CollegeBoard

# Answer Explanations
## SAT® Practice Test #2

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## Section 1: Reading Test

### QUESTION 1.

**Choice A is the best answer.** The narrator admits that his job is "irksome" (line 7) and reflects on the reasons for his dislike. The narrator admits that his work is a "dry and tedious task" (line 9) and that he has a poor relationship with his superior: "the antipathy which had sprung up between myself and my employer striking deeper root and spreading denser shade daily, excluded me from every glimpse of the sunshine of life" (lines 28-31).

Choices B, C, and D are incorrect because the narrator does not become increasingly competitive with his employer, publicly defend his choice of occupation, or exhibit optimism about his job.

### QUESTION 2.

**Choice B is the best answer.** The first sentence of the passage explains that people do not like to admit when they've chosen the wrong profession and that they will continue in their profession for a while before admitting their unhappiness. This statement mirrors the narrator's own situation, as the narrator admits he finds his own occupation "irksome" (line 7) but that he might "long have borne with the nuisance" (line 10) if not for his poor relationship with his employer.

Choices A, C, and D are incorrect because the first sentence does not discuss a controversy, focus on the narrator's employer, Edward Crimsworth, or provide any evidence of malicious conduct.

### QUESTION 3.

**Choice C is the best answer.** The first paragraph shifts from a general discussion of how people deal with choosing an occupation they later regret (lines 1-6) to the narrator's description of his own dissatisfaction with his occupation (lines 6-33).

Choices A, B, and D are incorrect because the first paragraph does not focus on the narrator's self-doubt, his expectations of life as a tradesman, or his identification of alternatives to his current occupation.

## QUESTION 4.

**Choice A is the best answer.** In lines 27-33, the narrator is describing the hostile relationship between him and his superior, Edward Crimsworth. This relationship causes the narrator to feel like he lives in the "shade" and in "humid darkness." These words evoke the narrator's feelings of dismay toward his current occupation and his poor relationship with his superior—factors that cause him to live without "the sunshine of life."

Choices B, C, and D are incorrect because the words "shade" and "darkness" do not reflect the narrator's sinister thoughts, his fear of confinement, or his longing for rest.

## QUESTION 5.

**Choice D is the best answer.** The narrator states that Crimsworth dislikes him because the narrator may "one day make a successful tradesman" (line 43). Crimsworth recognizes that the narrator is not "inferior to him" but rather more intelligent, someone who keeps "the padlock of silence on mental wealth which [Crimsworth] was no sharer" (lines 44-48). Crimsworth feels inferior to the narrator and is jealous of the narrator's intellectual and professional abilities.

Choices A and C are incorrect because the narrator is not described as exhibiting "high spirits" or "rash actions," but "Caution, Tact, [and] Observation" (line 51). Choice B is incorrect because the narrator's "humble background" is not discussed.

## QUESTION 6.

**Choice B is the best answer.** Lines 61-62 state that the narrator "had long ceased to regard Mr. Crimsworth as my brother." In these lines, the term "brother" means friend or ally, which suggests that the narrator and Crimsworth were once friendly toward one another.

Choices A, C, and D are incorrect because the narrator originally viewed Crimsworth as a friend, or ally, and later as a hostile superior; he never viewed Crimsworth as a harmless rival, perceptive judge, or demanding mentor.

## QUESTION 7.

**Choice D is the best answer.** In lines 61-62, the narrator states that he once regarded Mr. Crimsworth as his "brother." This statement provides evidence that the narrator originally viewed Crimsworth as a sympathetic ally.

Choices A, B, and C do not provide the best evidence for the claim that Crimsworth was a sympathetic ally. Rather, choices A, B, and C provide evidence of the hostile relationship that currently exists between the narrator and Crimsworth.

## QUESTION 8.

**Choice D is the best answer.** In lines 48-53, the narrator states that he exhibited "Caution, Tact, [and] Observation" at work and watched Mr. Crimsworth with "lynx-eyes." The narrator acknowledges that Crimsworth was "prepared to steal snake-like" if he caught the narrator acting without tact or being disrespectful toward his superiors (lines 53-56). Thus, Crimsworth was trying to find a reason to place the narrator "in a ridiculous or mortifying position" (lines 49-50) by accusing the narrator of acting unprofessionally. The use of the lynx and snake serve to emphasize the narrator and Crimsworth's adversarial, or hostile, relationship.

Choices A and B are incorrect because the description of the lynx and snake does not contrast two hypothetical courses of action or convey a resolution. Choice C is incorrect because while lines 48-56 suggest that Crimsworth is trying to find a reason to fault the narrator's work, they do not imply that an altercation, or heated dispute, between the narrator and Crimsworth is likely to occur.

## QUESTION 9.

**Choice B is the best answer.** Lines 73-74 state that the narrator noticed there was no "cheering red gleam" of fire in his sitting-room fireplace. The lack of a "cheering," or comforting, fire suggests that the narrator sometimes found his lodgings to be dreary or bleak.

Choices A and D are incorrect because the narrator does not find his living quarters to be treacherous or intolerable. Choice C is incorrect because while the narrator is walking home he speculates about the presence of a fire in his sitting-room's fireplace (lines 69-74), which suggests that he could not predict the state of his living quarters.

## QUESTION 10.

**Choice D is the best answer.** In lines 68-74, the narrator states that he did not see the "cheering" glow of a fire in his sitting-room fireplace. This statement provides evidence that the narrator views his lodgings as dreary or bleak.

Choices A, B, and C do not provide the best evidence that the narrator views his lodgings as dreary. Choices A and C are incorrect because they do not provide the narrator's opinion of his lodgings, and choice B is incorrect because lines 21-23 describe the narrator's lodgings only as "small."

## QUESTION 11.

**Choice D is the best answer.** In lines 11-12, the author introduces the main purpose of the passage, which is to examine the "different views on where ethics should apply when someone makes an economic decision." The passage examines what historical figures Adam Smith, Aristotle, and John Stuart Mill believed about the relationship between ethics and economics.

Choices A, B, and C are incorrect because they identify certain points addressed in the passage (cost-benefit analysis, ethical economic behavior, and the role of the free market), but do not describe the passage's main purpose.

## QUESTION 12.

**Choice D is the best answer.** In lines 4-5, the author suggests that people object to criticizing ethics in free markets because they believe free markets are inherently ethical, and therefore, the role of ethics in free markets is unnecessary to study. In the opinion of the critics, free markets are ethical because they allow individuals to make their own choices about which goods to purchase and which goods to sell.

Choices A and B are incorrect because they are not objections that criticize the ethics of free markets. Choice C is incorrect because the author does not present the opinion that free markets depend on devalued currency.

## QUESTION 13.

**Choice A is the best answer.** In lines 4-5, the author states that some people believe that free markets are "already ethical" because they "allow for personal choice." This statement provides evidence that some people believe criticizing the ethics of free markets is unnecessary because free markets permit individuals to make their own choices.

Choices B, C, and D are incorrect because they do not provide the best evidence of an objection to a critique of the ethics of free markets.

## QUESTION 14.

**Choice B is the best answer.** In lines 6-7, the author states that people "have accepted the ethical critique and embraced corporate social responsibility." In this context, people "embrace," or readily adopt, corporate social responsibility by acting in a certain way.

Choices A, C, and D are incorrect because in this context "embraced" does not mean lovingly held, eagerly hugged, or reluctantly used.

## QUESTION 15.

**Choice C is the best answer.** The third and fourth paragraphs of the passage present Adam Smith's and Aristotle's different approaches to defining ethics in economics. The fifth paragraph offers a third approach to defining ethical economics, how "instead of rooting ethics in character or the consequences of actions, we can focus on our actions themselves. From this perspective some things are right, some wrong" (lines 45-48).

Choice A is incorrect because the fifth paragraph does not develop a counterargument. Choices B and D are incorrect because although "character" is briefly mentioned in the fifth paragraph, its relationship to ethics is examined in the fourth paragraph.

## QUESTION 16.

**Choice A is the best answer.** In lines 57-59, the author states that "Many moral dilemmas arise when these three versions pull in different directions but clashes are not inevitable." In this context, the three different perspectives on ethical economics may "clash," or conflict, with one another.

Choices B, C, and D are incorrect because in this context "clashes" does not mean mismatches, collisions, or brawls.

## QUESTION 17.

**Choice C is the best answer.** In lines 59-64, the author states, "Take fair trade coffee . . . for example: buying it might have good consequences, be virtuous, and also be the right way to act in a flawed market." The author is suggesting that in the example of fair trade coffee, all three perspectives about ethical economics—Adam Smith's belief in consequences dictating action, Aristotle's emphasis on character, and the third approach emphasizing the virtue of good actions—can be applied. These three approaches share "common ground" (line 64), as they all can be applied to the example of fair trade coffee without contradicting one another.

Choices A, B, and D are incorrect because they do not show how the three different approaches to ethical economics share common ground. Choice A simply states that there are "different views on ethics" in economics, choice B explains the third ethical economics approach, and choice D suggests that people "behave like a herd" when considering economics.

## QUESTION 18.

**Choice C is the best answer.** In lines 83-88, the author states that psychology can help "define ethics for us," which can help explain why people "react in disgust at economic injustice, or accept a moral law as universal."

Choices A and B are incorrect because they identify topics discussed in the final paragraph (human quirks and people's reaction to economic injustice) but not its main idea. Choice D is incorrect because the final paragraph does not suggest that economists may be responsible for reforming the free market.

## QUESTION 19.

**Choice A is the best answer.** The data in the graph show that in Tanzania between the years 2000 and 2008, fair trade coffee profits were around $1.30 per pound, while profits of regular coffee were in the approximate range of 20–60 cents per pound.

Choices B, C, and D are incorrect because they are not supported by information in the graph.

## QUESTION 20.

**Choice B is the best answer.** The data in the graph indicate that between 2002 and 2004 the difference in per-pound profits between fair trade and regular coffee was about $1. In this time period, fair trade coffee was valued at around $1.30 per pound and regular coffee was valued at around 20 cents per pound. The graph also shows that regular coffee recorded the lowest profits between the years 2002 and 2004, while fair trade coffee remained relatively stable throughout the entire eight-year span (2000 to 2008).

Choices A, C, and D are incorrect because they do not indicate the greatest difference between per-pound profits for fair trade and regular coffee.

## QUESTION 21.

**Choice C is the best answer.** In lines 59-61, the author defines fair trade coffee as "coffee that is sold with a certification that indicates the farmers and workers who produced it were paid a fair wage." This definition suggests that purchasing fair trade coffee is an ethically responsible choice, and the fact that fair trade coffee is being produced and is profitable suggests that ethical economics is still a consideration. The graph's data support this claim by showing how fair trade coffee was more than twice as profitable as regular coffee.

Choice A is incorrect because the graph suggests that people acting on empathy (by buying fair trade coffee) is productive for fair trade coffee farmers and workers. Choices B and D are incorrect because the graph does not provide support for the idea that character or people's fears factor into economic choices.

