



AMERICA'S PREMIERE TESTING READINESS PROGRAM

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5 Ways to Increase Score Gains Using Cambridge's *Navigator Plus*

Navigator Plus is Cambridge's complete explanation guide to a previously administered test. It includes explanations for each item on the test, categorization for each item, an answer key, and more.

The following list provides suggestions for implementing the Navigator into your program to increase score gains.

- 1. Simulate test day as much as possible when proctoring tests.** Students will benefit from a testing experience that closely simulates what they will experience on test day. They will feel more confident if they know what to expect.
- 2. Follow up when you receive your data.** Use the reports you receive from Cambridge to cover the items your class struggled as a group to answer (see the Error Analysis report). Taking this step within two weeks of administering the test will ensure that your students haven't forgotten the items you cover and will be able to learn from their testing experiences.
- 3. Use the Pre-Assessment Item references in the *Victory* lesson to illustrate key points.** Your teacher's guide includes references to items on your pre-assessment that you can use as additional examples. Keep a copy of your pre-assessment test booklet handy so that you can cover these items with your students. Using pre-assessment items as additional examples helps students connect the concepts you are teaching with their test-day experiences.
- 4. Don't forget to review the wrong answers.** Many explanations in this Navigator packet include references to each wrong answer choice. Students will benefit from reviewing why each wrong answer is wrong so that they can recognize what makes the right answer correct and use the process of elimination to eliminate similar wrong answers in the future.
- 5. Pay attention to item categories.** Each item in this Navigator packet includes a category path that corresponds to the course concept outline in your *Victory* text as well as the categories listed in the Item Index of your *Victory* text. Use the Item Index to identify items students can use for further practice.

Category Paths

Throughout these explanations, each item includes a **Cambridge Category Path** which links the item to the Course Concept Outline in Cambridge's *Victory* series. For example:

Mathematics/Geometry/Triangles/Pythagorean Theorem

An item with this particular category path is found in the Mathematics Test (based on Level 1 of the category path, mathematics) and tests students' knowledge of geometry (Level 2 of the category path), more specifically of triangles (Level 3), and even more specifically of the Pythagorean theorem (Level 4). The *Victory* Mathematics Lesson includes a section on the Pythagorean theorem, which you can find by referencing the Course Concept Outline at the beginning of the mathematics section in the *Victory* book. Additionally, you can find items testing geometry, triangles, or the Pythagorean theorem using the Item Index at the end of the *Victory* Student Text and Teacher's Guide.



ACT ENGLISH TEST EXPLANATIONS

1. **(A) English/Knowledge of Language/Style/Conciseness.** Answer choices (B), (C), and (D) add information that is already provided in the sentence—the narrator starts the passage by stating he or she is waiting in the veterinarian’s office—so the additions would create needless repetition. The best answer, then, is to leave out the repetitive information, (A).
2. **(G) English/Production of Writing/Strategy/Appropriate Supporting Material.** This question asks for the most vivid, or detailed, description of iguanas on the floor of the rain forest. The sentence as written simply says that iguanas walk on the floor of the rain forest, which isn’t very descriptive, so it can be eliminated. “Living underneath the treetops” and “moving about down low” don’t describe the rainforest floor at all, so (H) and (J) are also wrong. “[S]cuttling through the dank undergrowth” says much more than simply walking and provides vivid imagery of “scuttling” under the overgrowth of trees, (G).
3. **(C) English/Conventions of Standard English/Sentence Structure/Problems of Coordination and Subordination and Punctuation/Commas and Semicolons.** The last clause of this sentence modifies “iguanas.” However, “which are,” (A), and “they are,” (B), incorrectly imply that the phrase modifies “trees.” Changing the comma to a semicolon, as (D) does, creates a punctuation error: “[H]idden in the canopy” is not a complete sentence and thus cannot be joined to another clause with a semicolon. Only (C) clarifies the sentence without any punctuation errors.
4. **(G) English/Production of Writing/Strategy/Appropriate Supporting Material.** The author of the passage is trying to figure out whether to keep the underlined portion, which expresses his or her feelings about the woman taking her iguana out of its cage. This portion does not suggest that the writer has previously sat next to an iguana, so (F) can be eliminated. It doesn’t provide background information about iguanas, so (J) is also wrong. The underlined portion also doesn’t mischaracterize the narrator in comparison to the rest of the passage—the narrator in the underlined portion is skeptical of the iguana, and continues to be throughout the passage—so (H) is also wrong. The underlined portion shows the narrator’s feelings about the iguana being taken out of its carrier, and thus should be kept, since the rest of the passage also focuses on the narrator’s feelings about the iguana, (G).
5. **(D) English/Production of Writing/Strategy/Appropriate Supporting Material.** This question asks for the most precise description of the pattern of spikes on the iguana’s spine—the key word is “most” because all answer choices provide description, so comparing the descriptions provided in the answer choices is the best way to find the correct answer. “[S]pikes that were just beginning to develop” isn’t as descriptive as the original “spine with tiny spikes,” so (B) can be eliminated, and “small spikes on its armored back” is more descriptive than “spine with tiny spikes,” so (A) can also be eliminated. “Small spikes on its armored back” is not as descriptive as “rows of budding spikes lining its spine,” so (C) is also wrong, making (D) the most descriptive, and therefore the correct, choice.
6. **(G) English/Conventions of Standard English/Grammar and Usage/Nouns and Noun Clauses.** The underlined portion in this question is a noun clause, but the problem with it as written is that it is needlessly wordy and uses too many descriptive phrases; “caress that was given tenderly” and “from the woman to the pet” is a long-winded way to say the woman tenderly caressed the iguana. (H) corrects the problem, but it turns the final phrase in the sentence (and watched it peacefully rest) into a fragment with no subject. (J) removes the reference to the caress and to the iguana, making it unclear what the woman showed tenderness to, so it is also wrong. Only (G) concisely words the clause in a way that modifies the appropriate antecedents.
7. **(B) English/Conventions of Standard English/Grammar and Usage/Pronoun Usage.** The sentence as written uses the second person “us,” but the only person lavishing so much affection on the iguana is the woman, (B). All other answer choices use a pronoun that does not accurately show who lavished the affection.

8. **(J) English/Conventions of Standard English/Punctuation/Commas.** The last clause of the sentence describes how the iguana’s eyes shone, and adding a comma anywhere in that clause breaks up the logical progression of that three-part description (large, bright, and from its scaly face). (F), (G), and (H) all add commas that break up the ideas in the clause, so (J) is the best answer.
9. **(B) English/Knowledge of Language/Vocabulary.** The question asks for the word that is NOT an acceptable substitute for “regarded” in the sentence. “Regarded” means giving attention or consideration to something or someone. “Considered” is almost identically aligned with this definition, so (D) can be eliminated. “Scrutinized” means to pay close attention or to analyze, and “appraised” has a similar definition: “to evaluate”; both these words are related to considering or giving attention, so (A) and (C) are also wrong. The only answer choice that isn’t a close synonym of “regarded” is (B), “supposed.”

TIP *Remind students that for questions that ask for the answer that is NOT correct, they are looking for the wrong answer. For Vocabulary questions like these, finding synonyms for the word in question is a quick way to eliminate the wrong—at least for these types of questions—answers.*

10. **(F) English/Conventions of Standard English/Grammar and Usage/Verb Tense.** This sentence is best left as is, as (G) and (H) are needlessly wordy compared to the succinct “delivering,” and the present tense verb “deliver” in (J) does not match the present progressive text in the rest of the sentence.
11. **(D) English/Conventions of Standard English/Punctuation/Commas.** The problem with the sentence as written is that it separates the compound direct object from the phrase that modifies it: The assistant called for both the cat and the narrator from the hallway. (B) commits the same error. While (C) corrects this mistake, adding a comma after hallway incorrectly creates separation from the restrictive clause that follows, so it is also wrong. The only answer choice that does not add unnecessary commas is (D).

TIP *Phrases that begin with “that” almost always indicate a restrictive clause and thus are usually not preceded by a comma.*

12. **(F) English/Knowledge of Language/Style/Conciseness.** For this question, the original sentence is correct. “Like as if it was giving off the impression of being,” (G); “appearing something like,” (H); and “sort of like it was,” (J) are all long-winded ways of saying “looking,” so it’s best to leave the sentence with the succinct version.

TIP *In questions that test concision, the shortest answer is usually the correct answer.*

13. **(B) English/Production of Writing/Strategy/Appropriate Supporting Material.** The sentence the writer wants to add provides a detail about the woman’s pet iguana, specifically that it is its first trip to the veterinarian and it likes special attention in unfamiliar surroundings, so it should be placed near other details introducing the iguana and the veterinarian’s office. (D) can be quickly eliminated because the vet’s office is the setting of the passage, the iguana is one of its main characters, and both details are established early in the passage instead of near the end. Point A in Paragraph 1 would make this additional sentence the first sentence of the passage, which wouldn’t logically make sense since it wouldn’t be clear who “she” is, so (A) can also be eliminated. At Point C in Paragraph 2, the author has moved on from introducing the setting and the iguana to the narrator’s opinions about iguanas, so it isn’t logical to add information about both the setting and the iguana at this point either, (C). The best place to add the sentence is at Point B in Paragraph 1, before the passage moves from the setting and an introduction of the woman with the iguana, but after both the woman and iguana have been introduced, (B).
14. **(F) English/Production of Writing/Strategy/Main Idea.** This question asks if the passage matches the author’s primary purpose of noticing something unexpected while observing surroundings. The author is at the vet’s office and noticed the woman and the iguana, which is noticing something expected while observing surroundings, so (H) and (J) can quickly be eliminated. The narrator does state that he or she



didn't want to be impolite when the woman asked if she could take her iguana out of its cage, but it's not what the narrator noticed that was unexpected, so (G) is also wrong. The narrator noticed and was surprised by the tender relationship between the iguana and its owner, (F).

15. (A) *English/Conventions of Standard English/Sentence Structure/Problems of Coordination and Subordination*. This sentence is correct as written: The first clause explains that Billy Mills qualified for the Olympics, and the second clause states that he was a long shot to win. The contrasting word “but” appropriately connects these two ideas. The connecting words “nonetheless” and “in fact” show a relationship or extension of similar ideas from one clause to the next, but Billy Mills being a long shot is not similar to his qualifying. It is a contrast, so (B) and (C) are wrong. Additionally, neither of these connecting words are conjunctions and using them with only a comma preceding their use creates a comma splice. (D) is wrong for the same reason: Removing the conjunction creates a comma splice.
16. (F) *English/Conventions of Standard English/Punctuation/Commas*. “Olympic” and “gold” are both adjectives that describe “medal,” and often commas are used to separate adjectives that modify the same noun, so it would be easy to assume that (J) is the right answer choice. However, the comma between the adjectives means that the adjectives are separate from each other. The medal is an “Olympic gold” medal, which is a specific type of gold medal. Therefore, no comma is necessary between the adjectives, (F). Placing a comma after “medal,” (G), separates the direct object from the prepositional phrase that modifies it; in addition to the error in (G), (H) makes an additional one: It adds a comma after “gold” that separates the adjective from the noun it modifies.
17. (C) *English/Conventions of Standard English/Grammar and Usage/Diction*. The idea of this sentence provides an explanation for why Billy Mills was a “long shot” in the Olympics: His qualifying time “lagged” the world-record time. “Lagged” means “to fall behind” or “not keep pace with others,” so his time must be a full minute behind the world record, (C).
18. (G) *English/Production of Writing/Organization/Sentence-Level Structure*. The first sentence introduces Billy Mills and states that he was a “long shot” in the Olympics. The second sentence states that he won an Olympic gold medal, and the third explains why he was a long shot: His qualifying time was a full minute behind the record. It is more logical to provide the explanation for why Mills was a long shot before stating that he defied these long odds and won an Olympic gold medal, making the most logical order Sentence 1, Sentence 3, and then Sentence 2, (G).
19. (A) *English/Conventions of Standard English/Punctuation/Commas*. Nonrestrictive clauses (clauses that are not necessary to the grammatical structure or meaning of the sentence) must be set off in matching punctuation—usually commas, em dashes, or parentheses. The clause “an Oglala Lakota” is a descriptive phrase that provides additional, but not necessary, detail about Mills, so this nonrestrictive clause is appropriately set off by matching commas, (A). No punctuation around the clause makes it difficult to understand what the phrase describes and thus makes meaning hard to follow, so (B) is wrong, and both (C) and (D) are missing either the needed comma before or after the nonrestrictive clause, so they are also wrong.
20. (H) *English/Production of Writing/Strategy/Effective Transitional Sentence*. The current paragraph provides background information on Mills, including other sports in which he was interested, particularly boxing. The next paragraph goes back to his success with running, introducing his high school and college accomplishments in track, so the last sentence of the previous paragraph needs to provide a transition from Mills’ love of boxing back to his running. Both (F) and (G) focus on boxing solely and do not provide an effective transition to his high school and college running accomplishments, so they can be eliminated, and (J) introduces other sports where Mills did not excel but also doesn’t provide the needed transition to running, so it is also wrong. Only (H) makes the connection between Mills’ first love, boxing, to his athletic forte: running.

