-Literacy.L.11-12.6. In the final paragraph, the author refers to the formation of the star (which was triggered by the triple-star system passing too close to the Milky Way's black hole) as a "cosmic misstep." So, for this reason, "freak accident" is a suitable description of the hypervelocity star's formation.

Passage 4

34. (C) *Writing and Language/Standard English Conventions/Sentence Structure/Fragments.* SAT Topic: SEC.1a.i; CC: ELA-Literacy.L.9-10.1. The original is wrong because it results in a sentence fragment: "Most notably James "Super Chikan" Johnson of Clarksdale." This construction lacks a main verb. A fragment can be solved by either providing a main verb or joining the construction to an already complete sentence. (C) takes the second approach.

35. (C) *Writing and Language/Standard English Conventions/Sentence Structure/Problems of Coordination and Subordination.* SAT Topic: SEC.1a.ii; CC: ELA-Literacy.L.9-10.1. The original suffers from faulty subordination. The author does not really intend to make the second clause dependent upon the first and certainly does not intend to create a contrast between the two ideas. (C) solves the problem by using the coordinating conjunction "and" to indicate that the two ideas are of equal importance.

36. (A) *Writing and Language/Standard English Conventions/Punctuation/Colons.* SAT Topic: SEC.3b; CC: ELA-Literacy.L.9-10.2. Colons can be used to signal that a detail or a further explanation will follow. Here, the author uses the colon to good effect, introducing James Johnson's new nickname: "Super Chikan."

37. (D) *Writing and Language/Expression of Ideas/Style/Conciseness.* SAT Topic: EXPID.3b; CC: ELA-Literacy.L.9-10.3. Since the adjective "used" implies that the guitar was "previously owned," the verbiage following "used guitar" is redundant and should be eliminated.

38. (D) *Writing and Language/Standard English Conventions/Grammar and Usage/Verb Tense.* SAT Topic: SEC.1b.i; CC: ELA-Literacy.L.9-10.1. The problem with the original is that the past perfect verb "had gone" is inconsistent with the past tense verbs used elsewhere in the paragraph. The past perfect suggests that Johnson playing with other Delta bluesmen preceded some other event, but no other event is described in the sentence. (D) solves the problem by using the simple past tense verb "went."

39. (A) *Writing and Language/Expression of Ideas/Strategy/Appropriate Supporting Material.* SAT Topic: EXPID.1b; CC: ELA-Literacy.L.11-12.3. The underlined sentence provides an interesting detail about Johnson's life and is entirely consistent with painting a compelling backstory to Johnson's career: Johnson talked to chickens, drove a cab, played homemade instruments, and wrote music while driving a truck.

40. (B) *Writing and Language/Expression of Ideas/Style/Idiomatic Expression.* SAT Topic: SEC.2f; CC: ELA-Literacy.L.9-10.1. The original is wrong because the preposition "up" is not idiomatic in this context. The author intends to say that Johnson "showed off" his musical abilities.

41. (C) *Writing and Language/Expression of Ideas/Style/Conciseness.* SAT Topic: EXPID.3b; CC: ELA-Literacy.L.9-10.3. This item suffers from redundancy: "solo," means "by oneself" or "alone," so "solo" should be used without "by himself."

42. (D) *Writing and Language/Standard English Conventions/Punctuation/Commas.* SAT Topic: SEC.3f; CC: ELA-Literacy.L.9-10.2. The problem with the original is that the comma immediately following "released" disrupts the logical flow of the sentence. (D) solves the problem by simply eliminating the comma.

43. (A) *Writing and Language/Expression of Ideas/Strategy/Effective Opening Sentence.* SAT Topic: EXPID.2b; CC: ELA-Literacy.L.11-12.3. This question is asking for the most effective opening sentence to introduce the remainder of the paragraph. (A) is the best option, as this paragraph provides details about the instruments that Johnson makes by hand.

44. (C) *Writing and Language/Expression of Ideas/Organization/Passage-Level Structure.* SAT Topic: EXPID.2a; CC: ELA-Literacy.L.9-10.3. (A), (B), and (D) are all mentioned earlier in the passage. While the author does mention in the third paragraph that Johnson played in local clubs when he was young, the idea that he *still* plays in hometown clubs is only mentioned in the last paragraph. So, (C) is the correct choice.

Section 3: Math—No Calculator

1. (C) *Math: Multiple-Choice/Problem Solving and Advanced Arithmetic/Common Problem Solving Items/Ratios.* SAT Topic: PSD.1; CC: 6.RP.A.3b. The landscaper can carry the bricks at a rate of 4 bricks per trip. She needs to move 38 bricks, so the number of trips needed is $38 \text{ bricks} \left(\dfrac{\text{trip}}{4 \text{ bricks}} \right) = 9.5$ trips. Since the item stem specifies the minimum number of trips, and the answer choices are whole numbers, round 9.5 up to the nearest whole number: 10 trips are necessary.

2. (A) *Math: Multiple-Choice/Algebra/Solving Algebraic Equations or Inequalities with One Variable/Simple Equations.* SAT Topic: ALG.6; CC: 6.EE.B.7. Solve the given equation for x: $x+1+2x+2+3x+3=6 \Rightarrow 6x+6=6 \Rightarrow 6x=0 \Rightarrow x=0$.

3. (D) *Math: Multiple-Choice/Algebra/Creating, Evaluating, and Interpreting Algebraic Equations and Functions/Creating Algebraic Equations.* SAT Topic: ALG.1; CC: 6.EE.B.6. Let n equal the number of coffees sold to break even and create an equation setting the cost equal to the profit: $8,000+0.5n=cn \Rightarrow 8,000=cn-0.5n=n(c-0.5) \Rightarrow n=\dfrac{8,000}{c-0.5}$.

4. (C) *Math: Multiple-Choice/Algebra/Manipulating Algebraic Expressions/Evaluating Expressions.* SAT Topic: PAM.6; CC: HSA-APR.A.1. Since x, y, and z are consecutive integers and $x>y>z$, $x=y+1$, $y=z+1$, and $x=z+2$. Thus, $y=x-1$ and $z=x-2$. Plug these expression for y and z into the given equation and evaluate: $[x-(x-1)][x-(x-2)][(x-1)-(x-2)] = (x-x+1)(x-x+2)(x-1-x+2)=(1)(2)(1)=2$.