## QUESTION 22.

**Choice C is the best answer.** The author of Passage 1 indicates that people can benefit from using screen-based technologies as these technologies strengthen "certain cognitive skills" (line 3) and the "brain functions related to fast-paced problem solving" (lines 14-15).

Choice A is incorrect because the author of Passage 1 cites numerous studies of screen-based technologies. Choice B is incorrect because it is not supported by Passage 1, and choice D is incorrect because while the author mentions some benefits to screen-based technologies, he does not encourage their use.

## QUESTION 23.

**Choice A is the best answer.** In lines 3-4, the author of Passage 1 provides evidence that the use of screen-based technologies has some positive effects: "Certain cognitive skills are strengthened by our use of computers and the Net."

Choices B, C, and D are incorrect because they do not provide the best evidence that the use of screen-based technologies has some positive effects. Choices B, C, and D introduce and describe the author's reservations about screen-based technologies.

## QUESTION 24.

**Choice B is the best answer.** The author of Passage 1 cites Patricia Greenfield's study, which found that people's use of screen-based technologies weakened their ability to acquire knowledge, perform "inductive analysis" and "critical thinking," and be imaginative and reflective (lines 34-38). The author of Passage 1 concludes that the use of screen-based technologies interferes with people's ability to think "deeply" (lines 47-50).

Choices A, C, and D are incorrect because the author of Passage 1 does not address how using the Internet affects people's health, social contacts, or self-confidence.

## QUESTION 25.

**Choice C is the best answer.** In lines 39-41, the author states, "We know that the human brain is highly plastic; neurons and synapses change as circumstances change." In this context, the brain is "plastic" because it is malleable, or able to change.

Choices A, B, and D are incorrect because in this context "plastic" does not mean creative, artificial, or sculptural.

## QUESTION 26.

**Choice B is the best answer.** In lines 60-65, the author of Passage 2 explains how speed-reading does not "revamp," or alter, how the brain processes information. He supports this statement by explaining how Woody Allen's reading of *War and Peace* in one sitting caused him to describe the novel as "about Russia." Woody Allen was not able to comprehend the "famously long" novel by speed-reading it.

Choices A and D are incorrect because Woody Allen's description of *War and Peace* does not suggest he disliked Tolstoy's writing style or that he regretted reading the book. Choice C is incorrect because the anecdote about Woody Allen is unrelated to multitasking.

## QUESTION 27.

**Choice D is the best answer.** The author of Passage 2 states that people like novelists and scientists improve in their profession by "immers[ing] themselves in their fields" (line 79). Both novelists and scientists, in other words, become absorbed in their areas of expertise.

Choices A and C are incorrect because the author of Passage 2 does not suggest that novelists and scientists both take risks when they pursue knowledge or are curious about other subjects. Choice B is incorrect because the author of Passage 2 states that "accomplished people" don't perform "intellectual calisthenics," or exercises that improve their minds (lines 77-78).

## QUESTION 28.

**Choice D is the best answer.** In lines 83-90, the author of Passage 2 criticizes media critics for their alarmist writing: "Media critics write as if the brain takes on the qualities of whatever it consumes, the informational equivalent of 'you are what you eat.'" The author then compares media critics' "you are what you eat" mentality to ancient people's belief that "eating fierce animals made them fierce." The author uses this analogy to discredit media critics' belief that consumption of electronic media alters the brain.

Choices A, B, and C are incorrect because the final sentence of Passage 2 does not use ornate language, employ humor, or evoke nostalgia for the past.

## QUESTION 29.

**Choice D is the best answer.** The author of Passage 1 argues that online and other screen-based technologies affect people's abilities to think deeply (lines 47-50). The author of Passage 2 argues that the effects of consuming electronic media are less drastic than media critics suggest (lines 81-82).

Choices A and B are incorrect because they discuss points made in the passages but not the main purpose of the passages. Choice C is incorrect because neither passage argues in favor of increasing financial support for certain studies.

## QUESTION 30.

**Choice B is the best answer.** The author of Passage 1 cites scientific research that suggests online and screen-based technologies have a negative effect on the brain (lines 25-38). The author of Passage 2 is critical of the research highlighted in Passage 1: "Critics of new media sometimes use science itself to press their case, citing research that shows how 'experience can change the brain.' But cognitive neuroscientists roll their eyes at such talk" (lines 51-54).

Choices A, C, and D are incorrect because they do not accurately describe the relationship between the two passages. Passage 1 does not take a clinical approach to the topic. Passage 2 does not take a high-level view of a finding examined in depth in Passage 1, nor does it predict negative reactions to the findings discussed in paragraph 1.

## QUESTION 31.

**Choice C is the best answer.** In Passage 1, the author cites psychologist Patricia Greenfield's finding that "'every medium develops some cognitive skills at the expense of others'" (lines 29-31). In Passage 2, the author states "If you train people to do one thing (recognize shapes, solve math puzzles, find hidden words), they get better at doing that thing, but almost nothing else" (lines 71-74). Both authors would agree than an improvement in one cognitive area, such as visual-spatial skills, would not result in improved skills in other areas.

Choice A is incorrect because hand-eye coordination is not discussed in Passage 2. Choice B is incorrect because Passage 1 does not suggest that critics of electronic media tend to overreact. Choice D is incorrect because neither passage discusses whether Internet users prefer reading printed texts or digital texts.

## QUESTION 32.

**Choice B is the best answer.** In Passage 1, the author cites Michael Merzenich's claim that when people adapt to a new cultural phenomenon, including the use of a new medium, we end up with a "different brain" (lines 41-43). The author of Passage 2 somewhat agrees with Merzenich's claim by stating, "Yes, every time we learn a fact or skill the wiring of the brain changes" (lines 54-56).

Choices A, C, and D do not provide the best evidence that the author of Passage 2 would agree to some extent with Merzenich's claim. Choices A and D are incorrect because the claims are attributed to critics of new media. Choice C is incorrect because it shows that the author of Passage 2 does not completely agree with Merzenich's claim about brain plasticity.

## QUESTION 33.

**Choice B is the best answer.** In lines 16-31, Stanton argues that men make all the decisions in "the church, the state, and the home." This absolute power has led to a disorganized society, a "fragmentary condition of everything." Stanton confirms this claim when she states that society needs women to "lift man up into the higher realms of thought and action" (lines 60-61).

Choices A and D are incorrect because Stanton does not focus on women's lack of equal educational opportunities or inability to hold political positions. Choice C is incorrect because although Stanton implies women are not allowed to vote, she never mentions that "poor candidates" are winning elections.

## QUESTION 34.

**Choice A is the best answer.** Stanton argues that women are repressed in society because men hold "high carnival," or have all the power, and make the rules in "the church, the state, and the home" (lines 16-31). Stanton claims that men have total control over women, "overpowering the feminine element everywhere" (line 18).

Choices B, C, and D are incorrect because Stanton does not use the term "high carnival" to emphasize that the time period is freewheeling, or unrestricted; that there has been a scandalous decline in moral values; or that the power of women is growing.

## QUESTION 35.

**Choice D is the best answer.** In lines 16-23, Stanton states that men's absolute rule in society is "crushing out all the diviner qualities in human nature," such that society knows very "little of true manhood and womanhood." Stanton argues that society knows less about womanhood than manhood, because womanhood has "scarce been recognized as a power until within the last century." This statement indicates that society's acknowledgement of "womanhood," or women's true character, is a fairly recent historical development.

Choices A, B, and C are incorrect because Stanton describes men's control of society, their domination of the domestic sphere, and the prevalence of war and injustice as long-established realities.

## QUESTION 36.

**Choice B is the best answer.** In lines 16-23, Stanton provides evidence for the claim that society's acknowledgement of "womanhood," or women's true character, is a fairly recent historical development: "[womanhood] has scarce been recognized as a power until within the last century."

Choices A, C, and D are incorrect because they do not provide the best evidence that society's acknowledgement of "womanhood," or women's true character, is a fairly recent historical development. Rather, choices A, C, and D discuss men's character, power, and influence.

## QUESTION 37.

**Choice B is the best answer.** In lines 23-26, Stanton states, "Society is but the reflection of man himself, untempered by woman's thought; the hard iron rule we feel alike in the church, the state, and the home." In this context, man's "rule" in "the church, the state, and the home" means that men have a controlling force in all areas of society.

Choices A, C, and D are incorrect because in this context "rule" does not mean a general guideline, an established habit, or a procedural method.

## QUESTION 38.

**Choice D is the best answer.** In lines 32-35, Stanton argues that people use the term "the strong-minded" to refer to women who advocate for "the right to suffrage," or the right to vote in elections. In this context, people use the term "the strong-minded" to criticize female suffragists, as they believe voting will make women too "masculine."

Choices A and B are incorrect because Stanton does not suggest that people use the term "the strong-minded" as a compliment. Choice C is incorrect because Stanton suggests that "the strong-minded" is a term used to criticize women who want to vote, not those who enter male-dominated professions.

## QUESTION 39.

**Choice C is the best answer.** In lines 36-39, Stanton states that society contains hardly any women in the "best sense," and clarifies that too many women are "reflections, varieties, and dilutions of the masculine gender." Stanton is suggesting that there are few "best," or genuine, women who are not completely influenced or controlled by men.

Choices A, B, and D are incorrect because in this context "best" does not mean superior, excellent, or rarest.

## QUESTION 40.

**Choice A is the best answer.** In lines 54-56, Stanton argues that man "mourns," or regrets, how his power has caused "falsehood, selfishness, and violence" to become the "law" of society. Stanton is arguing that men are lamenting, or expressing regret about, how their governance has created problems.

Choices B, C, and D are incorrect because Stanton does not suggest that men are advocating for women's right to vote or for female equality, nor are they requesting women's opinions about improving civic life.

## QUESTION 41.

**Choice B is the best answer.** In lines 54-56, Stanton provides evidence that men are lamenting the problems they have created, as they recognize that their actions have caused "falsehood, selfishness, and violence [to become] the law of life."

Choices A, C, and D are incorrect because they do not provide the best evidence that men are lamenting the problems they have created. Choice A explains society's current fragmentation. Choices C and D present Stanton's main argument for women's enfranchisement.

## QUESTION 42.

**Choice D is the best answer.** In the sixth paragraph, Stanton differentiates between men and masculine traits. Stanton argues that masculine traits or "characteristics," such as a "love of acquisition and conquest," serve to "subjugate one man to another" (lines 69-80). Stanton is suggesting that some masculine traits position men within certain power structures.

Choices A and B are incorrect because the sixth paragraph does not primarily establish a contrast between men and women or between the spiritual and material worlds. Choice C is incorrect because although Stanton argues that not "all men are hard, selfish, and brutal," she does not discuss what constitutes a "good" man.

## QUESTION 43.

**Choice C is the best answer.** In the first paragraph, the author identifies the natural phenomenon "internal waves" (line 3), and explains why they are important: "internal waves are fundamental parts of ocean water dynamics, transferring heat to the ocean depths and bringing up cold water from below" (lines 7-9).

Choices A, B, and D are incorrect because they do not identify the main purpose of the first paragraph, as that paragraph does not focus on a scientific device, a common misconception, or a recent study.