21. (C) *English/Conventions of Standard English/Sentence Structure/Misplaced Modifiers*. The underlined portion of this sentence describes Mills racing again while in the marines. “Races became part of his life again,” (A), and “racing was in his life,” (D) are needlessly wordy, so they can be eliminated. “His talent raced back to him” makes Mills’ talent do the racing, not him, so (B) is also wrong. The most succinct way to say that Mills started to race again is to say “he began racing,” (C).
22. (H) *English/Production of Writing/Strategy/Effective Transitional Sentence*. The question asks for the best sentence to not only open the paragraph, but also to connect to the first paragraph. While “[a]t an important point in his training” connects to the ideas in the previous paragraph to create a transition, this idea doesn’t connect to the idea in the opening paragraph of Mills qualifying for the 1964 Tokyo Olympics and winning a gold medal, so (F) is wrong. (J) is guilty of the same error. And, while Mills may be in the US Track and Field Hall of Fame, that idea also doesn’t clearly connect to idea in the opening paragraph. The best transition and connection to the first paragraph of the passage is to introduce what Mills wrote in his journal by referring back to the 1964 Olympics, (H).
23. (A) *English/Production of Writing/Strategy/Appropriate Supporting Material*. “Rather” in the previous sentence is placed before “unknown.” Removing it would simply state that Mills was “unknown as an athlete,” meaning no one knew about his skill. Even though he was a long shot for the Olympics because of his qualifying time, his success in high school and college track likely didn’t make him completely unknown as an athlete. With “rather” included, it shows that some people didn’t know about his skills, but that some did, (A). While Mills likely used his underdog status as motivation to win, removing “rather” doesn’t provide this information, so (B) is wrong. As for (C) and (D), there is no information in the passage to suggest that being unknown (or “rather” unknown) is why Mills wanted to compete in the Olympics or that being unknown had anything to do with Mills needed more training.
24. (H) *English/Production of Writing/Strategy/Appropriate Supporting Material*. The underlined word in this sentence is meant to introduce the idea that Mills borrowed a pair of shoes because he didn’t have a shoe sponsor like some athletes would. Because this is also the concluding sentence of this paragraph, its idea should also connect to the paragraph as a whole, which focuses on his progress toward his goal. While it might be “lucky” that Mills borrowed a pair of shoes to run in, “luckily” doesn’t relate to Mills being determined to win, so (F) can be eliminated. “Eventually” signals a progression in time or sequence, and this paragraph is a description of Mills’ determination to win, not a progression or a sequence, so (G) is also wrong. Mills likely concentrated his efforts on winning, but he probably didn’t have to concentrate to borrow shoes, so (J) is also wrong. The best word to introduce the clause that follows and connect to the paragraph’s theme of Mills’ determination is to say that he was “undeterred” by his setbacks, (H).
25. (D) *English/Production of Writing/Strategy/Appropriate Supporting Material*. The sentence the author is considering adding is about another runner who borrowed shoes in the Tokyo Olympics, Bob Hayes. Because this passage is about Billy Mills’ Olympic journey, not Bob Hayes, adding this sentence would interrupt the discussion of Mills’ journey and preparation for the 10,000-meter race in the Olympics and thus should be left out, (D). While the information in the sentence the author wants to add is related to the idea in that paragraph, these details are disconnected from the main idea of the passage, so (A) and (B) are wrong. As for (C), it is wrong because it misconstrues the main idea of the passage. The passage is not about US track team members and their shoes; it is about Billy Mills getting to the Olympics.
26. (J) *English/Knowledge of Language/Vocabulary*. This question asks for the best word to show who everyone was watching. “Overseers” are people who supervise others, and in a race, all eyes would not be on anyone supervising the race, so (F) is wrong. “Authorities” and “rulers” refer to people in charge, and no one would be watching these people, if these people were there, at the Olympics, either. People watch those who are winning the race, the “leaders,” (J).
27. (A) *English/Conventions of Standard English/Punctuation/Commas*. Nonrestrictive clauses (clauses that are not necessary to the grammatical structure or meaning of the sentence) must be set off in matching



punctuation. The clause “who had been in third place” describes Mills. If you took this phrase out, the sentence would still make sense and be grammatically correct, making it a nonrestrictive clause. The only answer choice that includes commas both before and after the clause is (A).

28. (F) *English/Conventions of Standard English/Grammar and Usage/Verb Tense.* This question asks for the correct verb tense, and at this point Mills has already won the race. The previous sentence says, “Mills, who had been in third place . . .” So (F), “had run,” maintains a consistent verb tense between the two sentences. The tense is also more logical than (G) or (J) would offer, since it describes the moments just after Mills finished running the race and is best done with the past perfect tense.
29. (C) *English/Production of Writing/Strategy/Appropriate Supporting Material.* The underlined portion in the sentence refers to two other runners, Mohamed Gammoudi and Ron Clarke, who were the two leaders of the race before Mills pulled ahead to win. At this point in the paragraph, the author has already stated that Mills won, which means he finished ahead of both these runners, so keeping the sentence would state information already evident, (C). The two runners in the underlined portion are not mentioned in the opening paragraph, so (A) is wrong, and there is no need to repeat or retell details of Mills’ victory, so (B) is also wrong. As for (D), the main point of the paragraph is Mills’ victory, which includes the detail about him beating Gammoudi and Clarke, but his win already makes this evident, so it doesn’t need to be explicitly stated.
30. (H) *English/Conventions of Standard English/Sentence Structure/Comma Splices.* The problem with the sentence as written is its structure. The clauses on both sides of the comma are complete sentences, and you can’t join two complete sentences with only a comma. Removing the comma, (J), or moving it to after “boy,” (G), creates a different sentence structure error—a run-on sentence—because there is no punctuation to join the two complete sentences. (H) is the only answer choice that correctly separates the two complete sentences at the right juncture.
31. (D) *English/Knowledge of Language/Style/Conciseness.* “This” is a demonstrative pronoun; it’s a pointing word. Adding “with that in mind,” (A), or “for the time being,” (B), needlessly refers again to what “this” already points to (in this case, the scene described in the previous sentence), so (A) and (B) can be eliminated. “Nevertheless” is a contrasting word, but there is no contrast being made and thus no need for this type of connecting word, so (C) is also wrong. The best choice is to let “this” do the pointing to the scene described on its own, (D).
32. (F) *English/Production of Writing/Strategy/Appropriate Supporting Material.* This question asks for the best wording to show that talkies put an end to silent movies. (G), (H), and (J) all introduce a new era or a description of a new era in film but don’t refer to the end of the silent movie era, so they are wrong. Only (F)’s wording describes the talkies ending silent movies.
33. (C) *English/Conventions of Standard English/Grammar and Usage/Pronoun Usage.* The problem with the original usage is that the pronoun “whom” is only used to refer to a direct object. (B) is wrong for the same reason and it makes the additional error of referring to Foley again as “himself.” The use of “he” in (D) creates a repetitive subject in “Foley” and “he,” so it is also wrong. “Foley” is the subject, not the direct object, in the sentence, so “who” is the correct pronoun, (C).
- TIP** *A good trick to figuring out when to use “who” and when to use “whom” is to phrase a question and then figure out if the answer is “he” or “she,” or “him” or “her.” For example, in question 33, if you asked, “Who figured out that squeezing a sock full of cornstarch was a sound like that of footsteps in the snow?” the answer would be “He did,” therefore, “who” is needed. When the answer is “him” or “her,” “whom” is needed.*
34. (H) *English/Conventions of Standard English/Sentence Structure/Fragments.* The sentence, as written, is missing a verb, which makes it an incomplete sentence or a fragment, and fragments cannot stand alone; they must be attached to a complete sentence. While (G) and (J) add the missing verb, they also add

either the function word “which” or the preposition “to,” neither of which correct the fragment. The only answer choice that adds the missing verb to make the sentence complete is (H).

35. **(C) English/Conventions of Standard English/Grammar and Usage/Diction.** All answer choices use verbs that are similar in meaning, so to determine the best answer, the context needs to be analyzed. Here, Foley works on either an “elusion,” “illusion,” or “allusion.” Understanding that he could only create an “illusion,” or a deceptive perception, rather than an “allusion” (historical reference) or “elusion” (act of hiding something), quickly eliminates all choices besides (C). However, the words “generate,” “produce,” “create,” and “make” also provide clues to the correct answer. “Generate” means “to cause,” and Foley isn’t causing an allusion, so (A) is wrong. Produce means “to manufacture,” the same meaning as “make.” “Create” also has a similar meaning. However, “produce” and “make” refer more to making something physical in structure, while “create” refers to imagination or creativity in the abstract form, which is needed to create an allusion, and thus makes more sense in this context, so (C) remains the best answer.
36. **(J) English/Conventions of Standard English/Sentence Structure/Fragments.** The problem with the sentence as written is that it is a fragment. (G) and (H) are guilty of the same error and are needlessly wordy. Removing “that” before “eventually” fixes the problem and makes the sentence complete, (J).
37. **(D) English/Production of Writing/Strategy/Appropriate Supporting Material.** While earlier in the paragraph the author refers to different ways that Foley created sound, by this point the author has already shown that Foley’s methods made him a Hollywood legend, so it isn’t logical to refer back to the cane or Foley’s process, (B) and (C). It also doesn’t make sense to refer to talkies or movies with sound in general since this paragraph details Foley’s tactics, so (A) is also wrong. The best choice is to delete the sentence and let Foley’s Hollywood legend status act as a transition into the need for real-life sound clutter in the next paragraph.
38. **(F) English/Conventions of Standard English/Grammar and Usage/Verb Tense.** This sentence is correct as written. If you remove “from” from the sentence, it’s not clear where the “sound of clutter” comes from, so (H) and (J) are wrong. As for (G), both the paragraph and the passage are written in present tense, and “aroused” is the past tense verb of “arise,” which creates an incorrect shift in tense, so (G) is also wrong.
39. **(D) English/Production of Writing/Strategy/Appropriate Supporting Material.** In this paragraph, the author describes the role of sound in a film, and in this sentence in particular, a sound technician’s role is presented. If the parenthetical phrase is removed, the reader may assume that a Foley artist—whose role also deals with sound—is the same as a sound technician, (D). The parenthetical phrase doesn’t provide a description of the role of the sound technician, only that it is different than a Foley artist, so (A) can be eliminated. The phrase also doesn’t clarify the origin of the “Foley artist,” nor does it reference other occupations influenced by Foley, so both (B) and (C) are also wrong.
40. **(J) English/Conventions of Standard English/Sentence Structure/Faulty Parallelism.** The two previous sentences follow a distinct structure: article, noun, present participle. This sentence follows a similar structure, but the present participle is missing. For these sentences/ideas to be in parallel structure, the adjective must be added. (J) follows this structure and makes the sentence parallel. All other answer choices are either missing part of the needed structure or add additional parts to it.
41. **(B) English/Conventions of Standard English/Punctuation/Dashes.** Nonrestrictive clauses (clauses that aren’t necessary for the grammatical structure or meaning of the sentence) must be set off in matching punctuation. Here, the clause “a small room with a screen, a microphone, and countless props” describes the studio, but this description is not necessary to the sentence, and thus must be set off by matching punctuation. The punctuation used after the clause is an em dash, so the punctuation before must also be an em dash, (B). All other answer choices either use punctuation that does not match or removes the punctuation before the clause entirely.



42. (F) *English/Knowledge of Language/Vocabulary*. This question asks for the best word to describe the thousands of dollars the movie studio saved by using a Foley classic audible. “Unspeakable” means unable to be spoken, but the budget savings are clearly being talked about, so (G) can be eliminated. “Speechless” means “having nothing to say,” but a budget can’t be speechless because it would not normally have anything to say—it doesn’t talk—so (H) is also wrong. As for (J), “endless” here would mean that the budget savings never end, or have no limit, but because movies and thus budgets do end, this word isn’t logical either. “Untold” means “immeasurable” and makes the most sense here. Using a microphone and simple objects such as keys created immeasurable budget savings (as explained in the next sentence), (F).
43. (C) *English/Conventions of Standard English/Sentence Structure/Run-On Sentences*. In this sentence, the clause “an army’s worth” describes how many actors and horses the director planned to ship. However, this clause is not necessary to the grammatical structure and meaning of the sentence, and thus should be set off in matching punctuation. Because a comma is used to introduce the clause, a comma must follow it. (A) and (D) can quickly be eliminated as they don’t include the necessary comma. While (B) does add the comma, the addition of “were headed to” creates a different error. Adding another verb phrase makes the sentence incomplete. Additionally, “were headed to” is redundant, since the director already planned to ship the actors and horses somewhere. The only answer choice that includes the requisite comma after the clause and doesn’t introduce any additional errors is (C).
44. (G) *English/Production of Writing/Strategy/Effective Concluding Sentence*. The last sentence provides an explanation for Foley’s impact on movies’ budgets without taking away from movies’ effects: His innovations with sound saved money, which helped the movie studios, and the viewers didn’t know the difference. This statement shows the impact that Foley’s work—the main idea of the passage—had on multiple audiences, (G). Because the passage needs a concluding sentence and the detail about the director doesn’t conclude the passage’s main focus about Foley’s work, the last sentence cannot be removed, so (H) and (J) can quickly be eliminated. (F) is wrong because stating that the audiences didn’t know the difference in sound effects doesn’t suggest that they came to know about Foley.
45. (C) *English/Conventions of Standard English/Punctuation/Commas*. In this sentence, the phrase “[i]n her lab at Princeton University” is an introductory clause that must be set off with a comma. (D) removes this necessary comma and thus can quickly be eliminated. Appositives (phrases that rename someone or something) must also be set off in commas, but in this sentence “Bonnie Bassler” is not a renaming of “molecular biologist” as there is no article (“a” or “the”) before “molecular biologist.” Without an article, the reader needs to know which molecular biologist was leaning over petri dishes, so there should be no comma after “biologist” or “Bassler.” Both (A) and (B) include a comma in one of these places, so the best answer is (C).
46. (J) *English/Conventions of Standard English/Sentence Structure/Fragments and Punctuation/Semicolons*. The problem with the sentence as written is that “her face illuminated by an aquamarine glow” is a dependent clause, but a semicolon connects two independent clauses or complete sentences. (G) and (H) are guilty of a different sentence-structure error: The addition of the verb “is” makes the clause a complete sentence, and two complete sentences cannot be joined by only a comma; they also need a conjunction (and, but, or, yet, so) to avoid a comma splice. Only (J) correctly changes the semicolon to a comma and doesn’t add additional words which create additional errors.
47. (C) *English/Conventions of Standard English/Punctuation/Commas*. Non-essential or non-restrictive clauses—those that are not necessary for the sentence to be complete and grammatically correct—must be set off in matching punctuation, which, in this case, is commas. The problem with the original sentence is that “of bacteria” is part of the non-restrictive clause, so the comma must go after, not before it. (B) is guilty of the same error, even though it adds the needed comma after “bacteria,” and (D) removes the needed comma after “bacteria,” so it is also wrong. Only (C) correctly includes one comma after “bacteria”—where the non-restrictive clause ends.