5. (B) *Math: Multiple-Choice/Algebra/Solving Equations or Inequalities with One Variable/Simple Equations* and *Creating, Evaluating, and Interpreting Algebraic Equations and Functions/Creating Algebraic Equations.* SAT Topic: ALG.1; CC: HSA-CED.A.1. Printer M prints $8d$ models in d days, so the total printed by M as a function of d is $120+8d$. Printer N prints $12d$ models in d days, so the total number of models printed by

Printer N is $80+12d$. Set the two expressions equal and solve for d: $120+8d=80+12d \Rightarrow 40=4d \Rightarrow d=10$.

6. **(C)** *Math: Multiple-Choice/Geometry/Volume* and *Algebra/Creating, Evaluating, and Interpreting Algebraic Equations and Functions/Creating Algebraic Equations.* SAT Topic: ATM.1; CC: 7.G.B.6. A cube has six faces, each with edge-length, e, so the surface area of the cube is: $6(e^2)=54x^2 \Rightarrow e^2=9x^2 \Rightarrow e=\sqrt{9x^2}=3x$. Thus, the volume of the cube is $(3x)^3=27x^3$.

7. **(A)** *Math: Multiple-Choice/Algebra/Solving Simultaneous Equations, Creating, Evaluating, and Interpreting Algebraic Equations and Functions/Creating Algebraic Equations,* and *Statistics/Measures of Center and Spread/Averages.* SAT Topic: ALG.5; CC: 8.EE.C.8c. First, create an equation representing the average temperature for the week and solve for $x+y$: $26=\dfrac{20+23+24+x+y}{5} \Rightarrow 26(5)=67+x+y \Rightarrow x+y=130-67=63$. Next, create an equation relating Thursday's temperature, x, to Friday's temperature, y: $x=\dfrac{3}{4}y$. Now, substitute $\dfrac{3}{4}y$ for x in the first equation and solve for y: $x+y=\dfrac{3}{4}y+y=63 \Rightarrow 1.75y=63 \Rightarrow y=36$. Finally, substitute 36 for y in either equation and solve for x: $x+36=63 \Rightarrow x=27$.

8. **(C)** *Math: Multiple-Choice/Algebra/Creating, Evaluating, and Interpreting Algebraic Equations and Functions/Function Notation.* SAT Topic: PAM.13; CC: HSF-IF.A.2. Perform the defined function on the values given: $[3]=3\cdot 3=9$ since 3 is odd, and $[4]=2\cdot 4=8$ since 4 is even. And $9\cdot 8=72$, so $[3]\cdot[4]=72$. Now, reason that since 72 is an even number, it is the result of performing the defined function on a number equal to one-half of 72, or 36. Therefore, $[3]\cdot[4]=72=[36]$.

9. **(D)** *Math: Multiple-Choice/Algebra/Creating, Evaluating, and Interpreting Algebraic Equations and Functions/Function Notation.* SAT Topic: PAM.13; CC: HSF-IF.A.2. If x is a prime number greater than 2, then x must be odd and $x-1$ is the next smaller number, which must be an even number. Since the quantity is even, the function tells you to multiply the quantity by 2: $2(x-1)=2x-2$.

   Alternatively, test the test using $x=3$: $[3-1]=[2]$, and 2 is even, so $[2]=2(2)=4$. Now test the choices:

   A) $3x=3(2)=6$, and $6 \neq 4$
   B) $2x=2(3)=6$, and $6 \neq 4$
   C) $3x-3=3(3)-3=6$, and $6 \neq 4$
   D) $2x-2=2(3)-2=4$, and $4=4$

10. **(A)** *Math: Multiple-Choice/Algebra/Creating, Evaluating, and Interpreting Algebraic Equations and Functions/Functions as Models.* SAT Topic: PAM.10; CC: HSF-LE.B.5. Any number, including 0.7, raised to a power of 0 is equal to 1. Therefore, for $t=0$, the value of the car is $12,000; that is, the original purchase price of the car was $12,000.

11. **(A)** *Math: Multiple-Choice/Algebra/Creating, Evaluating, and Interpreting Algebraic Equations and Functions/Creating Algebraic Equations.* SAT Topic: ALG.1; CC: 6.EE.B.6. Set up the formula by reasoning that Tom's age minus Y years is equal to 3 times Julie's age minus Y years: $T-Y=3(20-Y) \Rightarrow T-Y=60-3Y \Rightarrow T=60-2Y$.

12. **(B)** *Math: Multiple-Choice/Algebra/Manipulating Algebraic Expressions/Factoring Expressions.* SAT Topic: PAM.2; CC: 7.EE.A.1. Use prime factorization to solve this problem. As for (I), if x is a multiple of both 5 and 9, then the following are true: $x = [(3)(3)](5)(a)$ (for some other integer, a) and $x \neq 45$ whenever a is any integer other than 1. So, (I) is not true. As for (II), x is a multiple of 15 because $x = [(3)(5)](3)(a)$, so (II) must be true. As for (III) whenever a is even, x is even, so (III) is not true. The correct choice includes (II) only.

13. **(B)** *Math: Multiple-Choice/Algebra/Creating, Evaluating, and Interpreting Algebraic Equations and Functions/Concepts of Domain and Range* and *Coordinate Geometry/Graphs of Quadratic Equations and Relations.* SAT Topic: PAM.12; CC: HSF-IF.A.1. The domain of a function is the set of x-values and the range is the set of y-values, or $f(x)$. In this case, the function $f(x) = x^2 - 4$ is a quadratic in which the x is squared and has a positive coefficient (1), so the graph is a regular, up-right parabola. The minimum value of the parabola occurs for $x = 0$, so the minimum value for y is −4:
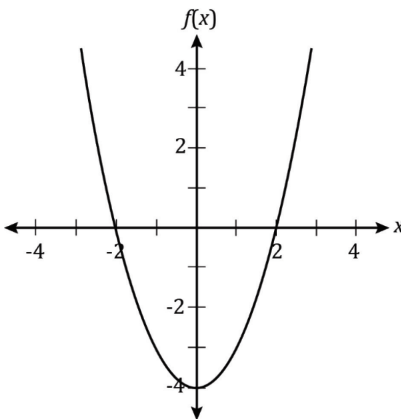

Therefore, the range of the function is all real numbers greater than or equal to −4.