## QUESTION 44.

**Choice B is the best answer.** In lines 17-19, researcher Tom Peacock argues that in order to create precise global climate models, scientists must be able to "capture processes" such as how internal waves are formed. In this context, to "capture" a process means to record it for scientific study.

Choices A, C, and D are incorrect because in this context "capture" does not mean to control, secure, or absorb.

## QUESTION 45.

**Choice D is the best answer.** In lines 17-19, researcher Tom Peacock argues that scientists need to "capture processes" of internal waves to develop "more and more accurate climate models." Peacock is suggesting that studying internal waves will inform the development of scientific models.

Choices A, B, and C are incorrect because Peacock does not state that monitoring internal waves will allow people to verify wave heights, improve satellite image quality, or prevent coastal damage.

## QUESTION 46.

**Choice C is the best answer.** In lines 17-19, researcher Tom Peacock provides evidence that studying internal waves will inform the development of key scientific models, such as "more accurate climate models."

Choices A, B, and D are incorrect because they do not provide the best evidence that studying internal waves will inform the development of key scientific models; rather, they provide general information about internal waves.

## QUESTION 47.

**Choice A is the best answer.** In lines 65-67, the author notes that Tom Peacock and his team "were able to devise a mathematical model that describes the movement and formation of these waves." In this context, the researchers devised, or created, a mathematical model.

Choices B, C, and D are incorrect because in this context "devise" does not mean to solve, imagine, or begin.

## QUESTION 48.

**Choice B is the best answer.** Tom Peacock and his team created a model of the "Luzon's Strait's underwater topography" and determined that its "distinct double-ridge shape . . . [is] responsible for generating the underwater [internal] waves" (lines 53-55). The author notes that this model describes only internal waves in the Luzon Strait but that the team's findings may "help researchers understand how internal waves are generated in other places around the world" (lines 67-70). The author's claim suggests that while internal waves in the Luzon Strait are "some of the largest in the world" (line 25) due to the region's topography, internal waves occurring in other regions may be caused by some similar factors.

Choice A is incorrect because the author notes that the internal waves in the Luzon Strait are "some of the largest in the world" (line 25), which suggests that internal waves reach varying heights. Choices C and D are incorrect because they are not supported by the researchers' findings.

## QUESTION 49.

**Choice D is the best answer.** In lines 67-70, the author provides evidence that, while the researchers' findings suggest the internal waves in the Luzon Strait are influenced by the region's topography, the findings may "help researchers understand how internal waves are generated in other places around the world." This statement suggests that all internal waves may be caused by some similar factors.

Choices A, B, and C are incorrect because they do not provide the best evidence that internal waves are caused by similar factors but influenced by the distinct topographies of different regions. Rather, choices A, B, and C reference general information about internal waves or focus solely on those that occur in the Luzon Strait.

## QUESTION 50.

**Choice D is the best answer.** During the period 19:12 to 20:24, the graph shows the 13°C isotherm increasing in depth from about 20 to 40 meters.

Choices A, B, and C are incorrect because during the time period 19:12 to 20:24 the 9°C, 10°C, and 11°C isotherms all decreased in depth.

## QUESTION 51.

**Choice D is the best answer.** In lines 3-6, the author notes that internal waves "do not ride the ocean surface" but "move underwater, undetectable without the use of satellite imagery or sophisticated monitoring equipment." The graph shows that the isotherms in an internal wave never reach the ocean's surface, as the isotherms do not record a depth of 0.

Choice A is incorrect because the graph provides no information about salinity. Choice B is incorrect because the graph shows layers of less dense water (which, based on the passage, are warmer) riding above layers of denser water (which, based on the passage, are cooler). Choice C is incorrect because the graph shows that internal waves push isotherms of warmer water above bands of colder water.

## QUESTION 52.

**Choice A is the best answer.** In lines 7-9, the author notes that internal waves are "fundamental parts of ocean water dynamics" because they transfer "heat to the ocean depths and brin[g] up cold water from below." The graph shows an internal wave forcing the warm isotherms to depths that typically are colder. For example, at 13:12, the internal wave transfers "heat to the ocean depths" by forcing the 10°C, 11°C, and 13°C isotherms to depths that typically are colder.

Choices B, C, and D are incorrect because the graph does not show how internal waves affect the ocean's density, surface temperature, or tide flow.

# Section 2: Writing and Language Test

## QUESTION 1.

**Choice B is the best answer** because it provides a noun, "reductions," yielding a grammatically complete and coherent sentence.

Choices A, C, and D are incorrect because each provides a verb or gerund, while the underlined portion calls for a noun.

## QUESTION 2.

**Choice B is the best answer** because it offers a transitional adverb, "Consequently," that communicates a cause-effect relationship between the funding reduction identified in the previous sentence and the staffing decrease described in this sentence.

Choices A, C, and D are incorrect because each misidentifies the relationship between the preceding sentence and the sentence of which it is a part.

## QUESTION 3.

**Choice A is the best answer** because the singular verb "has" agrees with the singular noun "trend" that appears earlier in the sentence.

Choices B, C, and D are incorrect because the plural verb "have" does not agree with the singular subject "trend," and the relative pronoun "which" unnecessarily interrupts the direct relationship between "trend" and the verb.

## QUESTION 4.

**Choice A is the best answer** because it states accurately why the proposed clause should be added to the sentence. Without these specific examples, readers have only a vague sense of what "nonprint" formats might be.

Choices B, C, and D are incorrect because each represents a misinterpretation of the relationship between the proposed clause to be added and the surrounding text in the passage.

## QUESTION 5.

**Choice D is the best answer** because it includes only the preposition and noun that the sentence requires.

Choices A, B, and C are incorrect because each includes an unnecessary pronoun, either "them" or "their." The sentence contains no referents that would circulate e-books.

## QUESTION 6.

**Choice D is the best answer** because the verb form "cataloging" parallels the other verbs in the series.

Choices A, B, and C are incorrect because each interrupts the parallel structure in the verb series, either through an incorrect verb form or with an unnecessary subject.

## QUESTION 7.

**Choice B is the best answer** because it consolidates references to the subject, "librarians," by placing the relative pronoun "whose" immediately following "librarians." This results in a logical flow of information within the sentence.

Choices A, C, and D are incorrect because each fails to place "librarians" as the main subject of the sentence without redundancy, resulting in a convoluted sentence whose relevance to the preceding and subsequent sentences is unclear.

## QUESTION 8.

**Choice D is the best answer** because no conjunction is necessary to communicate the relationship between the clauses in the sentence. The conjunction "While" at the beginning of the sentence already creates a comparison.

Choices A, B, and C are incorrect because each provides an unnecessary coordinating conjunction.

## QUESTION 9.

**Choice B is the best answer** because it mentions time periods when the free services described later in the sentence are particularly useful to library patrons.

Choices A, C, and D are incorrect because each creates redundancy or awkwardness in the remainder of the sentence.

## QUESTION 10.

**Choice B is the best answer** because it is concise; it is also consistent with the formal language in the rest of the sentence and the passage overall.

Choices A, C, and D are incorrect because each is either unnecessarily wordy or uses colloquial language that does not correspond with the tone of the passage.

## QUESTION 11.

**Choice C is the best answer** because it restates the writer's primary argument, which may be found at the end of the first paragraph: "As public libraries adapt to rapid technological advances in information distribution, librarians' roles are actually expanding."

Choices A, B, and D are incorrect because they do not paraphrase the writer's primary claim.

## QUESTION 12.

**Choice B is the best answer** because it clarifies that the sentence, which mentions a specific large-scale painting at the Art Institute of Chicago, is an example supporting the preceding claim about large-scale paintings.

Choices A, C, and D are incorrect because they propose transitional words or phrases that do not accurately represent the relationship between the preceding sentence and the sentence containing the underlined portion.

## QUESTION 13.

**Choice D is the best answer** because no punctuation is necessary in the underlined phrase.

Choices A, B, and C are incorrect because each separates parts of the noun phrase "painter Georges Seurat's 10-foot-wide *A Sunday Afternoon on the Island of La Grande Jatte*" from one another with one or more unnecessary commas.

## QUESTION 14.

**Choice C is the best answer** because it provides the appropriate possessive form, "its," and a colon to introduce the identifying phrase that follows.

Choices A, B, and D are incorrect because none contains both the appropriate possessive form of "it" and the punctuation that creates a grammatically standard sentence.

## QUESTION 15.

**Choice C is the best answer** because an analysis of the consequences of King Louis XV's reign is irrelevant to the paragraph.

Choices A, B, and D are incorrect because each represents a misinterpretation of the relationship between the proposed sentence to be added and the main point of the paragraph.

## QUESTION 16.

**Choice C is the best answer** because it provides a coordinating conjunction, "and," to connect the two verb phrases "are characterized" and "are covered."

Choices A, B, and D are incorrect because each lacks the conjunction needed to connect the two verb phrases "are characterized" and "are covered."

## QUESTION 17.

**Choice B is the best answer** because it offers an example of an additional household item, a "tea cup," with a specific measurement that is one-twelfth of its actual size.

Choices A, C, D are incorrect because, compared to the example preceding the underlined portion, each is vague and fails to offer a specific measurement of an additional household item.

## QUESTION 18.

**Choice B is the best answer** because it provides correct punctuation and the coordinating conjunction "but," which acknowledges the possible contrast between being "sparsely furnished" and displaying "just as true" period details.

Choices A, C, and D are incorrect because each communicates an illogical relationship between the phrases that precede and follow the underlined portion.

## QUESTION 19.

**Choice A is the best answer** because it provides a clause that is the most similar to the two preceding clauses, which both end with a reference to a specific wall.

Choices B, C, and D are incorrect because each deviates from the stylistic pattern of the preceding two clauses.

## QUESTION 20.

**Choice D is the best answer** because the article "a" requires the singular noun "visitor," and the simple present verb "remark" is the appropriate verb tense in this context.

Choices A, B, and C are incorrect because each contains either a noun or verb that does not fit the context.

## QUESTION 21.

**Choice D is the best answer** because it identifies the drawers, rather than the visitor, as being "dotted with pin-sized knobs."

Choices A, B, and C are incorrect because all three contain dangling modifiers that obscure the relationship between the visitor, the drawers, and the pin-sized knobs.

## QUESTION 22.

**Choice B is the best answer** because paragraph 3 offers an overview of the exhibit and so serves to introduce the specific aspects of particular miniature rooms described in paragraphs 2 and 4.

Choices A, C, and D are incorrect because each proposes a placement of paragraph 2 that prevents the passage from developing in a logical sequence.

## QUESTION 23.

**Choice A is the best answer** because it correctly completes the noun phrase that begins with "sea otters," and directly follows the noun phrase with the verb "help."

Choices B, C, and D are incorrect because each separates the noun "otters" from the verb "help" in a way that results in a grammatically incomplete sentence.

## QUESTION 24.

**Choice B is the best answer** because the data in the chart show lower sea urchin density in areas where sea otters have lived for two years or less than in areas where no otters are present.