48. (H) **English/Conventions of Standard English/Punctuation/Apostrophes.** An apostrophe at the end of a plural noun that ends in “s” indicates possession, so in the sentence, the apostrophe in “researchers” indicates that the researchers own or possess their discoveries. “Their” is a possessive pronoun, but since the apostrophe already shows possession, this pronoun is redundant, so both (F) and (G) are wrong. (G) also makes the additional error of moving the apostrophe before the “s” in “researcher’s,” incorrectly making it singular instead of plural. (J) removes all indications of possession, so it is also wrong. The only answer choice that removes redundancy and correctly shows that multiple researchers had discoveries that intrigued Bassler is (H).
49. (C) **English/Conventions of Standard English/Punctuation/Commas and Semicolons.** The last clause of the sentence, “a luminescent marine bacteria,” is a clause that describes the unfamiliar term that precedes it, “*Vibrio fischeri*.” This clause is not a complete sentence and thus cannot be joined to the previous independent clause with a semicolon, so (A) is wrong. While “which is” clarifies that the clause describes the unfamiliar term “*Vibrio fischeri*,” a comma is still needed to separate this dependent clause from the independent clause that precedes it, so (B) is also wrong. Additionally, the comma before the clause “a luminescent marine bacteria” will show that the clause describes its precedent, so including “which is” is redundant. (D) is wrong because it doesn’t connect the dependent clause to the previous sentence with any punctuation. (C) is the only answer choice that uses the appropriate punctuation (a comma) to connect the dependent clause to the sentence that precedes it without introducing any other errors.
50. (J) **English/Conventions of Standard English/Grammar and Usage/Verb Tense.** This question asks for the correct verb tense in the sentence, and this sentence—and the rest of the paragraph—is written in the present tense to describe the experiments. “Allowed” is past tense, so (F) is wrong; “would have allowed” is past perfect tense, so (G) is wrong; and “has allowed” is present perfect tense, so (H) is wrong. “Allow” or “allows” is the present tense verb of “allow,” (J).
51. (A) **English/Conventions of Standard English/Punctuation/Commas.** The clause “Once the bacteria have released a high enough concentration of autoinducer” is an introductory and dependent clause that must be connected by a comma to the complete sentence that follows, (A). Changing the comma to an em-dash incorrectly separates the clauses, making the logical progression of the sentence hard to follow, so (B) is wrong. Both (C) and (D) create sentence structure errors. (C) makes the dependent clause a fragment by making it its own sentence, and (D) removes the necessary punctuation to separate the clauses.
52. (G) **English/Production of Writing/Strategy/Effective Transitional Sentence.** This sentence asks for the best transitional phrase to open the paragraph. “On the contrary” introduces a contrasting idea, but this paragraph is about Bassler’s own experiment. Since the previous paragraph was about other researchers’ experiments, Bassler’s experiment is not a contrasting idea, so (F) is wrong. “Ordinarily” means “usually,” and “[n]amely” points to a specific example—neither of which is related to the move from other researchers’ experiments that Brassler studied as a student to her own experiment, so (H) and (J) are also wrong. Because Brassler studied the experiments described in the previous paragraph as a student, she “eventually” received her own lab to conduct her own experiments, (G).
53. (A) **English/Conventions of Standard English/Punctuation/Commas.** This sentence is correct as written. Adding a comma at any place in the clause “Bassler found evidence of a quorum sensing in a related bacterial species called *Vibrio harveyi*” separates essential elements of the sentence to logically follow the progression of the idea, and the only answer choice that doesn’t have an unnecessary comma is (A).
54. (J) **English/Knowledge of Language/Style/Tone.** The phrase “same neck of the woods” is an idiomatic expression to mean “in the same place or area,” and because the tone of this passage is more formal, idiomatic expressions are not appropriate. “Neighboring proximity,” (G), and “surrounding locale,” (H), are redundant phrases, as the second word means the same as the first word in each phrase, so both (G) and (H) are also wrong. The best way to succinctly say that the bacteria communicated with other species in the same area is “vicinity,” (J).



55. **(C) English/Conventions of Standard English/Grammar and Usage/Pronoun Usage.** This question asks for the pronoun that is not acceptable to point to bacteria that live in humans. “Ones” and “species” are general terms, but they still refer to bacteria that live in humans, and “those” is a demonstrative pronoun that points to specific bacteria, so (A), (B), and (C) are acceptable answers. “Them” is the third-person accusatory form of “they,” but the sentence isn’t accusing (or naming) bacteria in humans; it’s pointing to them as a specific bacteria, so it is not an acceptable alternative.
56. **(F) English/Conventions of Standard English/Grammar and Usage/Subject-Verb Agreement and Verb Tense.** This sentence asks for the correct verb to complete the clause. Here, the verb must match the subject in number, and because Bassler used information from her students to understand strains (plural) of bacteria, the verb must also be plural: “communicate,” (F). Both (G) and (H) not only are singular verb phrases, they also incorrectly change the verb tense, and (J) is also a singular verb, which does not match with the plural subject, so (J) is also wrong.
57. **(D) English/Knowledge of Language/Style/Conciseness.** This sentence says that the bacteria Bassler studied rely on quorum sensing to spread disease. Because the latter part of the sentence already says that the bacteria spread disease, adding the adjectival phrase “disease-spreading” before bacteria is redundant, so (A) is wrong. The demonstrative pronoun “these” points to the bacteria referenced in the previous sentence, which states that Bassler studied them, making the phrase “Bassler has studied” also redundant, so (B) is wrong. (C) is wrong for a similar reason: The demonstrative pronoun “these” points to the bacteria in the previous sentence, which states the bacteria is found in humans, so the phrase “that live in humans” is also redundant. The only answer choice that doesn’t repeat information is (D).
58. **(G) English/Conventions of Standard English/Grammar and Usage/Pronoun Usage.** The problem with the original is that “she” is not the correct pronoun for the sentence as it is an subjective pronoun and at this point in the sentence an object pronoun, not a subject, is needed. (G) and (H) are wrong because “them” is ambiguous here: To whom does “them” refer? (H) also makes the additional error of using the reflexive pronoun “herself.” Only (G) uses the object pronoun “her” and specifies the other object in the sentence, “her team.”
- TIP** *For questions that ask for correct pronoun usage, a good way to check for the correct answer is to substitute one or the other. For example, in the previous question, the choice was between “she” and “her.” Students can first read the sentence using only “she” and will quickly find that it is the wrong pronoun, but when they read the sentence using only “her,” they will hear that “her” is the right answer.*
59. **(B) English/Production of Writing/Strategy/Effective Concluding Sentence.** This question asks if the additional information the author is considering adding makes for an effective concluding sentence. The additional information says that Bassler’s team hopes to develop new methods of treating bacterial infections. Because the last paragraph explains that the bacteria Bassler focused on is found in humans, the additional material shows that the importance of her work is how her research could directly affect people, (B). The additional information clearly shows the importance of Bassler’s research, so (C) and (D) can quickly be eliminated, and the explanation provided in (A) is wrong because the previous sentences of the paragraph, not the additional material, show that the bacteria Bassler studies is found in humans.
60. **(G) English/Knowledge of Language/Style/Tone.** This question deals with the appropriate tone and language for the passage. “Creeping beneath” and “low-down alleys” are informal or idiomatic phrases that are not appropriate for this type of informational writing, so both (F) and (J) can be eliminated. As for (H), “submerged” means to “immerse” or “inundate” or to “be underwater”—none of which apply to subway lines, so it is also wrong. Only (G) eliminates the idiomatic expressions and uses the appropriate language to show that subways are underground.
61. **(D) English/Production of Writing/Strategy/Effective Transitional Sentence.** The problem with the original usage is that there is no result being introduced in the second sentence. There hasn’t been

enough information provided in the passage thus far to explain or introduce any result. At this early point in the passage, the second sentence also does not function as an example or as a second point, so both (B) and (C) are also wrong. The first sentence explained the need for a mapping system, and the best way to introduce the early system is simply to start with “[e]arly,” (D).

62. (H) *English/Production of Writing/Strategy/Appropriate Supporting Material*. This question asks for the best word or phrase to show the highest degree of failure of the early maps. Being “disappointing” in general, (G), and not “fully captur[ing],” (J) are general phrases that ultimately only say that the maps didn’t work, but don’t present any degree of failure, let alone the highest, so both answer choices can be eliminated. While saying that the maps “obscured” the heavily trafficked routes does show that subway passengers couldn’t see the heavily trafficked routes, which does indicate failure of the maps, “indecipherable” means “illegible” or “unable to be read,” which is worse than simply being concealed, so (H) is the best answer.
63. (C) *English/Production of Writing/Strategy/Appropriate Supporting Material*. The sentence the author is considering adding gives a general fact about the London Underground subway: It covers 250 miles of trackway. However, this paragraph is not covering general information and facts about London’s subway; it is focused on the problems with the early maps for the system, and this sentence does not support that focus, so both (A) and (B) are wrong. The sentence the author is considering adding also does not blur the actual focus of the paragraph, so (D) is also wrong; instead, the sentence is only loosely related to the focus of the paragraph, (C).
64. (G) *English/Conventions of Standard English/Grammar and Usage/Diction*. Here, the author is making a comparison between a stylistic outline of the routes and a true-to-life sketch. Beck created a stylistic outline rather “than” a true-to-life sketch, (G). “Besides” means “in addition to,” (F); “instead” means “in place of,” (H); and “into” involves movement to something, (J)—none of which show the needed comparison.
65. (C) *English/Conventions of Standard English/Sentence Structure/Problems of Subordination and Coordination and Punctuation/Semicolons*. A semicolon is used to join two complete sentences without a conjunction, but the problem with its use here is that what precedes the semicolon is not a complete sentence, so its use is not correct. (D) is guilty of the same error, just with a period instead of a semicolon. While (B) doesn’t commit any sentence structure errors, the addition of “and” disrupts the meaning of the sentence, since the first clause is dependent and thus does not need a conjunction to coordinate ideas. The only answer choice that doesn’t create any sentence structure or meaning errors and correctly joins the dependent clause to the independent clause is (C).
66. (J) *English/Knowledge of Language/Style/Conciseness*. The problem with the sentence as written is that it is needlessly wordy: The verb “had” is introduced earlier in the sentence to show what elements Beck’s map “had.” (G) and (H) commit the same error, just with different words, as “included” and “featuring” are synonyms for “had.” Only (J) correctly eliminates the repetition.
67. (A) *English/Conventions of Standard English/Grammar and Usage/Verb Tense*. This sentence starts in progressive tense, as indicated by the verb “[f]ocusing.” Therefore, the verb in the underlined portion must stay in progressive tense, which is correctly written as “to show,” (A). “Would show” is a conditional verb phrase, (B); “had shown” is past perfect tense, (C); and “showed” is past tense, (D). Using any of these verb phrases incorrectly shifts from the progressive tense the sentence starts with.
68. (F) *English/Production of Writing/Strategy/Appropriate Supporting Material*. This question asks for the best phrase to demonstrate the “simplest possible schema” for Beck’s map for subway passengers. The details of Beck’s irritation with maps do not help show the simplicity of his own map, so (G) can be eliminated. (H) states that his map is easy to use, and (J) simply states that his map is iconic, neither of which show how his map is simple. Only (F) provides language that demonstrates why Beck’s map was simple: He removed all references to city streets.