14. **(A)** *Math: Multiple-Choice/Coordinate Geometry/The Coordinate System* and *Geometry/Triangles/Properties of Triangles.* SAT Topic: PAM.14; CC: HSG-GPE.B.7. A figure of the given information will help:
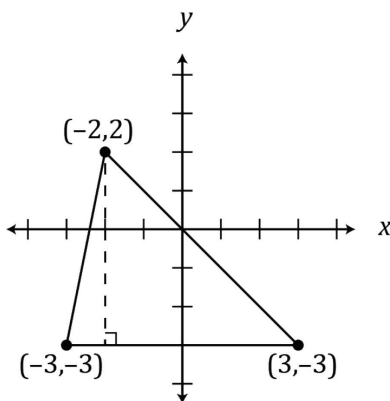

As indicated in the figure, the length of the triangle's base is 6 and the height of the triangle is 5. So, the area is $\dfrac{bh}{2} = \dfrac{(6)(5)}{2} = 15$.

15. (D) *Math: Multiple-Choice/Trigonometry/Right Triangles/Trigonometric Ratios* and *Triangles/ Properties of Triangles.* SAT Topic: ATM.2; CC: HSG-SRT.C.8. Since the points are both on the circle and the radius of the circle is 1, $\triangle MON$ is an isosceles triangle with two sides equal to 1:
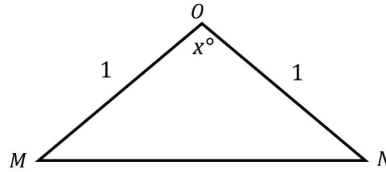
Draw a line segment from O to the center of $\overline{MN}$ to create two right triangles:
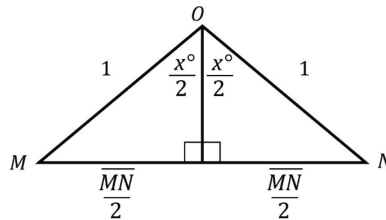
Now, use the trigonometric relationships to solve for $\overline{MN}$ in terms of $x°$. Since the side opposite $\dfrac{x°}{2}$ and the hypotenuse are both known values, relate these two: $\sin = \dfrac{\text{opposite}}{\text{hypotenuse}}$. Therefore, $\sin\dfrac{x}{2} = \dfrac{\overline{MN}/2}{1} = \dfrac{\overline{MN}}{2}$ and $\overline{MN} = 2\sin\dfrac{x}{2}$.

16. (15.5 or 31/2) *Math: Student-Produced Responses/Algebra/Evaluating Sequences Involving Exponential Growth.* SAT Topic: PAM.1; CC: HSF-LE.A.2. This item describes a situation demonstrating inverse exponential growth. The problem is simplified by writing the information in a table, decreasing the number of hours each day by half:

Monday	Tuesday	Wednesday	Thursday	Friday
8	$\dfrac{8}{2} = 4$	$\dfrac{4}{2} = 2$	$\dfrac{2}{2} = 1$	$\dfrac{1}{2} = 0.5$

Therefore: $8 + 4 + 2 + 1 + 0.5 = 15.5$. Note that the grid can also accommodate the fraction 31/2.

17. (4) *Math: Student-Produced Responses/Algebra/Solving Algebraic Equations or Inequalities with One Variable/Equations Involving Rational Expressions.* SAT Topic: PAM.7; CC: HSA-APR.D.7. Solve the given equation for *N*: $\dfrac{1}{2N} + \dfrac{1}{2N} = \dfrac{1}{4} \Rightarrow \dfrac{2}{2N} = \dfrac{1}{4} \Rightarrow \dfrac{1}{N} = \dfrac{1}{4} \Rightarrow N = 4$.

18. (29) *Math: Student-Produced Responses/Algebra/Manipulating Algebraic Expressions/Evaluating Expressions, Creating, Evaluating, and Interpreting Algebraic Equations and Functions/Creating Algebraic Equations,* and *Statistics/Measures of Center and Spread/Mode* and *Averages.* SAT Topic: PAM.4; CC: HSA-CED.A.2. A mode is the value with the greatest frequency in a set of numbers. There are three modes—*x, y,* and *z*—so each of these modes occur the same number of times and with a greater frequency than the other numbers, which include 4, $3(x + 2)$, $3y - 5$, and $3z$. This leaves six additional numbers, so the modes each

occur twice. The complete set is [4, x, x, y, y, z, z, $3(x+2)$, $3y-5$, $3z$]. Create an expression for the average of the set of numbers: $\dfrac{4+2x+2y+2z+3x+6+3y-5+3z}{10}=15\Rightarrow 5+5x+5y+5z=150\Rightarrow$

$5(x+y+z)=145\Rightarrow x+y+z=29$.

19. (**1**) *Math: Student-Produced Responses/Algebra/Solving Quadratic Equations and Relations/Roots of Quadratics.* SAT Topic: PAM.5; CC: HSA-REI.B.4b. This problem is greatly simplified if you remember that the product of the roots of a quadratic equation $ax^2+bx+c=0$ is $\dfrac{c}{a}$ and the sum of the roots is $\dfrac{-b}{a}$. Therefore, the product of the roots of the quadratic equation $3x^2-2x-1=0$, where $a=3$, $b=-2$, and $c=-1$, is $-\dfrac{1}{3}$ and the sum of the roots is $\dfrac{-(-2)}{3}=\dfrac{2}{3}$. The absolute value of the difference between these two values, that is, the distance between the two values on a number line, is 1.

Alternatively, determine the roots, either by factoring the quadratic equation or by applying the quadratic formula. According to the quadratic formula, the roots are $\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}=\dfrac{-(-2)\pm\sqrt{(-2)^2-4(3)(-1)}}{2(3)}=$

$\dfrac{2\pm\sqrt{4+12}}{6}=\dfrac{2\pm 4}{6}=-\dfrac{1}{3}$ and 1. The product of the roots is $-\dfrac{1}{3}$ and the sum is $\dfrac{2}{3}$, so the absolute value of the difference between these two values is 1.

20. (**9**) *Math: Student-Produced Responses/Coordinate Geometry/Graphs of Quadratic Equations and Relations and Geometry/Circles* SAT Topic: ATM.8; CC: HSF-IF.C.7a. To solve for a in the given quadratic equation, you'll need to determine a coordinate pair that falls on the parabola. The only coordinate pair that can be determined from the given figure and information is point X, which falls on both the circle and the parabola. The item stem states that $\overset{\frown}{XY}$ is an arc of a circle with center O, and $\angle XOY=90°$. Therefore, $\overset{\frown}{XY}$ is one-fourth of the circumference of the circle. Use this information and the length of $\overset{\frown}{XY}$ to find the radius of the circle: $\dfrac{3\pi}{2}=\dfrac{C}{4}=\dfrac{2\pi r}{4}\Rightarrow r=\dfrac{4(3\pi)}{2(2\pi)}=3$. Thus, point X has coordinates (3,0). Substitute 3 for x and 0 for y in the given quadratic equation and solve for a: $y=-x^2+a\Rightarrow 0=-(3)^2+a\Rightarrow a=9$.