Choices A, C, and D are incorrect because none accurately describes the data in the chart.

## QUESTION 25.

**Choice B is the best answer** because the conjunctive adverb "however" accurately communicates the contrast between an environment shaped by the presence of sea otters, described in the preceding sentence, and an environment shaped by the absence of sea otters, described in this sentence.

Choices A, C, and D are incorrect because each presents a conjunctive adverb that does not accurately depict the relationship between the preceding sentence and the sentence with the underlined word.

## QUESTION 26.

**Choice A is the best answer** because the additional information usefully connects the carbon dioxide levels mentioned in this sentence with the global warming mentioned in the previous sentence.

Choices B, C, and D are incorrect because each misinterprets the relationship between the proposed information and the main points of the paragraph and the passage.

## QUESTION 27.

**Choice D is the best answer** because it offers the verb "suggests" followed directly by its object, a that-clause, without interruption.

Choices A, B, and C are incorrect because each contains punctuation that unnecessarily separates the study from its findings—that is, separates the verb from its object.

## QUESTION 28.

**Choice A is the best answer** because it accurately reflects the fact that sea urchins "graze voraciously on kelp," as stated in the first paragraph, and it also maintains the tone of the passage.

Choices B, C, and D are incorrect because each offers a term that does not accurately describe the behavior of sea otters.

## QUESTION 29.

**Choice C is the best answer** because the possessive singular pronoun "its" corresponds with the referent "kelp," which appears later in the sentence, and with the possessive relationship between the pronoun and the "terrestrial plant cousins."

Choices A, B, and D are incorrect because none provides a pronoun that is both singular and possessive.

## QUESTION 30.

**Choice C is the best answer** because it provides the noun "sea otters" to identify who or what "played a role."

Choices A, B, and D are incorrect because each provides a pronoun that makes no sense in the context of the paragraph and the passage, which is about the role sea otters play—not the role scientists play or the role kelp plays.

## QUESTION 31.

**Choice D is the best answer** because sentence 5 indicates that sea otters' importance in decreasing atmospheric carbon dioxide was not known, and the sentence to be added indicates that a surprise will follow. Sentence 6 provides that surprise: sea otters have a large impact on the amount of carbon dioxide kelp can remove from the atmosphere.

Choices A, B, and C are incorrect because each interrupts the logical flow of ideas in the paragraph.

## QUESTION 32.

**Choice B is the best answer** because its clear wording and formal tone correspond with the passage's established style.

Choices A, C, and D are incorrect because each contains vague language that is inconsistent with the passage's clear wording and formal tone.

## QUESTION 33.

**Choice D is the best answer** because it provides punctuation that appropriately identifies "removed" as the definition of "sequestered."

Choices A, B, and C are incorrect because each contains punctuation that obscures the relationship between "sequestered," "removed," and the text that follows.

## QUESTION 34.

**Choice D is the best answer** because it provides a conjunction that correctly identifies the relationship between "a practice" and the actions involved in the practice.

Choices A, B, and C are incorrect because each contains a conjunction that miscommunicates the relationship between the text that precedes and follows the underlined portion.

## QUESTION 35.

**Choice A is the best answer** because it provides a comma to close the appositive clause "a practice whereby products are designed to have a limited period of usefulness," which also begins with a comma.

Choices B, C, and D are incorrect because each provides closing punctuation inconsistent with the punctuation at the beginning of the clause.

## QUESTION 36.

**Choice D is the best answer** because it provides an adjective that accurately describes the clear "contrast" between products "designed to have a limited period of usefulness" and those "produced to be durable."

Choices A, B, and C are incorrect because none provides an adjective that appropriately modifies "contrast" in the context of the paragraph.

## QUESTION 37.

**Choice A is the best answer** because by mentioning the "specialized" methods used in repair shops, it suggests that repairing goods is seen as a specialty rather than as a common activity. This connects logically with the "rare" repair shops introduced just before the underlined portion.

Choices B, C, and D are incorrect because none provides information that supports the claim made in the sentence.

## QUESTION 38.

**Choice B is the best answer** because it provides the correct spelling of the noun "fair," meaning exhibition, and uses the correct word "than" to create the comparison between a "fair" and a "café."

Choices A, C, and D are incorrect because each contains a misspelling of either "fair" or "than."

## QUESTION 39.

**Choice C is the best answer** because it offers a relative pronoun that properly links the noun "Martine Postma" with the appropriate verb "wanted."

Choices A, B, and D are incorrect because none contains a pronoun that is appropriate for the referent and placement of the clause.

## QUESTION 40.

**Choice D is the best answer** because it provides the most concise phrasing and links the sentence appropriately to the previous sentence.

Choices A, B, and C are incorrect because each provides an unnecessary adverb that obscures the relationship between this sentence and the previous one.

## QUESTION 41.

**Choice D is the best answer** because the gerund "waiting" corresponds with the preposition "for" and the present tense used in the rest of the sentence.

Choices A, B, and C are incorrect because each contains a verb form not used with the preposition "for."

## QUESTION 42.

**Choice C is the best answer** because it appropriately places sentence 5, which describes the places Repair Cafés can be found today, between a sentence that gives the first Repair Café's location and purpose and a statement about current customers and how they use Repair Cafés.

Choices A, B, and D are incorrect because each creates a paragraph with an inappropriate shift in verb tense and, therefore, an illogical sequence of information.

## QUESTION 43.

**Choice C is the best answer** because it accurately states that the issue of "corporate and service-based jobs" is not particularly relevant at this point in the paragraph. The focus here is on repairing objects in a "throwaway culture," not jobs.

Choices A, B, and D are incorrect because each misinterprets the relationship between the proposed text and the information in the paragraph.

## QUESTION 44.

**Choice D is the best answer** because the phrase "and other countries" communicates the fact that there are additional items not being named that could be added to the list; no other wording is required to clarify that point.

Choices A, B, and C are incorrect because each presents a word or phrase that results in a redundancy with "and other countries."

# Section 3: Math Test — No Calculator

## QUESTION 1.

**Choice C is correct.** Subtracting 6 from each side of $5x + 6 = 10$ yields $5x = 4$. Dividing both sides of $5x = 4$ by 5 yields $x = \frac{4}{5}$. The value of $x$ can now be substituted into the expression $10x + 3$, giving $10\left(\frac{4}{5}\right) + 3 = 11$.

Alternatively, the expression $10x + 3$ can be rewritten as $2(5x + 6) - 9$, and 10 can be substituted for $5x + 6$, giving $2(10) - 9 = 11$.

Choices A, B, and D are incorrect. Each of these choices leads to $5x + 6 \neq 10$, contradicting the given equation, $5x + 6 = 10$. For example, choice A is incorrect because if the value of $10x + 3$ were 4, then it would follow that $x = 0.1$, and the value of $5x + 6$ would be 6.5, not 10.

## QUESTION 2.

**Choice B is correct.** Multiplying each side of $x + y = 0$ by 2 gives $2x + 2y = 0$. Then, adding the corresponding sides of $2x + 2y = 0$ and $3x - 2y = 10$ gives $5x = 10$. Dividing each side of $5x = 10$ by 5 gives $x = 2$. Finally, substituting 2 for $x$ in $x + y = 0$ gives $2 + y = 0$, or $y = -2$. Therefore, the solution to the given system of equations is $(2, -2)$.

Alternatively, the equation $x + y = 0$ can be rewritten as $x = -y$, and substituting $x$ for $-y$ in $3x - 2y = 10$ gives $5x = 10$, or $x = 2$. The value of $y$ can then be found in the same way as before.

Choices A, C, and D are incorrect because when the given values of $x$ and $y$ are substituted into $x + y = 0$ and $3x - 2y = 10$, either one or both of the equations are not true. These answers may result from sign errors or other computational errors.

## QUESTION 3.

**Choice A is correct.** The price of the job, in dollars, is calculated using the expression $60 + 12nh$, where 60 is a fixed price and $12nh$ depends on the number of landscapers, $n$, working the job and the number of hours, $h$, the job takes those $n$ landscapers. Since $nh$ is the total number of hours of work done when $n$ landscapers work $h$ hours, the cost of the job increases by \$12 for each hour a landscaper works. Therefore, of the choices given, the best interpretation of the number 12 is that the company charges \$12 per hour for each landscaper.

Choice B is incorrect because the number of landscapers that will work each job is represented by $n$ in the equation, not by the number 12. Choice C is incorrect because the price of the job increases by $12n$ dollars each hour, which will not be equal to 12 dollars unless $n = 1$. Choice D is incorrect because the total number of hours each landscaper works is equal to $h$. The number of hours each landscaper works in a day is not provided.

## QUESTION 4.

**Choice A is correct.** If a polynomial expression is in the form $(x)^2 + 2(x)(y) + (y)^2$, then it is equivalent to $(x + y)^2$. Because $9a^4 + 12a^2b^2 + 4b^4 = (3a^2)^2 + 2(3a^2)(2b^2) + (2b^2)^2$, it can be rewritten as $(3a^2 + 2b^2)^2$.

Choice B is incorrect. The expression $(3a + 2b)^4$ is equivalent to the product $(3a + 2b)(3a + 2b)(3a + 2b)(3a + 2b)$. This product will contain the term $4(3a)^3 (2b) = 216a^3b$. However, the given polynomial, $9a^4 + 12a^2b^2 + 4b^4$, does not contain the term $216a^3b$. Therefore, $9a^4 + 12a^2b^2 + 4b^4 \neq (3a + 2b)^4$. Choice C is incorrect. The expression $(9a^2 + 4b^2)^2$ is equivalent to the product $(9a^2 + 4b^2)(9a^2 + 4b^2)$. This product will contain the term $(9a^2)(9a^2) = 81a^4$. However, the given polynomial, $9a^4 + 12a^2b^2 + 4b^4$, does not contain the term $81a^4$. Therefore, $9a^4 + 12a^2b^2 + 4b^4 \neq (9a^2 + 4b^2)^2$. Choice D is incorrect. The expression $(9a + 4b)^4$ is equivalent to the product $(9a + 4b)(9a + 4b)(9a + 4b)(9a + 4b)$. This product will contain the term $(9a)(9a)(9a)(9a) = 6{,}561a^4$. However, the given polynomial, $9a^4 + 12a^2b^2 + 4b^4$, does not contain the term $6{,}561a^4$. Therefore, $9a^4 + 12a^2b^2 + 4b^4 \neq (9a + 4b)^4$.

## QUESTION 5.

**Choice C is correct.** Since $\sqrt{2k^2 + 17} - x = 0$, and $x = 7$, one can substitute 7 for $x$, which gives $\sqrt{2k^2 + 17} - 7 = 0$. Adding 7 to each side of $\sqrt{2k^2 + 17} - 7 = 0$ gives $\sqrt{2k^2 + 17} = 7$. Squaring each side of $\sqrt{2k^2 + 17} = 7$ will remove the square root symbol: $\left(\sqrt{2k^2 + 17}\right)^2 = (7)^2$, or $2k^2 + 17 = 49$. Then subtracting 17 from each side of $2k^2 + 17 = 49$ gives $2k^2 = 49 - 17 = 32$, and dividing each side of $2k^2 = 32$ by 2 gives $k^2 = 16$. Finally, taking the square root of each side of $k^2 = 16$ gives $k = \pm 4$, and since the problem states that $k > 0$, it follows that $k = 4$.