69. **(B) English/Conventions of Standard English/Grammar and Usage/Diction.** This section of the passage deals with the need for the London Passenger Transport Board to raise subway ridership and revenue and asks for the best word to show this need. While “rise” is close to “raise,” it has a different meaning. “Rise” means “to get up,” which does not show the needed relationship, so (A) can be wrong. “Enlarge” means to “make bigger,” and “upend” means to “turn something on its end,” and neither of these words demonstrate that need to raise ridership and revenue, so both (C) and (D) are also wrong. The best synonym to raise is “increase,” (B).
70. **(G) English/Conventions of Standard English/Sentence Structure/Misplaced Modifiers.** The problem with the sentence as written is that it is in the passive and not the active voice. (H) makes the same mistake, and (J) removes a needed verb for the sentence to be complete, so they are both wrong as well. Only (G) correctly moves the direct object to after the verb, and thus makes the correct change from passive to active voice.
71. **(B) English/Production of Writing/Organization/Sentence-Level Structure.** Sentence 5, where it is now, is awkwardly placed. It provides a detail about why the London Passenger Transport Board initially resisted Beck’s map, but at the end of the paragraph, it’s already been explained that his map was eventually a success. Placing it after Sentence 2 or 3 doesn’t correct the problem as both sentences also transition to the printing of Beck’s map and its success. The best place for Sentence 5 is directly after the statement about the board resisting Beck’s map, which would be after Sentence 1, (B).
72. **(H) English/Conventions of Standard English/Grammar and Usage/Pronoun Usage.** “It’s” with an apostrophe is a contraction for “it is,” which does not make sense in this sentence. Here, a possessive pronoun to refer to the map is needed, and “its” without an apostrophe is the correct singular possessive pronoun, (H). “Their” is a plural pronoun, but the referent is “map,” which is singular, so (G) is wrong, and adding an apostrophe after the “s” in “its” also attempts to create a plural possessive pronoun, but creates an additional error because “it” is a singular pronoun that cannot be made plural.
73. **(C) English/Conventions of Standard English/Punctuation/Commas.** The underlined phrase in this question, “diagrammatic approach to mapping” is not a dependent clause; it is a descriptive clause that describes Beck’s approach to mapping. Adding a comma anywhere in the clause or before or after it separates the description from the subject or the subject and the description from the verb—scenarios that disrupt the logical flow of the sentence. The only answer choice that doesn’t add commas that obscure the meaning of the sentence is (C).
74. **(J) English/Knowledge of Language/Style/Conciseness.** The demonstrative pronoun “this” points to something specific, but in this case, it’s not clear exactly what that something is, so “this” is too ambiguous and (F) is wrong. (G) adds a dependent clause, not just a subject, so it is also wrong. And, while (H) provides the correct subject, “Beck’s deceptively simple approach to mapping” is both needlessly wordy and incorrect, as Beck’s approach wasn’t “deceptive.” “Beck’s innovative method” is the most concise and correct way to specify what “this” should refer to.
75. **(B) English/Production of Writing/Organization/Passage-Level Structure.** The sentence the writer is considering adding references distances, so it should logically be placed in a section of the passage that also deals with distance. At Point A in Paragraph 1, early maps are being described, and there are no details to distance, so (A) can be eliminated. At Points C and D in Paragraph 4, the writer is moving to a conclusion, and because the sentence the author is considering adding deals with a specific fact about distances, which influenced the creation of Beck’s map that was earlier described, it isn’t logical to add this detail in the conclusion, so both (C) and (D) are wrong. In Paragraph 2, Beck’s map is introduced as a map that does not “represent actual distances between points.” Adding the additional sentence after this idea logically provides a reason why the map doesn’t represent distances, (B).

ACT MATHEMATICS TEST EXPLANATIONS

1. **(C) Mathematics/Geometry/Rectangles and Squares.** The area of the rectangular table, 100 ft^2 , is equal to the product of the width, 5 ft, and the length, l , so $100 = 5l \Rightarrow l = \frac{100}{5} = 20$ feet.
2. **(J) Mathematics/Statistics and Probability/Probability.** The question asks for the probability that a bill drawn at random from a wallet is a twenty-dollar bill if the wallet contains 2 five-dollar bills, 9 ten-dollar bills, and 5 twenty-dollar bills. The probability is equal to the ratio of the number of twenty-dollar bills, 5, to the total number of bills, $2 + 9 + 5 = 16$. Therefore, the probability is $\frac{5}{16}$.
3. **(E) Mathematics/Statistics and Probability/Counting Methods.** To determine the number of different possible costume combinations that can be made, multiply together the numbers of each costume piece: $(\text{number}_{\text{noses}})(\text{number}_{\text{lips}})(\text{number}_{\text{wigs}}) = (4)(3)(2) = 24$ clown costumes.
4. **(F) Mathematics/Number and Quantity/Rates and Proportions.** First, determine how many individual units of each supply remain, other than the 84 cookies, which are already individual units:

$$3 \cancel{\text{ boxes of pens}} \left(\frac{10 \cancel{\text{ pens}}}{\cancel{\text{ box}}} \right) = 30 \text{ pens}$$

$$4 \cancel{\text{ boxes of notebooks}} \left(\frac{5 \cancel{\text{ notebooks}}}{\cancel{\text{ box}}} \right) = 20 \text{ notebooks}$$

$$2 \cancel{\text{ boxes of envelopes}} \left(\frac{12 \cancel{\text{ envelopes}}}{\cancel{\text{ box}}} \right) = 24 \text{ envelopes}$$

$$4\frac{1}{2} \cancel{\text{ boxes of candy bars}} \left(\frac{10 \cancel{\text{ candy bars}}}{\cancel{\text{ box}}} \right) = 45 \text{ candy bars}$$

To determine how many packages can be made from the remaining supplies, divide each by the number required for a care package:

$$\frac{30 \cancel{\text{ pens}}}{5 \cancel{\text{ pens}} / \text{package}} = 6 \text{ packages}$$

$$\frac{20 \cancel{\text{ notebooks}}}{2 \cancel{\text{ notebooks}} / \text{package}} = 10 \text{ packages}$$

$$\frac{24 \cancel{\text{ envelopes}}}{3 \cancel{\text{ envelopes}} / \text{package}} = 8 \text{ packages}$$

$$\frac{84 \cancel{\text{ cookies}}}{12 \cancel{\text{ cookies}} / \text{package}} = 7 \text{ packages}$$

$$\frac{45 \cancel{\text{ candy bars}}}{5 \cancel{\text{ candy bars}} / \text{package}} = 9 \text{ packages}$$



The number of remaining pens limits the number of care packages that can still be completed to 6 packages.

5. **(C) Mathematics/Geometry/Solids.** Substitute the given values for height h , radius r , and π into the given formula for the volume of a right circular cone: $V = \frac{1}{3}\pi r^2 h = \frac{1}{3}\left(\frac{22}{7}\right)(6 \text{ inches})^2(28 \text{ inches}) = \frac{22(36)(4)}{3} = 22(12)(4) = 1,056$ cubic inches.
6. **(G) Mathematics/Geometry/Lines and Angles and Triangles/Properties of Triangles.** Every triangle has a total interior angle sum of 180° , so find the missing angle in triangle ABE : $28^\circ + 90^\circ + \angle ABE = 180^\circ \Rightarrow \angle ABE = 62^\circ$. Since $\angle ABE + \angle CBE = 180^\circ$, $62^\circ + \angle CBE = 180^\circ \Rightarrow \angle CBE = 118^\circ$.
7. **(B) Mathematics/Algebra and Functions/Manipulating Algebraic Expressions/Basic Algebraic Manipulations.** Add the polynomials by combining like terms: $0.1x^2 + 3x + 80 + 0.5x^2 - 2x + 60 = (0.1x^2 + 0.5x^2) + (3x - 2x) + (80 + 60) = 0.6x^2 + x + 140$.
8. **(H) Mathematics/Algebra and Functions/Evaluating, Interpreting, and Creating Algebraic Functions/Functions as Models.** Rather than translating the table data directly to a function, test the answer choices using easy values. For $t = 0$, $d = 15$, so check the answer choices, eliminating any in which $d(0)$ does not equal 15:
- F. $d(0) = t + 15 = 15$ ✓
 G. $d(0) = 3t + 12 = 12$ ✗
 H. $d(0) = 3t + 15 = 15$ ✓
 J. $d(0) = 15t + 3 = 3$ ✗
 K. $d(0) = 33t = 0$ ✗
- To choose between (F) and (H), check another easy value for t , such as $t = 1$, for which $d = 18$:
- F. $d(1) = t + 15 = 16$ ✗
- By the process of elimination, (H) must be correct. Indeed, $d(1) = 3t + 15 = 3(1) + 15 = 18$.
9. **(C) Mathematics/Number and Quantity/Percentages.** First, find the percentage that \$30 is of \$40 using the “is-over-of” equation for percentages: $\frac{\text{is}}{\text{of}} = \frac{\%}{100} \Rightarrow \frac{30}{40} = \frac{\%}{100} \Rightarrow \% = \frac{30(100)}{40} = 75\%$. Since the \$30 pants were 75% of the original \$40 price, the pants were $100\% - 75\% = 25\%$ off.
10. **(G) Mathematics/Number and Quantity/Basic Arithmetic Manipulations.** The value of an expression between absolute value symbols is always the nonnegative equivalent. Therefore, $|-6| - |7 - 41| = 6 - |-34| = 6 - 34 = -28$.
11. **(C) Mathematics/Algebra and Functions/Solving Simultaneous Equations and Evaluating, Interpreting, and Creating Algebraic Functions/Functions as Models.** Begin by creating an equation to represent the combined value of the shares of stock, where n represents the price per share:

$$70n + 50n + 40n = \$6,880 \Rightarrow 160n = \$6,880 \Rightarrow n = \frac{\$6,880}{160} = \$43. \text{ Therefore, the value of Samantha's 70}$$

$$\text{shares is } 70 \text{ shares} \left(\frac{\$43}{\text{share}} \right) = \$3,010.$$

12. (G) **Mathematics/Number and Quantity/Properties of Numbers.** According to the information given in the item stem, the allowed ages are “at least 18” and “less than 30.” Therefore, the correct number line will include the value 18 (filled circle) but not the value 30 (empty circle) and include all values in between 18 and 30, as represented by the number line in (G).
13. (D) **Mathematics/Geometry/Triangles/Properties of Triangles.** To find the length of \overline{AC} , first determine the length of \overline{EC} . The three corresponding sides of $\triangle ADE$ and $\triangle ABC$ are proportional, so the triangles are similar and the three corresponding angles are congruent. Create a proportion between ratios of corresponding sides in $\triangle ADE$ and $\triangle ABC$: $\frac{\overline{AD}}{\overline{AB}} = \frac{\overline{AE}}{\overline{AC}} \Rightarrow \frac{6}{6+5+4} = \frac{12}{\overline{AC}} \Rightarrow \overline{AC} = \frac{12(15)}{6} = 30$. Therefore, $\overline{AC} = 30$.
14. (G) **Mathematics/Number and Quantity/Common Arithmetic Items/Properties of Numbers.** Simplify the given radical: $\frac{\sqrt{50}}{2} = \frac{\sqrt{25(2)}}{2} = \frac{5\sqrt{2}}{2}$. Since $\sqrt{2} \approx 1.414$, $\frac{5\sqrt{2}}{2} \approx 2.5(1.414) \approx 3.54$. Rounded to the nearest integer, the answer is 4.

TIP This is a perfect item to use your calculator to evaluate the given fraction directly: $\frac{\sqrt{50}}{2} \approx 3.5355 \approx 4$. It's very important to be familiar with the calculator you bring to the exam. Items such as this are ideal for calculator usage!

15. (D) **Mathematics/Algebra and Functions/Solving Simultaneous Equations and Evaluating, Interpreting, and Creating Algebraic Functions/Functions as Models.** Create a system of simultaneous equations, where x represents Jane's age and y represents her daughter's age. First, the ratio $x : y$ is equal to $9 : 2$, so $\frac{x}{y} = \frac{9}{2}$. And since the sum of the ages is 44, $x + y = 44$. The item stem asks for Jane's age, so solve the

$$\text{first equation for } x: \frac{x}{y} = \frac{9}{2} \Rightarrow x = \frac{9}{2}y. \text{ Solve the second equation for } y \text{ in terms of } x: x + y = 44 \Rightarrow$$

$y = 44 - x$. Finally, substitute this expression for y in the first equation and solve for x :

$$x = \frac{9}{2}y = \frac{9}{2}(44 - x) = 9(22) - \frac{9}{2}x \Rightarrow \frac{2}{2}x + \frac{9}{2}x = 198 \Rightarrow 11x = 198(2) \Rightarrow x = \frac{396}{11} = 36.$$

16. (H) **Mathematics/Number and Quantity/Basic Arithmetic Manipulations.** The sum of the fractions of the budget must equal 1, so if x represents the unknown fraction, $\frac{1}{9} + \frac{1}{6} + x =$

$$1 \Rightarrow x = 1 - \frac{1}{9} - \frac{1}{6} = \frac{18}{18} - \frac{2}{18} - \frac{3}{18} = \frac{13}{18}.$$



17. (A) **Mathematics/Algebra/Solving Algebraic Equations or Inequalities with One Variable/Equations Involving Rational Expressions.** This equation has rational expressions, so to solve for x , cross-multiply and simplify: $\frac{10}{10+x} = \frac{35}{42} \Rightarrow 10(42) = 35(10+x) \Rightarrow 420 = 350 + 35x \Rightarrow x = \frac{420 - 350}{35} = 2$.