Section 4: Math—Calculator

1. (**B**) *Math: Multiple-Choice/Algebra/Creating, Evaluating, and Interpreting Algebraic Equations and Functions/Creating Algebraic Equations.* SAT Topic: ALG.1; CC: 6.EE.B.6. Each big slice equals $\dfrac{1}{6}$ of the whole. Each slice is then cut into thirds: $\dfrac{1}{6}\left(\dfrac{1}{3}\right)=\dfrac{1}{18}$, so each small slice is $\dfrac{1}{18}$ of the whole. Pete had 4 small slices, or $\dfrac{4}{18}=\dfrac{2}{9}$ of the whole pie: $\dfrac{2T}{9}$.

2. (**A**) *Math: Multiple-Choice/Problem Solving and Advanced Arithmetic/Common Advanced Arithmetic Items/Sets: Union, Intersection, and Elements.* SAT Topic: PSD.7; CC: 6.EE.B.5. Count the pairs that fit the

requirement $a-b>0$, where a is an element from Set X and b is an element from Set Y: $(2,1)$, $(3,1)$, $(3,2)$, $(4,1)$, $(4,2)$, and $(4,3)$, for a total of 6 pairs.

3. (C) *Math: Multiple-Choice/Probability/Arithmetic Probability.* SAT Topic: PSD.1; CC: 7.SP.C.7a. Probability is the number of desirable outcomes divided by the total number of possible outcomes. In total, Estrella has $5+7+4+3+1=20$ coins. Of those coins, the nickels, dimes, quarters, and the half-dollar are not pennies—15 coins in total. Therefore, the probability of choosing a coin that is not a penny is $\dfrac{15}{20}=\dfrac{3}{4}$.

4. (A) *Math: Multiple-Choice/Problem Solving and Advanced Arithmetic/Common Problem Solving Items/Percentages.* SAT Topic: PSD.2; CC: 6.RP.A.3c. First, determine the number of seniors going to college: 80% of the 150 graduating is $0.8(150)=120$. Of those, 75% attend school in-state, so 25% attend school out-of-state: $0.25(120)=30$.

5. (C) *Math: Multiple-Choice/Problem Solving and Advanced Arithmetic/Common Problem Solving Items/Proportions and Direct-Inverse Variation* and *Geometry/Complex Figures.* SAT Topic: PSD.1; CC: 7.RP.A.3. The shaded area is $2\dfrac{1}{2}$ squares, which is 5 square miles, so each full square is 2 square miles. There are 9 squares in total, so the area of the entire piece of land is $9 \text{ squares}\left(\dfrac{2\text{ square miles}}{\text{square}}\right)=18$ square miles.

6. (D) *Math: Multiple-Choice/Algebra/Creating, Evaluating, and Interpreting Algebraic Equations and Functions/Creating Algebraic Equations.* SAT Topic: ALG.1; CC: 6.EE.B.6. Create an equation, in which P represents the original price: $P-\left(\dfrac{1}{3}\right)P=B \Rightarrow \left(\dfrac{2}{3}\right)P=B \Rightarrow P=\dfrac{3B}{2}$.

7. (B) *Math: Multiple-Choice/Geometry/Volume, Algebra/Manipulating Algebraic Expressions/ Evaluating Expressions,* and *Data Interpretation/Tables.* SAT Topic: ATM.1; CC: 7.G.B.6. Density is defined as mass divided by volume. The volume of the sample is $2.5\text{ cm}(6\text{ cm})(3\text{ cm})=45\text{ cm}^3$. Therefore, the density of the rock sample is $\dfrac{150\text{ grams}}{45\text{ cm}^3}\approx 3.33\text{ g/cm}^3$, which according to the table is most likely a chondrite meteorite.

8. (D) *Math: Multiple-Choice/Coordinate Geometry/Graphs of Linear Equations, Slope of a Line,* and *Slope-Intercept Form of a Linear Equation.* SAT Topic: ALG.7; CC: HSG-GPE.B.5. If two lines are parallel, but not identical, then they never intersect and the system of linear equations has no solution. In order for the lines to be parallel, they must have the same slope. Rewrite each equation in slope-intercept form: $\dfrac{x+y}{2}=1 \Rightarrow$ $y=-x+2$ and $ax+2y=10 \Rightarrow y=-\dfrac{ax}{2}+5$. Therefore, in order for the lines to have the same slope, $-\dfrac{a}{2}=-1 \Rightarrow a=2$.

9. **(B)** *Math: Multiple-Choice/Geometry/Triangles/Properties of Triangles.* SAT Topic: ATM.6; CC: 8.G.A.5. The triangle on the right is an equilateral triangle, so $2x = 8$, which means that $x = 4$. So, the length of side $\overline{AC}$ is $2(x) + x = 2(4) + 4 = 12$.

10. **(C)** *Math: Multiple-Choice/Problem Solving and Advanced Arithmetic/Common Problem Solving Items/Percentages.* SAT Topic: PSD.2; CC: 7.RP.A.3. In spite of the wordy item stem, simply compare $100 - (1 + 11) = 88\%$ of \$25 with $100 - (2 + 14) = 84\%$ of \$30. Avi's donation yields $0.88(25) = \$22$ and Brandon's donation yields $0.84(30) = \$25.20$. Therefore, Brandon's donation yields $\$25.20 - \$22 = \$3.20$ more than Avi's donation.

11. **(C)** *Math: Multiple-Choice/Statistics/Measures of Center and Spread/Averages.* SAT Topic: PSD.9; CC: HSS-ID.A.2. Use the technique for finding a missing element in an average. Since the three scores average 75, the student earned a total score of $3(75) = 225$. Since one score is 75, the remaining scores total $225 - 75 = 150$. The maximum that she could receive on any test is 100, and $150 - 100 = 50$. Thus, the lowest score that she could have received (and still maintain a 75 average) is 50.