Since the sides of an equation were squared while solving $\sqrt{2k^2 + 17} - 7 = 0$, it is possible that an extraneous root was produced. However, substituting 4 for $k$ in $\sqrt{2k^2 + 17} - 7 = 0$ confirms that 4 is a solution for $k$: $\sqrt{2(4)^2 + 17} - 7 = \sqrt{32 + 17} - 7 = \sqrt{49} - 7 = 7 - 7 = 0$.

Choices A, B, and D are incorrect because substituting any of these values for $k$ in $\sqrt{2k^2 + 17} - 7 = 0$ does not yield a true statement.

## QUESTION 6.

**Choice D is correct.** Since lines $\ell$ and $k$ are parallel, the lines have the same slope. Line $\ell$ passes through the points $(-5, 0)$ and $(0, 2)$, so its slope is $\frac{0 - 2}{-5 - 0}$, which is $\frac{2}{5}$. The slope of line $k$ must also be $\frac{2}{5}$. Since line $k$ has slope $\frac{2}{5}$ and passes through the points $(0, -4)$ and $(p, 0)$, it follows that $\frac{-4 - 0}{0 - p} = \frac{2}{5}$, or $\frac{4}{p} = \frac{2}{5}$. Multiplying each side of $\frac{4}{p} = \frac{2}{5}$ by $5p$ gives $20 = 2p$, and therefore, $p = 10$.

Choices A, B, and C are incorrect and may result from conceptual or calculation errors.

## QUESTION 7.

**Choice A is correct.** Since the numerator and denominator of $\frac{x^{a^2}}{x^{b^2}}$ have a common base, it follows by the laws of exponents that this expression can be rewritten as $x^{a^2-b^2}$. Thus, the equation $\frac{x^{a^2}}{x^{b^2}} = 16$ can be rewritten as $x^{a^2-b^2} = x^{16}$. Because the equivalent expressions have the common base $x$, and $x > 1$, it follows that the exponents of the two expressions must also be equivalent. Hence, the equation $a^2 - b^2 = 16$ must be true. The left-hand side of this new equation is a difference of squares, and so it can be factored: $(a + b)(a - b) = 16$. It is given that $(a + b) = 2$; substituting 2 for the factor $(a + b)$ gives $2(a - b) = 16$. Finally, dividing both sides of $2(a - b) = 16$ by 2 gives $a - b = 8$.

Choices B, C, and D are incorrect and may result from errors in applying the laws of exponents or errors in solving the equation $a^2 - b^2 = 16$.

## QUESTION 8.

**Choice C is correct.** The relationship between $n$ and $A$ is given by the equation $nA = 360$. Since $n$ is the number of sides of a polygon, $n$ must be a positive integer, and so $nA = 360$ can be rewritten as $A = \frac{360}{n}$. If the value of $A$ is greater than 50, it follows that $\frac{360}{n} > 50$ is a true statement. Thus, $50n < 360$, or $n < \frac{360}{50} = 7.2$. Since $n$ must be an integer, the greatest possible value of $n$ is 7.

Choices A and B are incorrect. These are possible values for $n$, the number of sides of a regular polygon, if $A > 50$, but neither is the greatest possible value of $n$. Choice D is incorrect. If $A < 50$, then $n = 8$ is the least possible value of $n$, the number of sides of a regular polygon. However, the question asks for the greatest possible value of $n$ if $A > 50$, which is $n = 7$.

## QUESTION 9.

**Choice B is correct.** Since the slope of the first line is 2, an equation of this line can be written in the form $y = 2x + c$, where $c$ is the $y$-intercept of the line. Since the line contains the point (1, 8), one can substitute 1 for $x$ and 8 for $y$ in $y = 2x + c$, which gives $8 = 2(1) + c$, or $c = 6$. Thus, an equation of the first line is $y = 2x + 6$. The slope of the second line is equal to $\frac{1-2}{2-1}$ or $-1$. Thus, an equation of the second line can be written in the form $y = -x + d$, where $d$ is the $y$-intercept of the line. Substituting 2 for $x$ and 1 for $y$ gives $1 = -2 + d$, or $d = 3$. Thus, an equation of the second line is $y = -x + 3$.

Since $a$ is the $x$-coordinate and $b$ is the $y$-coordinate of the intersection point of the two lines, one can substitute $a$ for $x$ and $b$ for $y$ in the two equations, giving the system $b = 2a + 6$ and $b = -a + 3$. Thus, $a$ can be found by solving the equation $2a + 6 = -a + 3$, which gives $a = -1$. Finally, substituting $-1$ for $a$ into the equation $b = -a + 3$ gives $b = -(-1) + 3$, or $b = 4$. Therefore, the value of $a + b$ is 3.

Alternatively, since the second line passes through the points (1, 2) and (2, 1), an equation for the second line is $x + y = 3$. Thus, the intersection point of the first line and the second line, $(a, b)$ lies on the line with equation $x + y = 3$. It follows that $a + b = 3$.

Choices A and C are incorrect and may result from finding the value of only $a$ or $b$, but not calculating the value of $a + b$. Choice D is incorrect and may result from a computation error in finding equations of the two lines or in solving the resulting system of equations.

## QUESTION 10.

**Choice C is correct.** Since the square of any real number is nonnegative, every point on the graph of the quadratic equation $y = (x - 2)^2$ in the $xy$-plane has a nonnegative $y$-coordinate. Thus, $y \geq 0$ for every point on the graph. Therefore, the equation $y = (x - 2)^2$ has a graph for which $y$ is always greater than or equal to $-1$.

Choices A, B, and D are incorrect because the graph of each of these equations in the $xy$-plane has a $y$-intercept at $(0, -2)$. Therefore, each of these equations contains at least one point where $y$ is less than $-1$.

## QUESTION 11.

**Choice C is correct.** To perform the division $\frac{3 - 5i}{8 + 2i}$, multiply the numerator and denominator of $\frac{3 - 5i}{8 + 2i}$ by the conjugate of the denominator, $8 - 2i$. This gives $\frac{(3 - 5i)(8 - 2i)}{(8 + 2i)(8 - 2i)} = \frac{24 - 6i - 40i + (-5i)(-2i)}{8^2 - (2i)^2}$. Since $i^2 = -1$, this can be simplified to $\frac{24 - 6i - 40i - 10}{64 + 4} = \frac{14 - 46i}{68}$, which then simplifies to $\frac{7}{34} - \frac{23i}{34}$.

Choices A and B are incorrect and may result from misconceptions about fractions. For example, $\frac{a + b}{c + d}$ is equal to $\frac{a}{c + d} + \frac{b}{c + d}$, not $\frac{a}{c} + \frac{b}{d}$. Choice D is incorrect and may result from a calculation error.

## QUESTION 12.

**Choice B is correct.** Multiplying each side of $R = \frac{F}{N + F}$ by $N + F$ gives $R(N + F) = F$, which can be rewritten as $RN + RF = F$. Subtracting $RF$ from each side of $RN + RF = F$ gives $RN = F - RF$, which can be factored

as $RN = F(1 - R)$. Finally, dividing each side of $RN = F(1 - R)$ by $1 - R$, expresses $F$ in terms of the other variables: $F = \frac{RN}{1 - R}$.

Choices A, C, and D are incorrect and may result from calculation errors when rewriting the given equation.

## QUESTION 13.

**Choice D is correct.** The problem asks for the sum of the roots of the quadratic equation $2m^2 - 16m + 8 = 0$. Dividing each side of the equation by 2 gives $m^2 - 8m + 4 = 0$. If the roots of $m^2 - 8m + 4 = 0$ are $s_1$ and $s_2$, then the equation can be factored as $m^2 - 8m + 4 = (m - s_1)(m - s_2) = 0$. Looking at the coefficient of $x$ on each side of $m^2 - 8m + 4 = (m - s_1)(m - s_2)$ gives $-8 = -s_1 - s_2$, or $s_1 + s_2 = 8$.

Alternatively, one can apply the quadratic formula to either $2m^2 - 16m + 8 = 0$ or $m^2 - 8m + 4 = 0$. The quadratic formula gives two solutions, $4 - 2\sqrt{3}$ and $4 + 2\sqrt{3}$ whose sum is 8.

Choices A, B, and C are incorrect and may result from calculation errors when applying the quadratic formula or a sign error when determining the sum of the roots of a quadratic equation from its coefficients.

## QUESTION 14.

**Choice A is correct.** Each year, the amount of the radioactive substance is reduced by 13 percent from the prior year's amount; that is, each year, 87 percent of the previous year's amount remains. Since the initial amount of the radioactive substance was 325 grams, after 1 year, $325(0.87)$ grams remains; after 2 years $325(0.87)(0.87) = 325(0.87)^2$ grams remains; and after $t$ years, $325(0.87)^t$ grams remains. Therefore, the function $f(t) = 325(0.87)^t$ models the remaining amount of the substance, in grams, after $t$ years.

Choice B is incorrect and may result from confusing the amount of the substance remaining with the decay rate. Choices C and D are incorrect and may result from confusing the original amount of the substance and the decay rate.

## QUESTION 15.

**Choice D is correct.** Dividing $5x - 2$ by $x + 3$ gives:

$$
\begin{array}{r}
5 \\
x + 3 \overline{)\,5x - 2} \\
5x + 15 \\
\hline
-17
\end{array}
$$

Therefore, the expression $\frac{5x - 2}{x + 3}$ can be rewritten as $5 - \frac{17}{x + 3}$.

Alternatively, $\frac{5x - 2}{x + 3}$ can be rewritten as

$$\frac{5x - 2}{x + 3} = \frac{(5x + 15) - 15 - 2}{x + 3} = \frac{5(x + 3) - 17}{x + 3} = 5 - \frac{17}{x + 3}.$$

Choices A and B are incorrect and may result from incorrectly canceling out the $x$ in the expression $\frac{5x-2}{x+3}$. Choice C is incorrect and may result from finding an incorrect remainder when performing long division.

## QUESTION 16.

**The correct answer is 3, 6, or 9.** Let $x$ be the number of \$250 bonuses awarded, and let $y$ be the number of \$750 bonuses awarded. Since \$3000 in bonuses were awarded, and this included at least one \$250 bonus and one \$750 bonus, it follows that $250x + 750y = 3000$, where $x$ and $y$ are positive integers. Dividing each side of $250x + 750y = 3000$ by 250 gives $x + 3y = 12$, where $x$ and $y$ are positive integers. Since $3y$ and 12 are each divisible by 3, it follows that $x = 12 - 3y$ must also be divisible by 3. If $x = 3$, then $y = 3$; if $x = 6$, then $y = 2$; and if $x = 9$, then $y = 1$. If $x = 12$, then $y = 0$, but this is not possible since there was at least one \$750 bonus awarded. Therefore, the possible numbers of \$250 bonuses awarded are 3, 6, and 9. Any of the numbers 3, 6, or 9 may be gridded as the correct answer.