TIP Alternatively, apply the “test-and-test” strategy. Substitute the values for x given in the answer choices in the equation given in the item stem. Only the correct value will yield a valid equality:

$$A. \quad x = 2: \quad \frac{10}{10+x} = \frac{35}{42} \Rightarrow \frac{10}{10+2} = \frac{35}{42} \Rightarrow \frac{10}{12} = \frac{35}{42} \Rightarrow \frac{5}{6} = \frac{5}{6} \quad \checkmark$$

Since the value in (A) works in the equation, don't bother testing the remaining choices. (A) must be the correct choice.

18. (J) **Mathematics/Geometry/Complex Figures and Triangles/Properties of Triangles.** The bottom of the rectangle has a length of 10 inches, so the missing length on the top of the rectangle is $10 - 4 = 6$ inches. The shaded region is comprised of two triangles, each with a height of 8 inches, one with a base of 4 inches and the other with a base of 6 inches. Therefore, the shaded area is equal to the sum of the two triangle areas, each of which is $\frac{(\text{base})(\text{height})}{2}$: $\text{area}_{\text{shaded}} = \frac{6(8)}{2} + \frac{4(8)}{2} = 3(8) + 2(8) = 24 + 16 = 40$ square inches.

19. (C) **Mathematics/Algebra and Functions/Solving Simultaneous Equations.** The first inequality states that x must be greater than 2, which eliminates (A) and (B). The second inequality states that y must be greater than 0, which eliminates (E). The third inequality states that the sum of x and y must be less than 5, which eliminates (D) and confirms that (C) is correct. The ordered pair (3,1) satisfies all three inequalities.

20. (H) **Mathematics/Algebra and Function/Expressing and Evaluating Algebraic Functions/Concepts of Domain and Range.** At first, this question seems at first to be about trigonometry, because the graphed function is trigonometric, but it's really much simpler than that: what is the range of y ? In the graph, the minimum y -value of the function is greater than -3 but less than 0, so eliminate (F), (J), and (K). The maximum y -value of the function is greater than 6, which eliminates (G), so (H) must be correct.

21. (D) **Mathematics/Algebra and Functions/Evaluating, Interpreting, and Creating Algebraic Functions/Function Notation.** Substitute -3 for x in the given function $g(x)$ and evaluate: $g(-3) = x^2 - 4 = (-3)^2 - 4 = 9 - 4 = 5$. Now, substitute 5 for x in the given function $f(x)$: $f(5) = 2x + 1 = 2(5) + 1 = 11$.

TIP When you are evaluating expressions, equations, and functions, make sure you use the correct order of operations. An easy way to remember the order is Please Excuse My Dear Aunt Sally: Parentheses, Exponents, Multiplication and Division, Addition and Subtraction.

22. (G) **Mathematics/Algebra and Functions/Solving Simultaneous Equations and Evaluating, Interpreting, and Creating Algebraic Functions/Functions as Models.** Create a system of equations to represent the given scenario. Let x represent the cost per yard of flannel and y represent the cost per yard of calico. Since 3 yards of flannel and 4 yards of calico cost \$25, $3x + 4y = 25$. And since 1 yard of flannel and 2 yards of calico cost \$11, $x + 2y = 11$. The item stem asks for the price of 1 yard of calico, y , so solve the system of equations for y by eliminating x :

$$\begin{array}{r} 3x + 4y = 25 \\ + \quad -3(x + 2y = 11) \\ \hline 3x - 3x + 4y - 6y = 25 - 33 \Rightarrow -2y = -8 \Rightarrow y = 4 \end{array}$$

Therefore, the price per yard of calico fabric is \$4.

23. **(C) Mathematics/Statistics and Probability/Measures of Center.** The median of a set of numbers is the middle value when the numbers are arranged in ascending or descending order (or the average of the two middle values if the set has an even number of values). Start by arranging the data set in ascending order:

71, 77, 78, 80, 86, 88, 88, 94, 94, 94

Now, it's easy to see that the two middle values are 86 and 88. Therefore, the median of the data set is the average of 86 and 88: 87.

TIP *If taking the paper-and-pencil ACT, rather than wasting valuable testing time rewriting the list of values in ascending order, mark off the least and greatest values in pairs until only the two middle values remain (since there is an even number of data values). The median is the average of the two middle values.*

24. **(H) Mathematics/Algebra and Functions/Solving Algebraic Equations or Inequalities with One Variable/Simple Equations and Evaluating, Interpreting, and Creating Algebraic Functions/Functions as Models and Geometry.** Opposite sides of a parallelogram are equal in length and the perimeter is equal to the sum of the sides, so $84 = 2(16) + 2x$, where x represents the unknown side length. Therefore,

$$x = \frac{84 - 32}{2} = 26 \text{ and the other three side lengths, in inches, are 16, 26, and 26.}$$

25. **(E) Mathematics/Number and Quantity/Basic Arithmetic Manipulations and Geometry/Rectangles and Squares.** This item isn't really a geometry problem but a fraction problem: what fraction of the total area of rectangle $ABCD$, which is 1 square unit, is the area of the shaded region? The total number of squares in rectangle $ABCD$ is $6(4) = 24$ and the total number of squares in the shaded region is $3(5) = 15$.

Therefore, the area, in square units, of the shaded region is $\frac{15}{24}$. Carry out the multiplications in the

answer choices to find the one that equals $\frac{15}{24}$:

- A. $\frac{1}{6} \left(\frac{1}{4} \right) = \frac{1}{24}$ ✗
- B. $\frac{1}{6} \left(\frac{3}{4} \right) = \frac{3}{24}$ ✗
- C. $\frac{1}{6} \left(\frac{5}{6} \right) = \frac{5}{36}$ ✗
- D. $\frac{5}{6} \left(\frac{1}{4} \right) = \frac{5}{24}$ ✗
- E. $\frac{5}{6} \left(\frac{3}{4} \right) = \frac{15}{24}$ ✓



26. (G) *Mathematics/Statistics and Probability/Probability and Algebra and Functions/Creating, Interpreting, and Evaluating Algebraic Functions/Functions as Models.* The probability of pulling a red marble after x additional red marbles have been added is represented by the equation

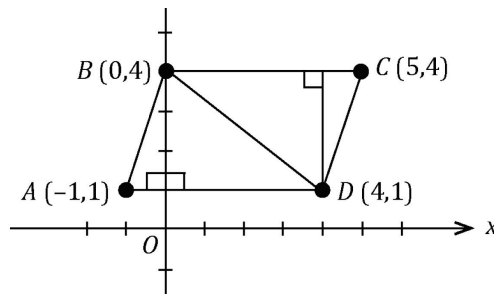
$$\frac{16+x}{16+x+7+19} = \frac{3}{5}. \text{ Solve the equation for } x: 5(16+x) = 3(42+x) \Rightarrow 80+5x = 126+3x \Rightarrow 2x = 46 \Rightarrow x = 23.$$

27. (E) *Mathematics/Algebra and Functions/Manipulating Algebraic Expressions/Manipulating Expressions Involving Exponents.* Recall the rule for negative exponents: $a^{-n} = \frac{1}{a^n}$. Therefore, $a^{-2} = \frac{1}{a^2}$.

28. (F) *Mathematics/Geometry/Triangles/Properties of Triangles.* If $\triangle MNP$ is a counterexample to the rule that a triangle in Set A is not isosceles, then $\triangle MNP$ must both be in Set A and isosceles.

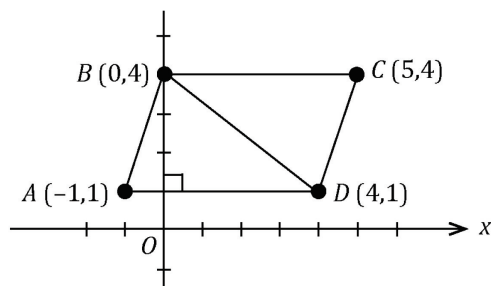
29. (D) *Mathematics/Geometry/Complex Figures and Triangles/Properties of Triangles and Rectangles and Squares.* If you remember the formula for the area of parallelogram, apply it:
 $\text{area}_{\text{parallelogram}} = (\text{base})(\text{height}) = (4 - (-1))(4 - 1) = (5)(3) = 15$ square coordinate units.

TIP Even if you forgot the formula for the area of a parallelogram, you can still find the area by deconstructing the parallelogram into two triangles and a rectangle:



The total area of the parallelogram is $\frac{(0 - (-1))(4 - 1)}{2} + \frac{(5 - 4)(4 - 1)}{2} + (4 - 0)(4 - 1) = \frac{1(3)}{2} + \frac{1(3)}{2} + 4(3) = 3 + 12 = 15$ square coordinate units.

30. (H) *Mathematics/Geometry/Triangles/Pythagorean Theorem.* The distance from B to D corresponds to the hypotenuse of a right triangle:

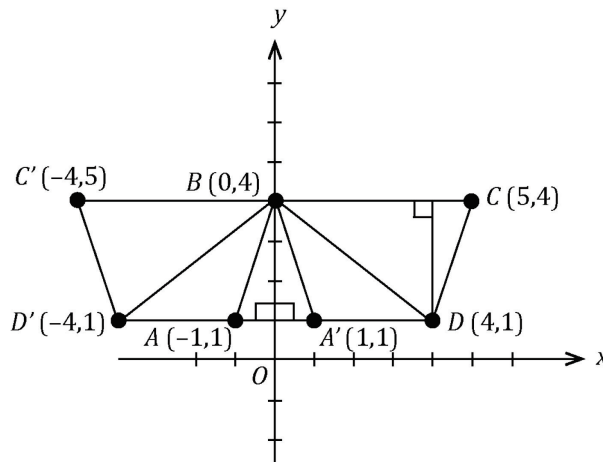


Use the Pythagorean theorem to determine the length of \overline{BD} : $\overline{BD}^2 = (4 - 0)^2 + (4 - 1)^2 = 4^2 + 3^2 = 16 + 9 = 25 \Rightarrow \overline{BD} = \sqrt{25} = 5$.

31. (A) **Mathematics/Algebra and Functions/Coordinate Geometry/Slope of a Line.** The slope of \overline{BC} is equal to the rise over run, or the ratio of the change in y to the corresponding change in x . However, \overline{BC} is a horizontal line, so the slope is equal to zero because all points on the line have the same y -coordinate. As a result, the change in y is zero, which makes the slope equal to zero.

TIP *On the other hand, vertical lines have undefined slope because all points on the line have the same x -coordinate. As a result, the change in x is zero, and a fraction with a denominator equal to zero is undefined, which makes the slope undefined.*

32. (J) **Mathematics/Algebra and Functions/Coordinate Geometry/The Coordinate System.** To reflect the figure across the y -axis, the y -coordinate of each coordinate pair remains the same, but the x -coordinate is transformed into its opposite sign:



Therefore, the coordinates of the image of A, which originally were $(-1,1)$, are $(1,1)$.

33. (A) **Mathematics/Number and Quantity/Properties of Numbers.** Rewrite the 8 as $(2)(2)(2)$ and take the square root of the 4: $8^2(4^{0.5}) = ([2][2][2])^2(\sqrt{4}) = ([2][2][2])([2][2][2])(2) = 2^7$.
34. (K) **Mathematics/Number and Quantity/Rates and Proportions.** To find the total number of applicants (accepted and not accepted), create a proportion and solve for the missing quantity:

$$\frac{2 \text{ accepted}}{630 \text{ accepted}} = \frac{7 \text{ applicants}}{x \text{ applicants}} \Rightarrow x = \frac{7(630)}{2} = 2,205$$
 Subtract the number of accepted applicants from the total number of applicants to find the number NOT accepted: $2,205 - 630 = 1,575$.
35. (B) **Mathematics/Algebra and Functions/Manipulating Algebraic Expressions/Logarithmic Expressions.** The logarithmic function $y = \log_a x$ is defined to be equivalent to the exponential equation $x = a^y$. If the a subscript is not included, it is presumed to be 10. In this case, the a subscript is 2. So, $y = \log_2 \sqrt{8}$ is equivalent to the exponential equation $\sqrt{8} = 2^y$. To solve this equation for y , rewrite $\sqrt{8}$ as $\sqrt{4(2)} = 2\sqrt{2}$. Therefore, $2(2)^{\frac{1}{2}} = 2^y \Rightarrow 2^{\frac{3}{2}} = 2^y$ and $y = \frac{3}{2}$.
36. (F) **Mathematics/Number and Quantity/Rates and Proportions and Geometry/Circles.** According to the item stem, the remainder of the circle graph is split evenly between three sectors. Since there are 90 students and 15 chose peach, $90 - 15 = 75$ students are split evenly between apples, bananas, and



strawberries: each of these sectors has $\frac{75}{3} = 25$ students. Create a proportion between the ratio of students who chose bananas to the total number of students and the ratio of the central angle measure x of the banana sector to 360° , the full measure of a circle, and solve for x : $\frac{25}{90} = \frac{x}{360^\circ} \Rightarrow$

$$x = \frac{360^\circ(25)}{90} = 100^\circ.$$

- 37. (E) Mathematics/Algebra and Functions/Manipulating Algebraic Expressions/Basic Algebraic Manipulations.** To add the two fractions, use the “flying x ” strategy for combining fractions:

$$\frac{4}{5} + \frac{7}{x} = \frac{4x + 7(5)}{5x} = \frac{4x + 35}{5x}.$$

TIP Recall the “flying x ” strategy for combining fractions, so called because the “ $\frac{a}{b} \times \frac{c}{d}$ ”, which shows the multiplication steps, looks like an x flying above the ground:

$$\frac{a}{b} + \frac{c}{d} = \frac{a}{b} \times \frac{c}{d} = \frac{ad + cb}{bd}$$

- 38. (K) Mathematics/Statistics and Probability/Data Representation/Tables.** The item stem asks what fraction of nonstudent residents replied that they disapproved of the change in hours:

$\frac{\text{\# nonstudents disapprove}}{\text{total \# nonstudents}}$. According to the table, the total number of nonstudents is

$85 + 353 + 47 = 485$ and the number of nonstudents that disapprove is 353. Therefore,

$$\frac{\text{\# nonstudents disapprove}}{\text{total \# nonstudents}} = \frac{353}{485}.$$

- 39. (D) Mathematics/Statistics and Probability/Probability.** The probability that a randomly chosen resident will NOT be a high school student and will NOT have replied with no opinion is equal to the fraction $\frac{\text{total \# college and nonstudents approve/disapprove}}{560 \text{ residents}}$. According to the table, $14 + 10 = 24$ college

students approved or disapproved and $85 + 353 = 438$ nonstudents approved or disapproved.