12. **(B)** *Math: Multiple-Choice/Problem Solving and Advanced Arithmetic/Common Problem Solving Items/Ratios, Geometry/Circles,* and *Complex Figures.* SAT Topic: PSD.1; CC: 7.RP.A.3. Let r be the radius of the original pool—its area is πr^2. Then, the radius of the larger pool is $2r$, so its area is $\pi(2r)^2 = 4\pi r^2$. The shaded part of the diagram is the larger circle minus the smaller one, so the area of the shaded part of the diagram is $4\pi r^2 - \pi r^2 = 3\pi r^2$. Therefore, the ratio of the shaded area to the unshaded area is $\dfrac{3\pi r^2}{\pi r^2} = \dfrac{3}{1}$.

13. **(A)** *Math: Multiple-Choice/ Problem Solving and Advanced Arithmetic/Common Problem Solving Items/Percentages, Geometry/Circles,* and *Complex Figures.* SAT Topic: PSD.2; CC: 7.RP.A.3. Let r be the radius of the original pool, so it has a surface area of πr^2. The radius of the new pool will be $1.2r$, so it has an area of $\pi(1.2r)^2 = 1.44\pi r^2$. Therefore, the area of the new pool is 144% of the area of the old pool.

Alternatively, choose some easy numbers to work with. Let the radius of the original pool equal 10. This means the radius of the new pool must be 12. Therefore, the area of the new pool is $\pi(12)^2 = 144\pi$ and the area of the original pool is $\pi(10)^2 = 100\pi$. And 144π is 144% of 100π.

14. **(A)** *Math: Multiple-Choice/Coordinate Geometry/Slope-Intercept Form of a Linear Equation* and *Graphs of Linear Equations.* SAT Topic: ALG.9; CC: 8.F.B.4. Use the slope-intercept form for linear equations, $y = mx + b$, in which m, the slope, is equal to $\dfrac{y_2 - y_1}{x_2 - x_1}$. Thus, $m = \dfrac{5 - 1}{7 - (-1)} = \dfrac{4}{8} = \dfrac{1}{2}$, so the equation is $y = \dfrac{x}{2} + b$. Substitute one of the given points into the equation to find the y-intercept, b: $1 = \dfrac{-1}{2} + b \Rightarrow b = \dfrac{3}{2}$. Therefore, $y = \dfrac{x}{2} + \dfrac{3}{2}$.

Alternatively, substitute the given points into the equations in the answer choices to determine which equation is true for both points.

15. (C) *Math: Multiple-Choice/Data Interpretation/Scatterplots* and *Statistics/Measures of Center and Spread/Median.* SAT Topic: PSD.9; CC: 6.SP.B.5c. The median is the middle value of the data when the values are arranged in order. Since the *x*-axis shows the total grams of fat for the nine items arranged in order, simply pick the middle data point: the fish sandwich, which has 18 grams of fat.

16. (C) *Math: Multiple-Choice/Data Interpretation/Scatterplots, Coordinate Geometry/Slope-Intercept Form of a Linear Equation,* and *Algebra/Creating, Evaluating, and Interpreting Algebraic Equations and Functions/Creating Algebraic Equations*. SAT Topic: PSD.4; CC: HSF-LE.A.2. Written in slope-intercept form, the line of best fit has the form $y = mx + b$, where m is the slope of the line and b is the *y*-intercept (the *y*-value for $x = 0$). According to the graph, the *y*-intercept is 50. Next, pick two points on the line, say $(5,140)$ and $(8,200)$, to determine the slope of the line: $m = \dfrac{\text{rise}}{\text{run}} = \dfrac{\Delta y}{\Delta x} = \dfrac{200 - 140}{8 - 5} = \dfrac{60}{3} = 20$. Therefore, the relationship between the calories and total grams of fat is $y = 20x + 50$.

17. (A) *Math: Multiple-Choice/Data Interpretation/Scatterplots* and *Algebra/Creating, Evaluating, and Interpreting Algebraic Equations and Functions/Functions as Models.* SAT Topic: PSD.5; CC: 8.SP.A.3. Based on the line of best fit, a 325-calorie fast food item will have approximately 15 grams of total fat, and (A) is closest, with 14 grams.

Alternatively, the equation determined in the previous item can also be used to determine the expected fat content of the 325-calorie item: $325 = 20(x) + 50 \Rightarrow x = \dfrac{325 - 50}{20} = 13.75 \approx 14$ grams.

18. (C) *Math: Multiple-Choice/Geometry/Triangles/Properties of Triangles* and *Rectangles and Squares.* SAT Topic: PAM.14; CC: 7.G.B.6. The rectangle has an area of $4(9) = 36$. Since the triangle has the same area as the rectangle, use this fact to solve for the height of the triangle: $\dfrac{h(12)}{2} = 36 \Rightarrow 12h = 72 \Rightarrow h = 6$.

19. (B) *Math: Multiple-Choice/Problem Solving and Advanced Arithmetic/Common Problem Solving Items/Percentages.* SAT Topic: PSD.2; CC: 7.RP.A.3. The acid concentration of each solution is the milliliters of acid per milliliters of solution—these concentrations are given as percentages in the item stem. Using these percentages and the known volume of each solution, create a table relating the given information and the unknown concentration of the final solution:

	$\dfrac{\text{mL acid}}{\text{mL solution}}$	mL solution	mL acid
35% acid solution	0.35	500	$0.35(500) = 175$
40% acid solution	0.40	250	$0.40(250) = 100$
Final solution	?	750	$100 + 175 = 275$

Since the final solution must have 275 mL of acid in 750 mL of solution, its acid concentration is $\dfrac{275}{750} = 36\dfrac{2}{3}\%$.

20. (D) *Math: Multiple-Choice/Algebra/Solving Algebraic Equations or Inequalities with One Variable/Equations Involving Absolute Value.* SAT Topic: ALG.6; CC: 7.NS.A.1b. Rewrite the equation by isolating the absolute value expression on one side: $\left|y^2-5\right|=4$. This means that $y^2-5=4$ or $-\left(y^2-5\right)=4$. Solve each equation for y: $y^2=9 \Rightarrow y=\pm 3$ or $y^2=1 \Rightarrow y=\pm 1$. Therefore, the complete solution set is $\{-3,-1,1,3\}$.