## QUESTION 17.

**The correct answer is 19.** Since $2x(3x + 5) + 3(3x + 5) = ax^2 + bx + c$ for all values of $x$, the two sides of the equation are equal, and the value of $b$ can be determined by simplifying the left-hand side of the equation and writing it in the same form as the right-hand side. Using the distributive property, the equation becomes $(6x^2 + 10x) + (9x + 15) = ax^2 + bx + c$. Combining like terms gives $6x^2 + 19x + 15 = ax^2 + bx + c$. The value of $b$ is the coefficient of $x$, which is 19.

## QUESTION 18.

**The correct answer is 12.** Angles $ABE$ and $DBC$ are vertical angles and thus have the same measure. Since segment $AE$ is parallel to segment $CD$, angles $A$ and $D$ are of the same measure by the alternate interior angle theorem. Thus, by the angle-angle theorem, triangle $ABE$ is similar to triangle $DBC$, with vertices $A$, $B$, and $E$ corresponding to vertices $D$, $B$, and $C$, respectively. Thus, $\frac{AB}{DB} = \frac{EB}{CB}$ or $\frac{10}{5} = \frac{8}{CB}$. It follows that $CB = 4$, and so $CE = CB + BE = 4 + 8 = 12$.

## QUESTION 19.

**The correct answer is 6.** By the distance formula, the length of radius $OA$ is $\sqrt{(\sqrt{3})^2 + 1^2} = \sqrt{3 + 1} = 2$. Thus, $\sin(\angle AOB) = \frac{1}{2}$. Therefore, the measure of $\angle AOB$ is 30°, which is equal to $30\left(\frac{\pi}{180}\right) = \frac{\pi}{6}$ radians. Hence, the value of $a$ is 6.

## QUESTION 20.

**The correct answer is $\frac{1}{4}$ or .25.** In order for a system of two linear equations to have infinitely many solutions, the two equations must be equivalent.

Thus, the equation $ax + by = 12$ must be equivalent to the equation $2x + 8y = 60$. Multiplying each side of $ax + by = 12$ by 5 gives $5ax + 5by = 60$, which must be equivalent to $2x + 8y = 60$. Since the right-hand sides of $5ax + 5by = 60$ and $2x + 8y = 60$ are the same, equating coefficients gives $5a = 2$, or a = $\frac{2}{5}$, and $5b = 8$, or $b = \frac{8}{5}$. Therefore, the value of $\frac{a}{b} = \left(\frac{2}{5}\right) \div \left(\frac{8}{5}\right)$, which is equal to $\frac{1}{4}$. Either the fraction $\frac{1}{4}$ or its equivalent decimal, .25, may be gridded asthe correct answer.

Alternatively, since $ax + by = 12$ is equivalent to $2x + 8y = 60$, the equation $ax + by = 12$ is equal to $2x + 8y = 60$ multiplied on each side by the same constant. Since multiplying $2x + 8y = 60$ by a constant does not change the ratio of the coefficient of $x$ to the coefficient of $y$, it follows that $\frac{a}{b} = \frac{2}{8} = \frac{1}{4}$.

# Section 4: Math Test — Calculator

## QUESTION 1.

**Choice C is correct.** Since the musician earns \$0.09 for each download, the musician earns $0.09d$ dollars when the song is downloaded $d$ times. Similarly, since the musician earns \$0.002 each time the song is streamed, the musician earns $0.002s$ dollars when the song is streamed $s$ times. Therefore, the musician earns a total of $0.09d + 0.002s$ dollars when the song is downloaded $d$ times and streamed $s$ times.

Choice A is incorrect because the earnings for each download and the earnings for time streamed are interchanged in the expression. Choices B and D are incorrect because in both answer choices, the musician will lose money when a song is either downloaded or streamed. However, the musician only earns money, not loses money, when the song is downloaded or streamed.

## QUESTION 2.

**Choice B is correct.** The quality control manager selects 7 lightbulbs at random for inspection out of every 400 lightbulbs produced. A quantity of 20,000 lightbulbs is equal to $\frac{20{,}000}{400} = 50$ batches of 400 lightbulbs. Therefore, at the rate of 7 lightbulbs per 400 lightbulbs produced, the quality control manager will inspect a total of $50 \times 7 = 350$ lightbulbs.

Choices A, C, and D are incorrect and may result from calculation errors or misunderstanding of the proportional relationship.

## QUESTION 3.

**Choice A is correct.** The value of $m$ when $\ell$ is 73 can be found by substituting the 73 for $\ell$ in $\ell = 24 + 3.5m$ and then solving for $m$. The resulting equation is $73 = 24 + 3.5m$; subtracting 24 from each side gives $49 = 3.5m$. Then, dividing each side of $49 = 3.5m$ by 3.5 gives $14 = m$. Therefore, when $\ell$ is 73, $m$ is 14.

Choice B is incorrect and may result from adding 24 to 73, instead of subtracting 24 from 73, when solving $73 = 24 + 3.5m$. Choice C is incorrect because 73 is the given value for $\ell$, not for $m$. Choice D is incorrect and may result from substituting 73 for $m$, instead of for $\ell$, in the equation $\ell = 24 + 3.5m$.

## QUESTION 4.

**Choice C is correct.** The amount of money the performer earns is directly proportional to the number of people who attend the performance. Thus, by the definition of direct proportionality, $M = kP$, where $M$ is the amount of money the performer earns, in dollars, $P$ is the number of people who attend the performance, and $k$ is a constant. Since the performer earns \$120 when 8 people attend the performance, one can substitute 120 for $M$ and 8 for $P$, giving $120 = 8k$. Hence, $k = 15$, and the relationship between the number of people who attend the performance and the amount of money, in dollars, the performer earns is $M = 15P$. Therefore, when 20 people attend the performance, the performer earns $15(20) = 300$ dollars.

Choices A, B, and D are incorrect and may result from either misconceptions about proportional relationships or computational errors.

## QUESTION 5.

**Choice C is correct.** If 43% of the money earned is used to pay for costs, then the rest, 57%, is profit. A performance where 8 people attend earns the performer \$120, and 57% of \$120 is $\$120 \times 0.57 = \$68.40$.

Choice A is incorrect. The amount \$51.60 is 43% of the money earned from a performance where 8 people attend, which is the cost of putting on the performance, not the profit from the performance. Choice B is incorrect. It is given that 57% of the money earned is profit, but 57% of \$120 is not equal to \$57.00. Choice D is incorrect. The profit can be found by subtracting 43% of \$120 from \$120, but 43% of \$120 is \$51.60, not \$43.00. Thus, the profit is $\$120 - \$51.60 = \$68.40$, not $\$120 - \$43.00 = \$77.00$.

## QUESTION 6.

**Choice B is correct.** When 4 times the number $x$ is added to 12, the result is $12 + 4x$. Since this result is equal to 8, the equation $12 + 4x = 8$ must be true. Subtracting 12 from each side of $12 + 4x = 8$ gives $4x = -4$, and then dividing both sides of $4x = -4$ by 4 gives $x = -1$. Therefore, 2 times $x$ added to 7, or $7 + 2x$, is equal to $7 + 2(-1) = 5$.

Choice A is incorrect because $-1$ is the value of $x$, not the value of $7 + 2x$. Choices C and D are incorrect and may result from calculation errors.

## QUESTION 7.

**Choice D is correct.** The $x$-intercepts of the parabola represented by $y = x^2 - 6x + 8$ in the $xy$-plane are the values of $x$ for which $y$ is equal to 0. The factored form of the equation, $y = (x - 2)(x - 4)$, shows that $y$ equals 0 if and only if $x = 2$ or $x = 4$. Thus, the factored form, $y = (x - 2)(x - 4)$, displays the $x$-intercepts of the parabola as the constants 2 and 4.

Choices A, B, and C are incorrect because none of these forms shows the $x$-intercepts 2 and 4 as constants or coefficients.

## QUESTION 8.

**Choice D is correct.** Since a player starts with $k$ points and loses 2 points each time a task is not completed, the player's score will be $k - 2n$ after $n$ tasks are not completed (and no additional points are gained). Since a player who fails to complete 100 tasks has a score of 200 points, the equation $200 = k - 100(2)$ must be true. This equation can be solved by adding 200 to each side, giving $k = 400$.

Choices A, B, and C are incorrect and may result from errors in setting up or solving the equation relating the player's score to the number of tasks the player fails to complete. For example, choice A may result from subtracting 200 from the left-hand side of $200 = k - 100(2)$ and adding 200 to the right-hand side.

## QUESTION 9.

**Choice A is correct.** Since $x$ is the number of 40-pound boxes, $40x$ is the total weight, in pounds, of the 40-pound boxes; and since $y$ is the number of 65-pound boxes, $65y$ is the total weight, in pounds, of the 65-pound boxes. The combined weight of the boxes is therefore $40x + 65y$, and the total number of boxes is $x + y$. Since the forklift can carry up to 45 boxes or up to 2,400 pounds, the inequalities that represent these relationships are $40x + 65y \leq 2{,}400$ and $x + y \leq 45$.

Choice B is incorrect. The second inequality correctly represents the maximum number of boxes on the forklift, but the first inequality divides, rather than multiplies, the number of boxes by their respective weights. Choice C is incorrect. The combined weight of the boxes, $40x + 65y$, must be less than or equal to 2,400 pounds, not 45; the total number of boxes, $x + y$, must be less than or equal to 45, not 2,400. Choice D is incorrect. The second inequality correctly represents the maximum weight, in pounds, of the boxes on the forklift, but the total number of boxes, $x + y$, must be less than or equal to 45, not 2,400.

## QUESTION 10.

**Choice B is correct.** It is given that $g(3) = 2$. Therefore, to find the value of $f(g(3))$, substitute 2 for $g(3)$: $f(g(3)) = f(2) = 3$.

Choices A, C, and D are incorrect and may result from misunderstandings about function notation.

## QUESTION 11.

**Choice B is correct.** Tony reads 250 words per minute, and he plans to read for 3 hours, which is 180 minutes, each day. Thus, Tony is planning to read $250 \times 180 = 45{,}000$ words of the novel per day. Since the novel has 349,168 words, it will take Tony $\frac{349{,}168}{45{,}000} \approx 7.76$ days of reading to finish the novel. That is, it will take Tony 7 full days of reading and most of an 8th day of reading to finish the novel. Therefore, it will take Tony 8 days to finish the novel.

Choice A is incorrect and may result from an incorrect calculation or incorrectly using the numbers provided in the table. Choice C is incorrect and may result from taking the total number of words in the novel divided by the rate Tony reads per hour. Choice D is incorrect and may result from taking the total number of words in the novel divided by the number of pages in the novel.