Therefore, $\frac{\text{total \# college and nonstudents approve/disapprove}}{560 \text{ residents}} = \frac{24 + 438}{560} = \frac{462}{560} = 0.825 \approx 0.83$.

- 40. (H) Mathematics/Number and Quantity/Percentages and Solving Algebraic Equations or Inequalities with One Variable/Simple Equations and Evaluating, Interpreting, and Creating Algebraic Functions/Functions as Models.** After the 15 residents who approved are correctly identified as students (high school or college) rather than nonstudents, 60% of college students replied that they approved. Let x represent the additional college students who approve (out of the 15), so

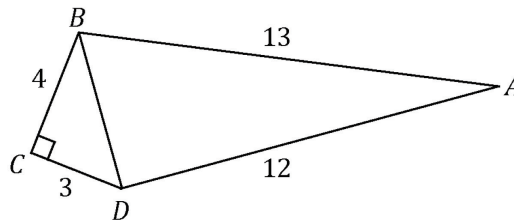
$$60\% = 0.6 = \frac{\text{\# college students approve}}{\text{total \# of college students}} = \frac{14 + x}{14 + x + 10 + 6}. \text{ Solve for } x: 0.6 = \frac{14 + x}{30 + x} \Rightarrow$$

$0.6(30 + x) = 14 + x \Rightarrow 18 + 0.6x = 14 + x \Rightarrow 4 = 0.4x \Rightarrow x = 10$. This means $15 - 10 = 5$ of the additional

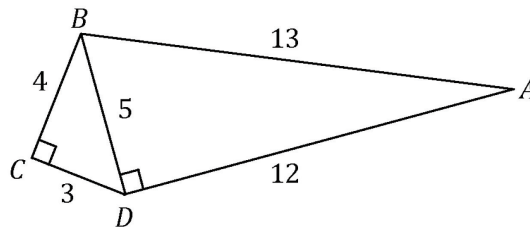
students who approve are high school students. Therefore, $\frac{\text{\# high school students approve}}{\text{total \# of high school students}} =$

$$\frac{30 + 5}{30 + 5 + 4 + 11} = \frac{35}{50} = 0.7 = 70\%.$$

41. (A) **Mathematics/Statistics and Probability/Measures of Center.** If all the numbers except one are the same in the two sets, and the remaining value in Set B is greater than the remaining value in Set A, the median will remain the same for both sets: when the sets are arranged in order of value, the middlemost value will still be one of the four identical values. Each set is made up of 5 distinct numbers, implying the sets have no mode. However, the mean (average) of the set with the smaller least value will be less than the mean of the set with the larger least value. Therefore, the mean must be greater for Set B than for Set A.
42. (G) **Mathematics/Geometry/Trigonometry/Trigonometric Relationships and Graphs of Trigonometric Functions.** The odd/even trigonometric identities state that $\sin(-x^\circ) = -\sin x^\circ$ and $\cos(-x^\circ) = \cos x^\circ$. Therefore, (G) must be the correct choice because $\sin(-x^\circ) \neq \sin x^\circ$. This also proves that (F) is wrong because $-\sin(-x^\circ) = -(-\sin x^\circ) = \sin x^\circ$. The cofunction identities state that $\sin(90 - x)^\circ = \cos x^\circ$ and $\cos(90 - x)^\circ = \sin x^\circ$, so (H) is wrong. Furthermore, $\cos(-x^\circ) = \cos x^\circ$, so $\cos(-(90 - x)^\circ) = \cos(x - 90^\circ) = \cos(90 - x)^\circ$, which we already showed equals $\sin x^\circ$, so (J) is wrong. Finally, from the Pythagorean identity $(\sin x^\circ)^2 + (\cos x^\circ)^2 = 1$, $\sin x^\circ = \sqrt{1 - (\cos x^\circ)^2}$, so (K) is wrong.
43. (D) **Mathematics/Geometry/Solids.** The volume of the smallest square box that can hold the pie has the same width and length as the diameter of the pie: 8 inches. Therefore, the volume of the box is (width)(length)(height) = (8 inches)(8 inches)(3 inches) = 192 cubic inches.
44. (G) **Mathematics/Geometry/Trigonometry/Definitions of the Six Trigonometric Functions and Triangles/Pythagorean Theorem.** The trick to solving this item is to draw a hypotenuse for $\triangle BCD$ from B to D:



Since the legs of right triangle $\triangle BCD$ are 3 and 4, $\triangle BCD$ is a 3-4-5 triangle. And since 5-12-13 is also a Pythagorean triple, $\triangle ABD$ is also a right triangle:



Therefore, $\tan A = \frac{\text{side opposite } A}{\text{side adjacent } A} = \frac{5}{12}$.

TIP Recall that Pythagorean triples consist of three positive integers a , b , and c , such that $a^2 + b^2 = c^2$. The name is derived from the Pythagorean theorem, which states that every right triangle has side lengths satisfying the formula $a^2 + b^2 = c^2$. So, Pythagorean triples describe the three integer side lengths of a right



triangle. Common Pythagorean triples include 3-4-5, 5-12-13, 7-24-25, 9-40-41, and any integer multiple of these.

TIP Remember the definitions of sine, cosine, and tangent using the mnemonic SOH-CAH-TOA:

$$\text{Sine} = \frac{\text{Opposite}}{\text{Hypotenuse}}; \text{Cosine} = \frac{\text{Adjacent}}{\text{Hypotenuse}}; \text{and Tangent} = \frac{\text{Opposite}}{\text{Adjacent}}.$$

45. (D) **Mathematics/Number and Quantity/Basic Arithmetic Manipulations.** There are seven days in a week, so divide 200 by 7: the remainder will be the number of days before Tuesday that the day of the week was 200 days ago. Divide using long division:

$$\begin{array}{r} 28 \\ 7 \overline{) 200} \\ \underline{-14} \\ 60 \\ \underline{-56} \\ 4 \end{array}$$

Now, count back from Tuesday the remaining 4 days: Monday, Sunday, Saturday, Friday. Therefore, the day of the week 200 days before Tuesday was Friday.

46. (G) **Mathematics/Geometry/Lines and Angles.** Vertical angles created by two intersecting lines are equal, so $\angle 1 = \angle 2 \Rightarrow 3x - 10 = 2x + 10 \Rightarrow x = 10 + 10 = 20$. And the total number of degrees in a straight line is 180° and a right angle has 90° , so $\angle 3 + 90^\circ + \angle 1 = 180^\circ \Rightarrow \angle 3 = 180^\circ - 90^\circ - \angle 1 = 90^\circ - (3x - 10)^\circ = 90^\circ - 3(20)^\circ + 10^\circ = 40^\circ$.

47. (E) **Mathematics/Number and Quantity/Properties of Numbers.** According to the item stem, the GCF of two whole numbers is 10 and the LCM of these same 2 numbers is 120. First, check the two numbers given in each answer choice to determine if the GCF of the two numbers is 10:

- A. 6 and 20: 6 is not divisible by 10 ✗
- B. 10 and 12: 12 is not divisible by 10 ✗
- C. 10 and 20: both are divisible by 10 and there is no greater common factor of the two ✓
- D. 20 and 60: both are divisible by 10, but 20 is a greater common factor of the two ✗
- E. 30 and 40: both are divisible by 10 and there is no greater common factor of the two ✓

To choose between (C) and (E), check whether the LCM of the two numbers in each is 120:

- C. 10 and 20: the least common multiple of 10 and 20 is 20 ($2[10] = 20$ and $1[20] = 20$) ✗
- E. 30 and 40: the least common multiple of 30 and 40 is 120 ($4[30] = 120$ and $3[40] = 120$) ✓

TIP The greatest common factor (GCF) is the greatest factor that divides two integers. To find the GCF of two integers, list the prime factors of each and multiply the factors that both integers have in common. If there are no common prime factors, the GCF is 1. The least common multiple (LCM) is the smallest positive integer that is divisible by two integers.

48. (H) **Mathematics/Geometry/Triangles/Pythagorean Theorem and Properties of Triangles.** Test whether the triangle is a right triangle by applying the Pythagorean theorem, where the hypotenuse is equal to the longest side: $4^2 + 5^2 \stackrel{?}{=} 7^2 \Rightarrow 16 + 25 \stackrel{?}{=} 49 \Rightarrow 41 < 49$. Since the sum of the squares of the legs is less than the square of the hypotenuse, the triangle is obtuse, which eliminates (F), (G), and (K). To choose

between (H) and (J), recall the definitions of scalene and isosceles. A scalene triangle has three unequal sides, whereas an isosceles triangle has only two equal sides. Since all three side lengths are different (4, 5, and 7), the triangle is scalene obtuse.

TIP To determine if a triangle is right, acute, or obtuse, apply the Pythagorean theorem, where the hypotenuse is equal to the longest side length. If $a^2 + b^2 = c^2$, the triangle is right; if $a^2 + b^2 > c^2$, the triangle is acute; and if $a^2 + b^2 < c^2$, the triangle is obtuse. This can be seen by looking at an equilateral triangle, with side lengths of 5: $5^2 + 5^2 = 5^2 \Rightarrow 50 > 25$. Since equilateral triangles are acute, when the sum of the squares of the legs of a triangle is greater than the square of the hypotenuse, the triangle is acute.

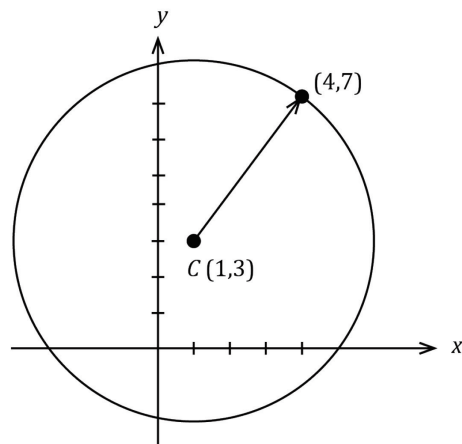
49. **(D) Mathematics/Statistics and Probability/Probability.** Since the outcome of Saturday’s game does not affect the outcome of Sunday’s game, the two events are independent. To find the probability of two independent events, multiply the probability of the first event by the probability of the second event. The probability of losing Saturday’s game is $100\% - 60\% = 40\%$ and the probability of losing Sunday’s game is $100\% - 35\% = 65\%$. Therefore, the probability of losing both games is $(0.4)(0.65) = 0.26 = 26\%$.

50. **(J) Mathematics/Algebra and Functions/Expressing and Evaluating Algebraic Functions/Concepts of Domain and Range.** This question asks for the domain of the given function $f(x)$, which is also shown in a graph. Even if you forget whether x -values or y -values correspond to domain or range, the answer choices tell you: the domain corresponds to the valid x -values of the function. You can see from the graph that the x values extend from both directions towards $x = -1$, but never actually reach it. Also, the empty circle at $x = 3$ indicates that this value isn’t part of the domain either. Therefore, the domain of $f(x)$ is all values of x except -1 and 3 : $\{x \mid x \neq -1 \text{ and } x \neq 3\}$.

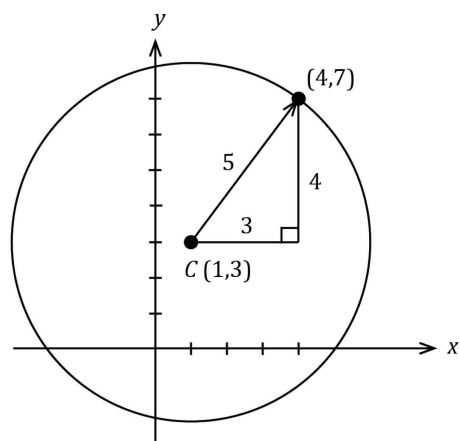
TIP This item can also be solved by factoring the denominator of the function $f(x)$ to find the values of x that make the function undefined due to division by zero: $\frac{x-3}{x^2-2x-3} = \frac{x-3}{(x-3)(x+1)}$. Since $x = 3$ and $x = -1$ both result in division by zero, the domain of $f(x)$ does not include these values for x .