21. (B) *Math: Multiple-Choice/Problem Solving and Advanced Arithmetic/Common Problem Solving Items/Percentages* and *Data Interpretation/Bar, Cumulative, and Line Graphs.* SAT Topic: PSD.2; CC: 8.EE.A.4. According to the graph, 177×10^3 degrees were in social studies/history. Since the total number of degrees awarded was 1.716×10^6, the percentage of degrees that were in social studies/history was

$$\frac{177\times 10^3}{1.716\times 10^6}=\frac{177\times 10^3}{1{,}716\times 10^3}\approx \frac{1}{10}=10\%.$$

22. (D) *Math: Multiple-Choice/Problem Solving and Advanced Arithmetic/Common Problem Solving Items/Ratios* and *Data Interpretation/Bar, Cumulative, and Line Graphs.* SAT Topic: PSD.1; CC: 8.EE.A.4. The number of degrees awarded in the five most popular majors is $(365+177+143+104+101)\times 10^3 = 890\times 10^3$. Notice that the item stem specifies that the comparison is with "all other undergraduate majors," which is $1.716\times 10^6 - 890\times 10^3 = (1{,}716-890)\times 10^3 = 826\times 10^3$. Therefore, the ratio of the number of degrees in the five most popular majors to all other undergraduate majors was $\dfrac{890\times 10^3}{826\times 10^3}=\dfrac{890}{826}\approx \dfrac{1}{1}=1:1$.

23. (D) *Math: Multiple-Choice/Statistics/Data Interpretation/Drawing Inferences.* SAT Topic: PSD.6; CC: HSS-ID.C.9. This item tests understanding of the terms "correlation" and "causation" in statistics. Correlation indicates the extent to which two or more variables fluctuate together. A positive correlation indicates the extent to which those variables increase or decrease in parallel; a negative correlation indicates the extent to which one variable increases as the other decreases. However, correlation doesn't explain how or why the relationship between two variables exists—only that it does exist. Causation goes a step further than correlation, stating that a change in the value of the *x*-variable will cause a change in the value of the *y*-variable. This item doesn't given enough information to assume that causation exists, but only that correlation exists.

24. (D) *Math: Multiple-Choice/Problem Solving and Advanced Arithmetic/Common Problem Solving Items/Percentages* and *Data Interpretation/Bar, Cumulative, and Line Graphs.* SAT Topic: PSD.5; CC: HSN-Q.A.1. The fraction of uranium-235 remaining after 1.5 billion years is approximately 0.2. The fraction of uranium-235 remaining after 2.5 billion years is approximately 0.1. The uranium-235 remaining after 2.5 billion years is $\dfrac{0.1}{0.2}=\dfrac{1}{2}=50\%$ of that remaining after 1.5 billion years.

25. (A) *Math: Multiple-Choice/Algebra/Creating, Evaluating, and Interpreting Algebraic Equations and Functions/Creating Algebraic Equations.* SAT Topic: ALG.1; HSF-BF.A.2. After one half-life, the amount of uranium-235 remaining is $\dfrac{A_0}{2}$. After two half-lives, the amount of remaining is $\dfrac{\frac{A_0}{2}}{2}=\dfrac{A_0}{4}$. After three half-lives, the amount remaining is $\dfrac{A_0}{8}$, and after four half-lives, the amount remaining is $\dfrac{A_0}{16}$.

26. **(C)** *Math: Multiple-Choice/Coordinate Geometry/Qualitative Behavior of Graphs of Functions.* SAT Topic: PSD.6; CC: HSF-LE.A.1. This item tests your understanding of the general shape of a particular function. In this case, the data shows a negative relationship that slows with increasing time: a negative exponential, (C). Note that (A) would be a line with a negative slope; (B) would be a line with a positive slope; and (D) would be a positive relationship that increases with increasing time: a positive exponential.

27. **(B)** *Math: Multiple-Choice/Coordinate Geometry/Graphs of Linear Equations, Slope of a Line,* and *Solving Simultaneous Equations.* SAT Topic: ALG.9; CC: 8.EE.C.8a. Both equations are linear (the power of x is 1 in both equations), so they intersect at most once, or if they are parallel, not at all. They are parallel if they have the same slope, but the slope of the first equation is $-\dfrac{1}{2}$ and the slope of the second is 4. Therefore, they are not parallel, so they must intersect at one point, so (B) or (C) must be correct. Only the first equation passes through the point (0,3), so (B) must be correct. Indeed, setting the two equations equal to one another shows that they intersect when $-\dfrac{x}{2}+3=4x+6 \Rightarrow -x+6=8x+12 \Rightarrow 9x=-6 \Rightarrow x=-\dfrac{2}{3}$. For $x=-\dfrac{2}{3}$, $y=4\left(-\dfrac{2}{3}\right)+6=-\dfrac{8}{3}+\dfrac{18}{3}=\dfrac{10}{3}$. Therefore, the two lines intersect at $\left(-\dfrac{2}{3},\dfrac{10}{3}\right)$.

28. **(C)** *Math: Multiple-Choice/Algebra/Creating, Evaluating, and Interpreting Algebraic Equations and Functions/Creating Algebraic Equations* and *Solving Simultaneous Equations.* SAT Topic: ALG.5; HSA-CED.A.3. Since x and y are single digits, $x+2=6$ and $8+x=10+y$. Indeed, solving the system of equations shows that $x=4$, $8+4=10+y \Rightarrow y=2$, and the arithmetic problem is $84+42=126$.

29. **(C)** *Math: Multiple-Choice/Coordinate Geometry/Graphs of Linear Equations, Slope of a Line,* and *Slope-Intercept Form of a Linear Equation.* SAT Topic: ALG.9; CC: HSG-GPE.B.5. Two lines are perpendicular if the product of their slopes is –1, i.e., if the slopes of the two lines are negative reciprocals of each other, then the two lines are perpendicular. Each of the answer choices gives an equation for a line in slope-intercept form, $y=mx+b$, where m is the slope (and b is the y-intercept). Since the given line has a slope of $\dfrac{3}{2}$, a perpendicular line must have a slope of $-\dfrac{2}{3}$. (C) is the only equation with a slope of $-\dfrac{2}{3}$.

30. **(B)** *Math: Multiple-Choice/Problem Solving and Advanced Arithmetic/Common Problem Solving Items/Proportions and Direct-Inverse Variation* and *Geometry/Circles.* SAT Topic: PSD.1; CC: 7.RP.A.3. Since the length of the needle is the radius of the circle swept by the needle, the distance the tip of the needle travels along the arc is proportional to the angle swept by the needle: $\dfrac{30}{360}=\dfrac{1}{12}$. So, the pendulum moves through 1/12th of a circle with radius 4, which is 1/12th of $C=2\pi r=2\pi(4)=8\pi$ inches, or $\dfrac{8\pi}{12}=\dfrac{2\pi}{3}$ inches between each click. Since the setting is 30 beats per minute, the metronome clicks every 2 seconds—that is, the tip of the needle travels $\dfrac{2\pi}{3}$ inches every 2 seconds, or $\dfrac{2\pi/3}{2}=\dfrac{2\pi}{6}=\dfrac{\pi}{3}$ inches per second.