## QUESTION 12.

**Choice D is correct.** Since there were 175,000 tons of trash in the landfill on January 1, 2000, and the amount of trash in the landfill increased by 7,500 tons each year after that date, the amount of trash, in tons, in the landfill $y$ years after January 1, 2000 can be expressed as $175{,}000 + 7{,}500y$. The landfill has a capacity of 325,000 tons. Therefore, the set of years where the amount of trash in the landfill is at (equal to) or above (greater than) capacity is described by the inequality $175{,}000 + 7{,}500y \geq 325{,}000$.

Choice A is incorrect. This inequality does not account for the 175,000 tons of trash in the landfill on January 1, 2000, nor does it accurately account for the 7,500 tons of trash that are added to the landfill each year after January 1, 2000. Choice B is incorrect. This inequality does not account for the 175,000 tons of trash in the landfill on January 1, 2000. Choice C is incorrect. This inequality represents the set of years where the amount of trash in the landfill is at or below capacity.

## QUESTION 13.

**Choice D is correct.** Survey research is an efficient way to estimate the preferences of a large population. In order to reliably generalize the results of survey research to a larger population, the participants should be randomly selected from all people in that population. Since this survey was conducted

with a population that was not randomly selected, the results are not reliably representative of all people in the town. Therefore, of the given factors, where the survey was given makes it least likely that a reliable conclusion can be drawn about the sports-watching preferences of all people in the town.

Choice A is incorrect. In general, larger sample sizes are preferred over smaller sample sizes. However, a sample size of 117 people would have allowed a reliable conclusion about the population if the participants had been selected at random. Choice B is incorrect. Whether the population is large or small, a large enough sample taken from the population is reliably generalizable if the participants are selected at random from that population. Thus, a reliable conclusion could have been drawn about the population if the 117 survey participants had been selected at random. Choice C is incorrect. When giving a survey, participants are not forced to respond. Even though some people refused to respond, a reliable conclusion could have been drawn about the population if the participants had been selected at random.

## QUESTION 14.

**Choice C is correct.** According to the graph, the horizontal line that represents 550 billion miles traveled intersects the line of best fit at a point whose horizontal coordinate is between 2000 and 2005, and slightly closer to 2005 than to 2000. Therefore, of the choices given, 2003 best approximates the year in which the number of miles traveled by air passengers in Country X was estimated to be 550 billion.

Choice A is incorrect. According to the line of best fit, in 1997 the estimated number of miles traveled by air passengers in Country X was about 450 billion, not 550 billion. Choice B is incorrect. According to the line of best fit, in 2000 the estimated number of miles traveled by air passengers in Country X was about 500 billion, not 550 billion. Choice D is incorrect. According to the line of best fit, in 2008 the estimated number of miles traveled by air passengers in Country X was about 600 billion, not 550 billion.

## QUESTION 15.

**Choice A is correct.** The number of miles Earth travels in its one-year orbit of the Sun is 580,000,000. Because there are about 365 days per year, the number of miles Earth travels per day is $\frac{580{,}000{,}000}{365} \approx 1{,}589{,}041$. There are 24 hours in one day, so Earth travels at $\frac{1{,}589{,}041}{24} \approx 66{,}210$ miles per hour. Therefore, of the choices given, 66,000 miles per hour is closest to the average speed of Earth as it orbits the Sun.

Choices B, C, and D are incorrect and may result from calculation errors.

## QUESTION 16.

**Choice B is correct.** According to the table, there are 18 + 7 = 25 graduates who passed the bar exam, and 7 of them did not take the review course. Therefore, if one of the surveyed graduates who passed the bar exam is chosen at random, the probability that the person chosen did not take the review course is $\frac{7}{25}$.

Choices A, C, and D are incorrect. Each of these choices represents a different probability from the conditional probability that the question asks for. Choice A represents the following probability. If one of the surveyed graduates who passed the bar exam is chosen at random, the probability that the person chosen did take the review course is $\frac{18}{25}$. Choice C represents the following probability. If one of the surveyed graduates is chosen at random, the probability that the person chosen passed the bar exam is $\frac{25}{200}$. Choice D represents the following probability. If one of the surveyed graduates is chosen at random, the probability that the person chosen passed the exam and took the review course is $\frac{7}{200}$.

## QUESTION 17.

**Choice C is correct.** To find the atomic weight of an unknown element that is 20% less than the atomic weight of calcium, multiply the atomic weight, in amu, of calcium by (1 − 0.20): (40)(1 − 0.20) = (40)(0.8) = 32.

Choice A is incorrect. This value is 20% of the atomic weight of calcium, not an atomic weight 20% less than that atomic weight of calcium. Choice B is incorrect. This value is 20 amu less, not 20% less, than the atomic weight of calcium. Choice D is incorrect. This value is 20% more, not 20% less, than the atomic weight of calcium.

## QUESTION 18.

**Choice C is correct.** The mean and median values of a data set are equal when there is a symmetrical distribution. For example, a normal distribution is symmetrical. If the mean and the median values are not equal, then the distribution is not symmetrical. Outliers are a small group of values that are significantly smaller or larger than the other values in the data. When there are outliers in the data, the mean will be pulled in their direction (either smaller or larger) while the median remains the same. The example in the question has a mean that is larger than the median, and so an appropriate conjecture is that large outliers are present in the data; that is, that there are a few homes that are valued much more than the rest.

Choice A is incorrect because a set of home values that are close to each other will have median and mean values that are also close to each other.

Choice B is incorrect because outliers with small values will tend to make the mean lower than the median. Choice D is incorrect because a set of data where many homes are valued between $125,000 and $165,000 will likely have both a mean and a median between $125,000 and $165,000.

## QUESTION 19.

**Choice B is correct.** The median of a data set is the middle value when the data points are sorted in either ascending or descending order. There are a total of 600 data points provided, so the median will be the average of the 300th and 301st data points. When the data points are sorted in order:

- Values 1 through 260 will be 0.
- Values 261 through 450 will be 1.
- Values 451 through 540 will be 2.
- Values 541 through 580 will be 3.
- Values 581 through 600 will be 4.

Therefore, both the 300th and 301st values are 1, and hence the median is 1.

Choices A, C, and D are incorrect and may result from either a calculation error or a conceptual error.

## QUESTION 20.

**Choice C is correct.** When survey participants are selected at random from a larger population, the sample statistics calculated from the survey can be generalized to the larger population. Since 10 of 300 students surveyed at Lincoln School have 4 siblings, one can estimate that this same ratio holds for all 2,400 students at Lincoln School. Also, since 10 of 300 students surveyed at Washington School have 4 siblings, one can estimate that this same ratio holds for all 3,300 students at Washington School. Therefore, approximately $\frac{10}{30} \times 2{,}400 = 80$ students at Lincoln School and $\frac{10}{30} \times 3{,}300 = 110$ students at Washington School are expected to have 4 siblings. Thus, the total number of students with 4 siblings at Washington School is expected to be $110 - 80 = 30$ more than the total number of students with 4 siblings at Lincoln School.

Choices A, B, and D are incorrect and may result from either conceptual or calculation errors. For example, choice A is incorrect; even though there is the same ratio of survey participants from Lincoln School and Washington School with 4 siblings, the two schools have a different total number of students, and thus, a different expected total number of students with 4 siblings.

## QUESTION 21.

**Choice D is correct.** The difference between the number of hours the project takes, $y$, and the number of hours the project was estimated to take, $x$, is $|y - x|$. If the goal is met, the difference is less than 10, which can be represented as $|y - x| < 10$ or $-10 < y - x < 10$.

Choice A is incorrect. This inequality states that the estimated number of hours plus the actual number of hours is less than 10, which cannot be true because the estimate is greater than 100. Choice B is incorrect. This inequality states that the actual number of hours is greater than the estimated number of hours plus 10, which could be true only if the goal of being within 10 hours of the estimate were not met. Choice C is incorrect. This inequality states that the actual number of hours is less than the estimated number of hours minus 10, which could be true only if the goal of being within 10 hours of the estimate were not met.

## QUESTION 22.

**Choice B is correct.** To rearrange the formula $I = \frac{P}{4\pi r^2}$ in terms of $r^2$, first multiply each side of the equation by $r^2$. This yields $r^2 I = \frac{P}{4\pi}$. Then dividing each side of $r^2 I = \frac{P}{4\pi}$ by $I$ gives $r^2 = \frac{P}{4\pi I}$.

Choices A, C, and D are incorrect and may result from algebraic errors during the rearrangement of the formula.

## QUESTION 23.

**Choice A is correct.** If $I_A$ is the intensity measured by Observer A from a distance of $r_A$ and $I_B$ is the intensity measured by Observer B from a distance of $r_B$, then $I_A = 16 I_B$. Using the formula $I = \frac{P}{4\pi^2}$, the intensity measured by Observer A is $I_A = \frac{P}{4\pi r_A^2}$, which can also be written in terms of $I_B$ as $I_A = 16 I_B = 16 \left( \frac{P}{4\pi r_B^2} \right)$. Setting the right-hand sides of these two equations equal to each other gives $\frac{P}{4\pi r_A^2} = 16 \left( \frac{P}{4\pi r_B^2} \right)$, which relates the distance of Observer A from the radio antenna to the distance of Observer B from the radio antenna. Canceling the common factor $\frac{P}{4\pi}$ and rearranging the equation gives $r_B^2 = 16 r_A^2$. Taking the square root of each side of $r_B^2 = 16 r_A^2$ gives $r_B = 4 r_A$, and then dividing each side by 4 yields $r_A = \frac{1}{4} r_B$. Therefore, the distance of Observer A from the radio antenna is $\frac{1}{4}$ the distance of Observer B from the radio antenna.

Choices B, C, and D are incorrect and may result from errors in deriving or using the formula $\frac{P}{4\pi r_A^2} = (16) \left( \frac{P}{4\pi r_B^2} \right)$.

## QUESTION 24.

**Choice A is correct.** The equation of a circle with center $(h, k)$ and radius $r$ is $(x - h)^2 + (y - k)^2 = r^2$. To put the equation $x^2 + y^2 + 4x - 2y = -1$ in this form, complete the square as follows:

$$\begin{aligned} x^2 + y^2 + 4x - 2y &= -1 \\ (x^2 + 4x) + (y^2 - 2y) &= -1 \\ (x^2 + 4x + 4) - 4 + (y^2 - 2y + 1) - 1 &= -1 \\ (x + 2)^2 + (y - 1)^2 - 4 - 1 &= -1 \\ (x + 2)^2 + (y - 1)^2 &= 4 = 2^2 \end{aligned}$$

Therefore, the radius of the circle is 2.

Choice C is incorrect because it is the square of the radius, not the radius. Choices B and D are incorrect and may result from errors in rewriting the given equation in standard form.

## QUESTION 25.

**Choice A is correct.** In the $xy$-plane, the slope $m$ of the line that passes through the points $(x_1, y_1)$ and $(x_2, y_2)$ is given by the formula $m = \frac{y_2 - y_1}{x_2 - x_1}$. Thus, if the graph of the linear function $f$ has intercepts at $(a, 0)$ and $(0, b)$, then the slope of the line that is the graph of $y = f(x)$ is $m = \frac{0 - b}{a - 0} = -\frac{b}{a}$. It is given that $a + b = 0$, and so $a = -b$. Finally, substituting $-b$ for $a$ in $m = -\frac{b}{a}$ gives $m = -\frac{b}{-b} = 1$, which is positive.