51. **(E) Mathematics/Statistics and Probability/Counting Methods.** The fundamental rule of counting applies here: multiply the number of outcomes possible for each event together to get the total number of possible outcomes. There are four events—the last four digits in the phone number—each of which can have 10 possible outcomes (0 through 9). Therefore, the total number of possible outcomes is $(10)(10)(10)(10) = 10^4$.

52. **(F) Mathematics/Algebra and Functions/Coordinate Geometry/Graphs of Quadratic Equations and Relations.** To help conceptualize the problem, draw a sketch of the described circle in the coordinate plane:



Note that the point $(4,7)$ is 3 coordinates to the right of the center and 4 coordinates up from the center, which creates a 3-4-5 triangle with a hypotenuse equal to the line segment between the center and the point $(4,7)$:



Therefore, the radius of the circle is 5 units and all the points on the circle are at a distance of 5 coordinate units from the center at $(1,3)$.

53. **(B) Mathematics/Algebra and Functions/Manipulating Algebraic Expressions/Logarithmic Expressions.** This question is really asking for the value of x that makes $\ln(x-2)+3$ equal to 7: solve $\ln(x-2)+3=7$ for x . Recall that the logarithmic function $y = \log_a x$ is defined to be equivalent to the exponential equation $x = a^y$. And the natural logarithm of a number is its logarithm to the base of the mathematic constant e : $y = \ln x = \log_e x$, which is the equivalent of $x = e^y$. Therefore,
- $$\ln(x-2)+3=7 \Rightarrow \ln(x-2)=4 \Rightarrow x-2=e^4 \Rightarrow x=e^4+2.$$
54. **(F) Mathematics/Algebra and Functions/Coordinate Geometry/Qualitative Behavior of Graphs of Functions and Slope of a Line.** According to the item stem, the three copy machines copy at the same rate, which corresponds to a given number of copies per time interval. Note that the slope of this function $n(t)$ at any particular point is equivalent to number of copies per time interval. So, from 8 a.m. to 10 a.m., when all three machines are copying, the slope of the function should be at its greatest. Then, at 10 am to 12 pm, only Machines B and C are copying, so the slope is less. At 12 pm, the slope again

decreases as Machine B stops copying, but at 1 pm, the slope increases again when Machine A starts copying again. At 3 pm, the slope increases again when Machine B starts copying again, and this same slope continues until 5 pm. The only graph that matches these changes in slope is (F).

55. (E) *Mathematics/Number and Quantity/Basic Arithmetic Manipulations.* The simplest approach to this problem is to start with the revenue for 40 caps at \$22 per cap and then calculate the revenue for every \$1 decrease in price and 4 cap increase in sales until the revenue peaks and then decreases again. Revenue R is equal to the product of the price per cap and the number of caps:

$$R(\$22) = 22(40) = \$880$$

$$R(\$21) = 21(44) = \$924$$

$$R(\$20) = 20(48) = \$960$$

$$R(\$19) = 19(52) = \$988$$

$$R(\$18) = 18(56) = \$1,008$$

$$R(\$17) = 17(60) = \$1,020$$

$$R(\$16) = 16(64) = \$1,024$$

$$R(\$15) = 15(68) = \$1,020$$

The revenue decreases from the maximum when the price reaches \$15 per cap. Therefore, the maximum possible revenue for 1 week is \$1,024.

56. (K) *Mathematics/Algebra and Functions/Coordinate Geometry/Graphs of First-Degree Inequalities.* Solve the given inequality for y : $ax + by \leq c \Rightarrow y \leq \frac{-ax + c}{b} \Rightarrow y \leq -\frac{a}{b}x + \frac{c}{b}$. Since both a and b are greater than 0, the slope of the line $y = -\frac{a}{b}x + \frac{c}{b}$ is negative—it will decrease from left to right, which eliminates (F). And since y is less than or equal to the line, eliminate (G) and (H). To choose between (J) and (K), note that the y -intercept of the line is $y(0) = \frac{c}{b}$. Since both c and b are greater than 0, the y -intercept is greater than 0, and the correct graph is (K).

57. (A) *Mathematics/Number and Quantity/Rates and Proportions.* Calculate the number of yards of blue material and white material needed for 500 banners: $500 \text{ banners} \left(\frac{\frac{1}{4} \text{ yd. blue}}{\text{banner}} \right) = 125 \text{ yards of blue}$

material and $500 \text{ banners} \left(\frac{\frac{3}{8} \text{ yd. blue}}{\text{banner}} \right) = 187.5 \text{ yards of white material}$. The number of full blue bolts

that would need to be purchased is $125 \text{ yd. blue} \left(\frac{1 \text{ blue bolt}}{10 \text{ yd. blue}} \right) = 12.5$, which rounds up to 13 blue bolts.

The number of full white bolts that would need to be purchased is

$187.5 \text{ yd. white} \left(\frac{1 \text{ white bolt}}{12 \text{ yd. white}} \right) = 15.625$, which rounds up to 16 white bolts. Now, find the difference



in yardage between the two purchases: $13 \cancel{\text{ blue bolt }} \left(\frac{10 \text{ yd. blue}}{1 \cancel{\text{ blue bolt}}} \right) = 130$ yards of blue and

$16 \cancel{\text{ white bolt }} \left(\frac{12 \text{ yd. white}}{1 \cancel{\text{ white bolt}}} \right) = 192$ yards of white, so the difference is $130 - 125 = 5$ yards of blue and

$192 - 187.5 = 4.5$ yards of white. This translates to enough blue material for $5 \cancel{\text{ yd. blue }} \left(\frac{1 \text{ banner}}{\frac{1}{4} \cancel{\text{ yd. blue}}} \right) =$

20 banners and enough white material for $4.5 \cancel{\text{ yd. white }} \left(\frac{1 \text{ banner}}{\frac{3}{8} \cancel{\text{ yd. white}}} \right) = 12$ banners. Therefore, there

is enough extra blue and white material for 12 banners if full bolts of material are purchased instead of the exact amount.

58. (F) **Mathematics/Number and Quantity/Complex Numbers.** Multiply the complex binomial $x - 3i$ by itself three times using the FOIL method and apply the property $i^2 = -1$ as needed:

$$(x - 3i)(x - 3i)(x - 3i) = (x^2 - 3xi - 3xi + 9i^2)(x - 3i) = (x^2 - 6xi - 9)(x - 3i) =$$

$$x^3 - 3x^2i - 6x^2i + 18xi^2 - 9x + 27i = x^3 - 9x^2i - 18x - 9x + 27i = x^3 - 9x^2i - 27x + 27i.$$

TIP Recall the FOIL method for multiplying binomial expressions: First, Outer, Inner, Last. For example,

$$(x + a)(x + b) = x(x) + x(b) + a(x) + a(b) = x^2 + ax + bx + ab.$$

59. (D) **Mathematics/Algebra and Functions/Coordinate Geometry/Qualitative Behavior of Graphs of Functions.** To determine which function is graphed in the xy -coordinate plane, recall that the zeros of a function correspond to zero values of the y -coordinate—in other words, any value of x that corresponds to $y = 0$. The zeros in the given graph are for $x = -4$, 0 , and 6 , which eliminates (B) and (C) since these functions are not equal to zero for these values of x . Next, the end behavior of a polynomial function is determined by the leading coefficient on the highest order x -term and the power of that x -term. The graphed function increases at both ends, so the leading coefficient on the highest order x -term must be positive and the power on the highest order x -term must be even. All the functions have the same coefficients on the x -term: 1. The highest order on the x -term in each function is equal to the sum of the powers on the x -terms:

A. $x(x)(x) = x^3$

D. $x^2(x^3)(x) = x^6$

E. $x^3(x^2)(x) = x^6$

Since n must be even, this eliminates (A). Now, the simplest way to decide between the remaining functions (without dealing with multiplicities of zero and turning points) is to either graph the two remaining functions on a graphing calculator or “test-the-test” by plugging in a unique x -value to check whether the corresponding y -value matches that in the graph. Let’s test $x = 3$, where the corresponding y -value must be negative:

D. $p(3) = x^2(x - 6)^3(x + 4) = (3)^2(3 - 6)^3(3 + 4) = 9(-3)^3(7)$, which is negative

E. $q(x) = x^3(x - 6)^2(x + 4) = (3)^3(3 - 6)^2(3 + 4) = 3^3(-3)^2(7)$, which is positive

Since the function in (D) is negative for $x = 3$ and (E) is positive, (D) must be the correct choice.



Note that in this item, we don't reach for the calculator until we've been able to eliminate several choices using math logic. Otherwise, it might be too time-consuming, especially toward the end of the test, to graph all five functions to find the one that matches the given graph. Graphing only two functions, after eliminating the other three, is a much faster approach to this item.

60. (K) **Mathematics/Number and Quantity/Matrices and Vectors.** Two matrices can only be multiplied if the number of columns in the first matrix is equal to the number of rows in the second matrix. That is, if A is an $m \times r$ matrix and B is an $r \times n$ matrix, the product matrix AB is an $m \times n$ matrix— a matrix with m rows and n columns. Check each of the answer choices to see whether the number of columns in the first matrix in the product is equal to the number of rows in the second matrix. Only AC is NOT a possible matrix product because the number of columns in A , n , is not equal to the number of rows in C , k .



ACT READING TEST EXPLANATIONS

Passage I

1. **(B) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Explicit Detail.** In Passage A, it's not clear why the character is referred to as "you," throughout, (A), and the blond woman who sits next to "you" doesn't explain what she was thinking about at the end of the passage, (C), or where she is originally from, (D). She does, however, provide details about where she is going: Palm Beach to visit a man, (B).



The correct answer for an Explicit Detail item will, as the name states, be stated explicitly in the passage, so look for specific words or phrases in the item stem or answer choices that are also found in the passage.

2. **(H) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Vocabulary.** In line 24, the blond woman is explaining what the man in Palm Beach told her about her eyes: They are as blue as the Atlantic Ocean. This man can't bear to look at "it" without her being there with him, so "it" must refer to what he is comparing her eyes to—the ocean, (H).
3. **(D) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Vocabulary.** "Occasional" means "not frequent," so in this phrase, as it is used to describe homes with "firefly porch lights" that "you" and the blond woman pass on the bus, it must mean that there aren't many homes, or that they are far apart, (D). The explanation in (C) focuses on details of the fireflies, not the homes, and is not information given in the passage, much less the phrase in question, so it can be eliminated. (A) suggests that some of the homes are aglow with firefly light, but the use of "every" before "occasional" in the phrase means that all homes were aglow, not some, so (A) is also wrong. While it can be inferred that there are no porch lights on because the fireflies give enough light, (B) references "most" homes, and again the use of "every" before "occasional" is a reference to all homes, not most, so (B) is also wrong.
4. **(F) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Explicit Detail.** Passage B provides a lot of detail about the girl because the narrator observed and analyzed her on the train, but there is never an interaction between the two or even a mention of her acknowledgment of the narrator, so she paid no attention to him, (F).
5. **(B) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Main Idea.** In the second paragraph of Passage B, the narrator describes the girl who opens the window in detail. The narrator described her "lusterless hair" (line 52), her "chapped and red" cheeks (line 55), and her "grimy woolen scarf" (lines 55–56)—details that made the narrator want to "blot her existence" (line 58) or pretend she didn't exist. Because of the critical nature of these descriptions and the narrator "gazing coldly" (line 62) at the girl while trying to open the window, it can be inferred that the narrator's general foul disposition made him want her to fail, (B). There is no detail in the passage about the girl's future or that describes her as helpless, so (A) is wrong. While it can be inferred that the conductor's "cursing" (line 46) is because of the girl's last-minute boarding, the conductor's attitude has nothing to do with the narrator's, so (D) is also wrong. While the young boys' "high pitched cheer" (line 74) demonstrates pleasure at seeing their sister, off, the narrator only realizes the situation after the girl gets the window open, not as she's trying to open it, so (C) is also wrong.
6. **(F) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Implied Idea.** Passage B closes with the narrator's realization: The girl had been "carrying in her bundle these oranges and tossed them to her younger brothers as a token of gratitude for coming to see her off" (lines 83–85). Therefore, it can be reasonably inferred that the girl needed to get the window open so that she could throw the oranges to her brothers, (F). Based on the context of the passage, there is no need for the girl to try to prove herself able in an emergency, so (G) is wrong. The narrator does note that the

smell after the girl opens the window is refreshing (lines 65–69), but there is no evidence to suggest that is why she needed to open the window, so (J) is also wrong. As for (H), while the narrator’s observation of the girl is certainly critical, there is no mention that the girl registered the narrator on the train, so she wouldn’t need to put space between them.