31. **(11)** *Math: Student-Produced Responses/Problem Solving and Advanced Arithmetic/Ratios.* SAT Topic: PSD.1; CC: 7.RP.A.3. Rate multiplied by time equals work; that is, the number of envelopes sealed is equal to the rate in envelopes per second multiplied by time in seconds. Work through the given scenario, a step at a time, setting up expressions so units cancel leaving the desired quantity. Rasheed's rate is 50 envelopes

per 60 seconds and Tae-John's is 50 envelopes per 80 seconds. If Rasheed first seals 240 envelopes, this takes $\dfrac{60 \text{ seconds}}{50 \text{ envelopes}}(240 \text{ envelopes}) = 288$ seconds . Then, Tae-John working for 4 minutes seals

$\dfrac{50 \text{ envelopes}}{80 \text{ seconds}}(4 \text{ minutes})\left(\dfrac{60 \text{ seconds}}{1 \text{ minute}}\right) = 150$ envelopes . This is a total of $240 + 150 = 390$ envelopes,

leaving $500 - 390 = 110$ envelopes for Rasheed to seal: $\dfrac{60 \text{ seconds}}{50 \text{ envelopes}}(110 \text{ envelopes}) = 132$ seconds.

Therefore, the total time required to complete the job is $288 + 4(60) + 132 = 660 \text{ seconds}\left(\dfrac{1 \text{ minute}}{60 \text{ seconds}}\right) =$ 11 minutes.

32. (2) *Math: Student-Produced Responses/Coordinate Geometry/Graphs of Quadratic Equations and Relations.* SAT Topic: PAM.10; CC: HSF-IF.C.8a. The axis of symmetry for a quadratic equation gives the maximum or minimum of the equation, depending on whether the quadratic is upright or not. In this case, the coefficient of the x^2 term is negative, so it is an up-side down parabola—the vertex (on the axis of symmetry) is a maximum. For a quadratic equation in the form $y = ax^2 + bx + c$, the *x*-value of the axis of symmetry (maximum or minimum *y*-value), is $\dfrac{-b}{2a}$. In the given equation, $b = 4{,}000$ and $a = -1{,}000$, so $x = \dfrac{-4{,}000}{2(-1{,}000)} = 2$ —the number of sales staff that maximizes daily profits. Alternatively, test some numbers.

33. (6000) *Math: Student-Produced Responses/Algebra/Creating, Evaluating, and Interpreting Algebraic Equations and Functions/Function Notation and Functions as Models.* SAT Topic: PAM.13; CC: HSF-IF.A.2. This item builds on the previous item: the maximum daily profit is the value of the given quadratic equation for the *x*-value of the axis of symmetry: the number of sales staff that maximizes profit is 2. So, $y = -1{,}000x^2 + 4{,}000x + 2{,}000 = -1{,}000(2^2) + 4{,}000(2) + 2{,}000 = -4{,}000 + 8{,}000 + 2{,}000 = 6{,}000$.

34. (4) *Math: Student-Produced Responses/Algebra/Solving Quadratic Equations and Relations/Roots of Quadratic Equations, The Quadratic Formula, and Graphs of Quadratic Equations and Relations.* SAT Topic: PAM.11; CC: HSA-REI.B.4b. The roots of a quadratic equation correspond to the *x*-values that make the equation equal to zero—in this case, zero profit. Use the quadratic formula to find the roots of the equation $ax^2 + bx + c = 0$. To simplify, factor $-1{,}000$ out of the equation, so $-1{,}000(x^2 - 4x - 2) = 0 \Rightarrow x^2 - 4x - 2 = 0$: $\dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \dfrac{-(-4) \pm \sqrt{(-4)^2 - 4(1)(-2)}}{2(1)} = \dfrac{4 \pm \sqrt{16 + 8}}{2} = \dfrac{4 \pm 2\sqrt{6}}{2} = 2 \pm \sqrt{6}$. Since $\sqrt{4} = 2$ and $\sqrt{9} = 3$, $2 - \sqrt{6}$ is a negative value and not possible for the number of sales staff. The other root, $2 + \sqrt{6}$ is between 4 and 5, so 5 employees would push the profit below zero (for *x*-values greater than the positive root, the corresponding *y*-value is negative; the same is true of *x*-values less than the negative root, but as already explained, a negative number of sales staff is not possible). Therefore, the maximum number of sales staff that can work on a given day and still yield positive profits must be the next lowest integer value (because sales staff must, by definition, be whole numbers of people): 4.

35. (80) *Math: Student-Produced Responses/Geometry/Volume.* SAT Topic: ATM.1; CC: 7.G.B.6. After the pieces are cut out, the box will have a length of 8 cm, a width of 10 cm and a height of 1 cm. Therefore, the volume of the box will be $(\text{length})(\text{width})(\text{height}) = 8(10)(1) = 80$ cubic centimeters.

36. (9) *Math: Student-Produced Responses/Statistics/Measures of Center and Spread/Range.* SAT Topic: PSD.9; CC: 6.SP.B.5c. Range is the difference between the smallest value and the greatest value. In the figure, the smallest value is 51 inches (Alli); the largest value is 60 inches (Azuany). Therefore, the range is 9 inches.

37. (53) *Math: Student-Produced Responses/Geometry/Circles, Properties of Tangent Lines,* and *Triangles/Properties of Triangles.* SAT Topic: ATM.5; CC: HSG-C.A.2. When a line intersects a circle at only one point, that line is perpendicular to the radius at that point;
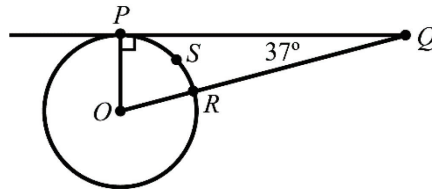
So, $\angle OPQ = 90°$, $90° + 37° + \angle POQ = 180° \Rightarrow \angle POQ = 53°$, and $\angle POQ = \angle POR = 53°$. Since O is the center of the circle and an arc of a circle is equal to its central angle, and $\overparen{PSR} = \angle POR = 53°$.