Choices B, C, and D are incorrect and may result from a conceptual misunderstanding or a calculation error.

## QUESTION 26.

**Choice D is correct.** The definition of the graph of a function $f$ in the $xy$-plane is the set of all points $(x, f(x))$. Thus, for $-4 \le a \le 4$, the value of $f(a)$ is 1 if and only if the unique point on the graph of $f$ with $x$-coordinate $a$ has $y$-coordinate equal to 1. The points on the graph of $f$ with $x$-coordinates $-4$, $\frac{3}{2}$, and 3 are, respectively, $(-4, 1)$, $\left(\frac{3}{2}, 1\right)$, and $(3, 1)$. Therefore, all of the values of $f$ given in I, II, and III are equal to 1.

Choices A, B, and C are incorrect because they each omit at least one value of $x$ for which $f(x) = 1$.

## QUESTION 27.

**Choice D is correct.** According to the graph, in the interval from 0 to 10 minutes, the non-insulated sample decreased in temperature by about 18°C, while the insulated sample decreased by about 8°C; in the interval from 10 to 20 minutes, the non-insulated sample decreased in temperature by about 9°C, while the insulated sample decreased by about 5°C; in the interval

from 40 to 50 minutes, the non-insulated sample decreased in temperature by about 1°C, while the insulated sample decreased by about 3°C; and in the interval from 50 to 60 minutes, the non-insulated sample decreased in temperature by about 1°C, while the insulated sample decreased by about 2°C. The description in choice D accurately summarizes these rates of temperature change over the given intervals. (Note that since the two samples of water have equal mass and so must lose the same amount of heat to cool from 60°C to 25°C, the faster cooling of the non-insulated sample at the start of the cooling process must be balanced out by faster cooling of the insulated sample at the end of the cooling process.)

Choices A, B, and C are incorrect. None of these descriptions accurately compares the rates of temperature change shown in the graph for the 10-minute intervals.

## QUESTION 28.

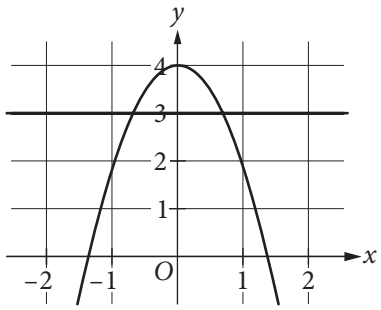
**Choice B is correct.** In the $xy$-plane, the slope $m$ of the line that passes through the points $(x_1, y_1)$ and $(x_2, y_2)$ is $m = \frac{y_2 - y_1}{x_2 - x_1}$. Thus, the slope of the line through the points $C(7, 2)$ and $E(1, 0)$ is $\frac{2 - 0}{7 - 1}$, which simplifies to $\frac{2}{6} = \frac{1}{3}$. Therefore, diagonal $AC$ has a slope of $\frac{1}{3}$. The other diagonal of the square is a segment of the line that passes through points $B$ and $D$. The diagonals of a square are perpendicular, and so the product of the slopes of the diagonals is equal to $-1$. Thus, the slope of the line that passes through $B$ and $D$ is $-3$ because $\frac{1}{3}(-3) = -1$. Hence, an equation of the line that passes through $B$ and $D$ can be written as $y = -3x + b$, where $b$ is the $y$-intercept of the line. Since diagonal $BD$ will pass through the center of the square, $E(1, 0)$, the equation $0 = -3(1) + b$ holds. Solving this equation for $b$ gives $b = 3$. Therefore, an equation of the line that passes through points $B$ and $D$ is $y = -3x + 3$, which can be rewritten as $y = -3(x - 1)$.

Choices A, C, and D are incorrect and may result from a conceptual error or a calculation error.

## QUESTION 29.

**Choice B is correct.** Substituting 3 for $y$ in $y = ax^2 + b$ gives $3 = ax^2 + b$, which can be rewritten as $3 - b = ax^2$. Since $y = 3$ is one of the equations in the given system, any solution $x$ of $3 - b = ax^2$ corresponds to the solution $(x, 3)$ of the given system. Since the square of a real number is always nonnegative, and a positive number has two square roots, the equation $3 - b = ax^2$ will have two solutions for $x$ if and only if (1) $a > 0$ and $b < 3$ or (2) $a < 0$ and $b > 3$. Of the values for $a$ and $b$ given in the choices, only $a = -2$, $b = 4$ satisfy one of these pairs of conditions.

Alternatively, if $a = -2$ and b = 4, then the second equation would be $y = -2x^2 + 4$. The graph of this quadratic equation in the $xy$-plane is a parabola with $y$-intercept (0, 4) that opens downward. The graph of the first equation, $y = 3$, is the horizontal line that contains the point (0, 3). As shown below, these two graphs have two points of intersection, and therefore, this system of equations has exactly two real solutions. (Graphing shows that none of the other three choices produces a system with exactly two real solutions.)




Choices A, C, and D are incorrect and may result from calculation or conceptual errors.

## QUESTION 30.

**Choice A is correct.** The regular hexagon can be divided into 6 equilateral triangles of side length $a$ by drawing the six segments from the center of the regular hexagon to each of its 6 vertices. Since the area of the hexagon is $384\sqrt{3}$ square inches, the area of each equilateral triangle will be $\frac{384\sqrt{3}}{6} = 64\sqrt{3}$ square inches.

Drawing any altitude of an equilateral triangle divides it into two 30°-60°-90° triangles. If the side length of the equilateral triangle is $a$, then the hypotenuse of each 30°-60°-90° triangle is $a$, and the altitude of the equilateral triangle will be the side opposite the 60° angle in each of the 30°-60°-90° triangles. Thus, the altitude of the equilateral triangle is $\frac{\sqrt{3}}{2}a$, and the area of the equilateral triangle is $\frac{1}{2}(a)\left(\frac{\sqrt{3}}{2}a\right) = \frac{\sqrt{3}}{4}a^2$. Since the area of each equilateral triangle is $64\sqrt{3}$ square inches, it follows that $a^2 = \frac{4}{\sqrt{3}}(64\sqrt{3})$ = 256 square inches. And since the area of the square with side length $a$ is $a^2$, it follows that the square has area 256 square inches.

Choices B, C, and D are incorrect and may result from calculation or conceptual errors.

## QUESTION 31.

**The correct answer is 14**. Since the coastal geologist estimates that the country's beaches are eroding at a rate of 1.5 feet every year, they will erode by $1.5x$ feet in $x$ years. Thus, if the beaches erode by 21 feet in $x$ years, the equation $1.5x = 21$ must hold. The value of $x$ is then $\frac{21}{1.5} = 14$. Therefore, according to the geologist's estimate, it will take 14 years for the country's beaches to erode by 21 feet.

## QUESTION 32.

**The correct answer is 7**. There are 60 minutes in each hour, and so there are $60h$ minutes in $h$ hours. Since $h$ hours and 30 minutes is equal to 450 minutes, it follows that $60h + 30 = 450$. This equation can be simplified to $60h = 420$, and so the value of $h$ is $\frac{420}{60} = 7$.

## QUESTION 33.

**The correct answer is 11.** It is given that the function $f(x)$ passes through the point (3, 6). Thus, if $x = 3$, the value of $f(x)$ is 6 (since the graph of $f$ in the $xy$-plane is the set of all points $(x, f(x))$. Substituting 3 for $x$ and 6 for $f(x)$ in $f(x) = 3x^2 - bx + 12$ gives $6 = 3(3)^2 - b(3) + 12$. Performing the operations on the right-hand side of this equation gives $6 = 3(9) - 3b + 12 = 27 - 3b + 12 = 39 - 3b$. Subtracting 39 from each side of $6 = 39 - 3b$ gives $-33 = -3b$, and then dividing each side of $-3b = -33$ by $-3$ gives the value of $b$ as 11.

## QUESTION 34.

**The correct answer is 105.** Let $D$ be the number of hours Doug spent in the tutoring lab, and let $L$ be the number of hours Laura spent in the tutoring lab. Since Doug and Laura spent a combined total of 250 hours in the tutoring lab, the equation $D + L = 250$ holds. The number of hours Doug spent in the lab is 40 more than the number of hours Laura spent in the lab, and so the equation $D = L + 40$ holds. Substituting $L + 40$ *for* $D$ in $D + L = 250$ gives $(L + 40) + L = 250$, or $40 + 2L = 250$. Solving this equation gives $L = 105$. Therefore, Laura spent 105 hours in the tutoring lab.

## QUESTION 35.

**The correct answer is 15.** The amount, $a$, that Jane has deposited after $t$ fixed weekly deposits is equal to the initial deposit plus the total amount of money Jane has deposited in the $t$ fixed weekly deposits. This amount $a$ is given to be $a = 18t + 15$. The amount she deposited in the $t$ fixed weekly deposits is the amount of the weekly deposit times $t$; hence, this amount must be given by the term $18t$ in $a = 18t + 15$ (and so Jane must have deposited 18 dollars each week after the initial deposit). Therefore, the amount of Jane's original deposit, in dollars, is $a - 18t = 15$.

## QUESTION 36.

**The correct answer is 32.** Since segments $LM$ and $MN$ are tangent to the circle at points $L$ and $N$, respectively, angles $OLM$ and $ONM$ are right angles. Thus, in quadrilateral $OLMN$, the measure of angle $O$ is $360° - (90° + 60° + 90°) = 120°$. Thus, in the circle, central angle $O$ cuts off $\frac{120}{360} = \frac{1}{3}$ of the circumference; that is, minor arc $\overset{\frown}{LN}$ is $\frac{1}{3}$ of the circumference. Since the circumference is 96, the length of minor arc $\overset{\frown}{LN}$ is $\frac{1}{3} \times 96 = 32$.

## QUESTION 37.

**The correct answer is 3284.** According to the formula, the number of plants one year from now will be $3000 + 0.2(3000)\left(1 - \frac{3000}{4000}\right)$, which is equal to 3150. Then, using the formula again, the number of plants two years from now will be $3150 + 0.2(3150)\left(1 - \frac{3150}{4000}\right)$, which is 3283.875. Rounding this value to the nearest whole number gives 3284.

## QUESTION 38.

**The correct answer is 7500.** If the number of plants is to be increased from 3000 this year to 3360 next year, then the number of plants that the environment can support, $K$, must satisfy the equation $3360 = 3000 + 0.2(3000)\left(1 - \frac{3000}{K}\right)$. Dividing both sides of this equation by 3000 gives $1.12 = 1 + 0.2\left(1 - \frac{3000}{K}\right)$, and therefore, it must be true that $0.2\left(1 - \frac{3000}{K}\right) = 0.12$, or equivalently, $1 - \frac{3000}{K} = 0.6$. It follows that $\frac{3000}{K} = 0.4$, and so $K = \frac{3000}{0.4} = 7500$.