38. (7/24 or .292) *Math: Student-Produced Responses/Algebra/Solving Algebraic Equations or Inequalities with One Variable/Equations Involving Absolute Value.* SAT Topic: ALG.6; CC: 8.EE.C.7b. Since $\left|\dfrac{1}{3} - \dfrac{1}{2}\right| = \dfrac{1}{6}$, create

the derivative equations: $k - \dfrac{1}{8} = \dfrac{1}{6}$ or $-k + \dfrac{1}{8} = \dfrac{1}{6}$. Solve for k: $k = \dfrac{14}{48} = \dfrac{7}{24}$ or $k = -\dfrac{1}{24}$. Since the item stem

asks for a positive number, the answer must be $\dfrac{7}{24}$, which is also approximately 0.292.

Section 5: Essay

Sample Essay Responses and Analyses

Above Average Response

Almost everyone can attest to the benefit of a good night's sleep. When we are well-rested, we feel energetic, our minds are sharp, and we feel ready to take on the day. If we get a poor night's sleep, we can feel the effects throughout the entire day. What most people may not know is that sleep deprivation is one of the major public health issues facing both adults and children. In her essay "Raising Awareness of Sleep as a Healthy Behavior," Geraldine S. Perry discusses the impact of sleep deprivation, and the effects are more seriously than simply feeling sleepy throughout the day. Perry uses clinical evidence to show how sleep deprivation affects adults and children and how clinicians are not as likely to provide patients with information on healthy sleep habits.

Perry begins her essay by discussing the percentages of adults and children who are sleep deprived in order to set up the context for her argument. The numbers are staggering: nearly 35% of adults and 70% of high school students are not getting the necessary amount of sleep. These numbers mean more than a lot of sleepy adults and teenagers: they mean an increased risk of dying of coronary heart disease (for adults) and higher instances of obesity (for children). Perry's claim that sleep is a public health issue becomes clear with the presentation of these effects of sleep deprivation. Both children and adults experience higher instances of mood disorders and see a decrease in overall performance. Sleep deprivation also leads to higher instances of workplace injuries, car accidents, and occupational/medical errors. This means that the sleep deprived person is not only hurting themselves, but their lack of sleep may very well be affecting the wellness and livelihood of those around them, making sleep deprivation the very definition of a public health issue. These statistics and facts are intended to make the information relevant to a broad audience and to shock and perhaps even scare that audience. They are successful persuasive devices because they affect, or have the potential to affect, everybody, and they address grave concerns of sleep deprivation. The reader's interest is won and the argument proceeds.

It is possible that the widespread sleep deprivation issue goes deeper than the demands of children's schoolwork and the busy schedules of adults. The public may not be receiving sufficient information from their health care professionals about healthy sleep habits. In fact, many people may not even be aware of the amount of sleep that they should be getting each night. Again, this lack of education puts sleep deprivation at the top of the list of public health concerns. It has been shown that health care providers do not generally assess sleep habits or provide counseling on healthy sleep behavior. In one survey, only about 10% of health care providers could say that they have a good knowledge of sleep and sleep disorders. This point about lack of information regarding sleep is included to show that the reader may be sleep deprived and not even realize it, increasing the gravity of the issue. This worries the audience and works because it exposes to us that not only we, but even our health care providers, may not even be aware that we are suffering the consequences of sleep deprivation.

Perry further builds the impact of her claim by addressing the public health burden of sleep deprivation. She argues, "there are substantial public health investments in all areas related to sleep, from obesity and other chronic conditions to motor vehicle accidents." This point is included in order to demonstrate the far reach of this issue of sleep deprivation. Everyone, she demonstrates, is affected, including the entirety of the audience of this text, whose tax dollars are paying for the consequences of sleep deprivation. This is meant to engage and concern the entire audience, and is effective because people generally do not like to see their tax dollars being used to pay for other people's bad decisions or for things that don't affect them. In this way, Perry gains the attention of those who may be getting enough sleep and who know that they are, but who do not like the idea of "substantial public health investments" for sleep-related issues.

Perry's essay includes some startling information about the general public's poor sleep habits and the lack of attention health care professionals give to sleep education. The combination, and perhaps interrelation, of these two topics show how sleep really is one of the most widespread public health issues facing both adults and children.

Analysis of Above Average Response

The writer is able to effectively take ideas discussed in the passage and connect them to make a case for the author's main argument. The sentence structure and vocabulary are appropriate and the tone remains consistent throughout the writer's response. The writer provides evidence from the passage to support the author's claims and is able to connect them appropriately.

Below Average Response

It's pretty obvious that people don't get enough sleep. That's why there are places like Starbucks and things like energy drinks, because people don't get enough sleep and have to find there energy somewhere else. For example, most car accidents happen because people are falling asleep at the wheel. I am going to explain to you what happens when people don't get enough sleep. They have health problems, they do not know how much sleep they should be getting, and there doctors don't know how to help them sleep more and better.

When you don't get enough sleep weird things start to happen. For example, people who don't get enough sleep are sick more often than people who get a good amount of sleep. The things that can happen are cardiovascular morbidity, metabolic disorders, obesity, diabetes, heart disease, and hypertension. People who don't get enough sleep tend to die sooner than people who do get enough sleep. So it's pretty much a major problem that can be solved really easily. All you need to do is sleep more. If people got more sleep, they could very easily avoid all these dangerous health issues.

Second of all people really don't know how much sleep they need. The author says that 35% of adults and 70% of children aren't getting enough sleep. Its possible that they think that they are getting enough sleep but they don't really know how much they should be getting so its not enough. What they need is some education that tells them exactly how much sleep they should be getting. This can be done by teaching students in school or telling adults when they visit their doctors.

Also, it seems like a lot of doctors don't really know a lot about how to help people get more sleep. They just don't provide the information like they should and so as a result people are uneducated on sleep. It would be good if doctors could have more information on sleep so they can give this information to their patients and let them know how much sleep they need and how they can sleep better.

In conclusion we would all be better off if we got more sleep and we were able to avoid all the problems that come with not sleeping enough. Its hard to do that when we don't know how much sleep we need to get and that our doctors can't really help us because they don't seem to know either. Not getting enough sleep leads to a lot of health problems, people don't know how much sleep to get, and doctors don't have the information to help people out. Maybe someday people will get more sleep, but right now it is just causing a lot of problems.

Analysis of Below Average Response

The writer does not follow the prompt: the response discusses aspects of the issue presented in the passage, but does not discuss how the author makes his/her argument. Some information from the passage is incorrectly interpreted. Grammatical errors make the response choppy and difficult to read at times. The information presented is somewhat repetitive, and the response is not well-developed.