7. **(C) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Explicit Detail.** The first paragraph of Passage B details the girl boarding the train at the last minute: The narrator heard the “clattering of dry-weather clogs” and the “[c]ursing of the conductor” (lines 45–46), (C). All other answer choices reference only one of these descriptions and add an additional detail not explicitly mentioned in the passage.
8. **(J) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Main Idea.** This question asks about the similarities between the two passages. While the second person point of view is used in Passage A, first person is used in Passage B, so (F) can be eliminated. No specific time period is given for either passage, so (G) is also wrong, and while “you” and the blond woman engage in dialogue in Passage A, there is no dialogue between the characters in Passage B, so (H) is also wrong. In both passages, the characters are on public transportation and observe and analyze someone they are traveling with, (J).
9. **(D) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Explicit Detail.** In Passage A, “you” makes a critical observation of the woman who sits next to him on the bus, a woman who “looks ready to talk” and who “you” “pretends” not to see (lines 2–3) and who “you” only speaks to in the last line of the passage but who speaks to “you” throughout the passage. In Passage B, the narrator makes critical observations of the girl who throws oranges to her brothers, but neither the narrator nor the girl does much talking, so the character most interested in having a conversation must be the blond woman from Passage A, (D).
10. **(F) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Application.** “You” in Passage A and the narrator in Passage B make critical observations of the blond woman on the bus and the girl on the train, respectively. “You” observes the blond woman’s “sad, neglected teeth” (line 14) that makes “you” want to “smile at her in the dark” (line 16), and the narrator in Passage B notes the girl’s “grimy, woolen scarf” (lines 55–56) and her “lusterless hair” (line 52). These descriptions demonstrate reactions that show they consider the other character to have a sad or pitiful appearance, (F). While in Passage B the girl’s late arrival may have delayed the train’s departure, there is no mention of a delay in Passage A, so (G) is wrong. Passage A presents the woman’s reason for traveling—visiting a man—but in Passage B, the narrator only guesses at why the girl is traveling, so (H) is wrong. As for (J), both “you” and the narrator’s critical observations about the respective characters demonstrate pity, not envy.

Passage II

11. **(D) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Vocabulary.** The phrase “the rougher fringes” in line 3 describes the life that Stevenson preferred, one that preferred to avoid or “circumnavigate civilization” and its “increasing reliance on contraptions” (lines 1–3), so another phrase from the passage must also capture this meaning. “The fire of adventure” in line 9 references the scenes and plots from Stevenson’s novels, not his life preferences, so (A) is wrong. “An epic ocean voyage” in lines 32–33 does demonstrate Stevenson’s lifestyle preference, but it doesn’t describe his overall style, only one thing that he preferred to do, so (B) is wrong. “A glittering hieroglyph” in line 64 describes a realization Stevenson had: technological innovations will eventually allow all lights to be lit at once “by the touch of a button” (lines 67–68). This anticipation is in direct conflict with Stevenson’s preference to avoid society’s “increasing reliance on contraptions,” so (C) is also wrong. Rather, Stevenson’s preference to “circumnavigate civilization” or live on “the rougher fringes” of it means he lives on its “skirts,” (D).



12. **(F) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Implied Idea.** In line 48, the author of the passage introduces the fact that he or she “shadowed” Stevenson, and the rest of that paragraph and part of the next describe his interactions with Stevenson, so it can be reasonably inferred that the author is credible because of his firsthand experience traveling and working with Stevenson, (F). Stevenson’s novels may be inspired by his personal preferences, but reading his books does not provide biographical knowledge that would make the author a credible source, so (G) is wrong. There is no mention of the author of the passage working in Stevenson’s family offices or of being from Edinburgh, so both (H) and (J) are also wrong.
13. **(D) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Main Idea.** The second paragraph of the passage details the accomplishments of Stevenson’s family tree. His grandfather and three of his grandfather’s sons were civil engineers that were “esteemed for [their] technological genius” (line 15) and his own father invented “louvre-boarded screens for the protection of thermometers” that “are still in use today,” (lines 21–22), so Stevenson came from a family of men who were revered for their technological accomplishments, (D). While this paragraph does describe that three of his grandfather’s sons were also engineers, there is no mention that he insisted on it, so (A) is wrong. The paragraph does start with the statement that Stevenson was “destined to be a modern man” (lines 13–15), but this idea is at odds with the overall idea of the passage—that Stevenson’s lifestyle preferences were to skirt modernity—and the main idea of the paragraph is on that of Stevenson’s family’s technological success, not Stevenson, so (B) is wrong. The paragraph does detail both Stevenson’s grandfather’s success with lighthouses and his father’s with louvre-boarded screens, but there is no comparison of these successes in this paragraph, and they are details, not the main idea, so (C) is wrong.
14. **(G) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Main Idea.** The fifth paragraph details a time in London when Stevenson “gazed down” on the city and “imagined a technological miracle of the future” (lines 61–62)—eventually, lights would be able to be turned on and off all at once, instead of one by one, and this realization was “not for him” as he preferred the “flickering gas lamp” (lines 68–69), (G). Although Stevenson’s preference for gas light inspiring details of his books is introduced in the next paragraph, this paragraph doesn’t deal with any of Steven’s books, so (F) can be eliminated. The paragraph clearly states that Stevenson preferred the flickering gas lamps, so (H) is also wrong. As for (J), Stevenson does realize that the eventual improvement in optics will be the “technological miracle of the future” in this paragraph, but this “miracle” is not attributed to Stevenson’s father.
15. **(C) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Explicit Detail.** The answer to this question can be found by looking for the specific occupations Stevenson entered. He was a writer (line 26), and many of his books are referenced throughout the passage; he was also an apprentice engineer (line 50) and a mariner (line 88), but there is no mention of him being a lamplighter (although it is clear he preferred lamp lighting to electricity) or a builder, so the correct answer is (C).
16. **(H) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Implied Idea.** The first paragraph of the passage introduces Stevenson and his lifestyle preferences. He did not like modern technology and “turned his back” on “progress” (lines 4–5). The phrase later in this description that Stevenson “loved the clashing of swords” and “didn’t want them getting tangled up in telephone wires overhead” (lines 10–12) illustrates exactly how Stevenson turned his back on progress because his preference for swords (historical weapons) did not coexist with telephone wires (progress), (H). This section of the passage clearly states that progress was an “idol” of the time, meaning that people were fond of advancements and probably experienced many of them, so (F) is wrong. Stevenson created a life that allowed him to not be dependent on modern technology, so (G) is also wrong. As for (J), Stevenson may have “loved the sound of clashing swords,” but this doesn’t suggest that he himself was a swordfighter, only that he loved both the sound and the lack of modern technology involved.

17. **(A) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Vocabulary.** The phrase “wringing of hands” suggests stress or disconcerting attitudes or opinions toward something, and in line 24, the “great wringing of hands” refers to Stevenson’s announcement to not enter the family business, (A). While Stevenson traveled he was “longhaired” and “careless about food,” but the phrase “wringing of hands” is directly correlated to Stevenson’s choice of profession, not his appearance or diet, so (B) is wrong. Stevenson also did not renounce his family name, and even wrote of his father “all the time” (line 85), so (C) is wrong. And, Stevenson did write his family with “pleas” to “take [him] as [he] is” (line 29), but he wrote these letters because they did not agree with his choice of profession, so (D) is also wrong.
18. **(J) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Implied Idea.** Lines 34–39 detail Stevenson’s travel preferences: He “travel[ed] not to go anywhere, but to go,” to “travel for travel’s sake” as the “great affair [was] to move.” Because Stevenson clearly liked to travel “for travel’s sake” it can be reasonably inferred that the act of simply moving was enough and that he was likely happiest when he had no plans or itinerary and could just “move,” (J). The idea of moving for movement’s sake is at odds with the destination being the worthwhile part of the trip, so (F) is wrong, and while Stevenson’s travel preferences did “forg[e] the template of college-educated adventurers to come” (lines 34–35), this means that his style became a model, not that he encouraged any other men to travel as he did, so (G) is also wrong. As for (H), there is no mention that he was searching for a model for the character in one of his books.
19. **(A) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Vocabulary.** The phrase “stumbled across” when used literally means “tripped over,” but here, the literal meaning does not work as the passage author cannot trip over a house, so (D) can be eliminated. “Staggered toward” means to move unsteadily toward something, which also doesn’t fit this context, so (B) is also wrong. “Unearthed” means to find something by digging, and the passage author did not dig to find the Abernethy house, so (C) is also wrong. The phrase “stumbled across” in this context most nearly means “found by accident,” (A).
- TIP** *Some Vocabulary items test meanings of words students may be familiar with. If students encounter such items, they can usually eliminate the most common meanings of the word because, more likely than not, those familiar meanings will not be the correct answer.*
20. **(J) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Explicit Detail.** The passage details Stevenson’s father’s later life in the sixth paragraph: “Thomas Stevenson’s name may not have been widely known, yet ‘all the time, his lights were in every part of the world” (lines 83–85), (J). This detail does not suggest that he was estranged from his son; the opposite is suggested since Robert Louis Stevenson wrote of his father, so (F) is wrong. This detail also does not associate Thomas Stevenson with lighthouses, nor does it say that he was more famous than his son, so (G) and (H) are also wrong.

Passage III

21. **(B) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Development.** In the fifth paragraph of the passage, the author introduces and defines “cultural intuition.” Then, at the beginning of the sixth paragraph, the author states that she draws on her own “cultural intuition and knowledge when reading a book about Pueblo Indians” (lines 71–72). She gives the example of McDermott’s *Arrow to the Sun: A Pueblo Indian Tale*, which portrays several kivas, to show how she draws on her cultural intuition while reading it, (B). While the author does reference Bruchac’s perspective on ancient tales (lines 25–32), (A), her own research with Pueblo communities (lines 54–62), (C), and Silko’s impression of the oral narrative (lines 9–24), (D), none of these exemplify or give an example of her cultural intuition.



22. **(G) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Development.** The first paragraph introduces types of traditional stories: myths, legends, and folktales. Then, the author explains that these stories are “more than simple entertainment” and that “they matter—in significant ways—to the well-being of the communities from which they originate” (lines 6–9). Therefore, these stories have value and function within communities, (G). While the author does mention that stories change over time, this idea is not addressed until later in the passage, so (F) is wrong. The author is also not contrasting the different types of traditional stories, so (H) is also wrong. As for (J), while the end of the first paragraph does introduce that a culture’s “worldview [is] complete with proven strategies of survival” (lines 12–14), this demonstrates the realistic qualities associated with narratives that impacts a culture’s worldview, not how these views have changed over time.
23. **(D) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Application.** The third paragraph of the passage details the way stories change over time. A “storyteller may revise a story according to his or her own interpretation, or according to the knowledge of the audience” (lines 39–41) but that for the story to be “acceptable . . . it should remain true to the spirit and content of the original” (lines 42–44). Therefore, the author would mostly likely believe that if someone were to significantly change the spirit of the story, it would be unacceptable, (D). All other answer choices are described as part of the nature of storytelling and thus the author would view those practices as acceptable.
24. **(G) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Development.** The author introduces her home pueblo and its differences from the many other pueblos in New Mexico in the fifth paragraph, and she introduces the idea of cultural intuition during the description of these differences. Then, in the sixth paragraph, the author applies her own cultural intuition by explaining how her own unique experiences in her specific pueblo cause her to understand McDermott’s book differently, as much of the information in his book is in direct contrast to her experience, so her description of the different types of pueblo communities in New Mexico serve to support the analysis of McDermott’s book, (G). While the author does describe her own culture and traditions, it is her complex “cultural intuition,” an idea that is carried into the next paragraph, that makes the use of these differences more complex than simply describing her home and traditions, so (F) is wrong. As for (H) and (J), there is no direct comparison of her own tribe to other nations, only a statement that the author is aware of distinctions (lines 66–67), and there is no mention of criteria used to evaluate books.
25. **(C) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Implied Idea.** The answer to this question lies in the last paragraph of the passage: “[E]lders at one Pueblo would say the book could be used with their children, while elders at another Pueblo would disagree” and this is “not a question of cultural authenticity; it is one of appropriateness in teaching, given a specific audience” (lines 88–92). Because depictions that may be “culturally acceptable at one Pueblo are not necessarily acceptable at a different Pueblo” (lines 86–88), it can be inferred that the approval of a children’s book will depend on how well it reflects the values of that particular culture, (C).
26. **(H) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Explicit Detail.** Leslie Marmon Silko is introduced in the first paragraph, and an excerpt from her discussion of hunting stories is provided. These hunting stories “carefully described key landmarks and locations” and thus “might also serve as a map” (lines 18–20)—maps that “contained information of critical importance about the behavior and migration patterns of mule deer” (lines 15–17). Hunters used these stories then to identify the behavior and migration patterns of game, (H). Though lost travelers and pinon-nut gatherers “have been saved” because they recognize landmarks from the stories, the passage does not state that these stories were meant to locate and rescue lost hunters or to find food by following these people’s trails, so both (F) and (J) are wrong. As for (G), there is no mention of the number of successful hunts from season to season.
27. **(A) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Explicit Detail.** The answer to this question can be found in the fifth paragraph: “As a scholar in American Indian

studies, I know there are great distinctions between and across American Indian tribal nations,” (A). There is no mention in this section, or anywhere in the passage, of the author being a friend of McDermott or of being an editor of picture books, so both (B) and (C) can be quickly eliminated. While the author does state that she is from the Nambe Pueblo community, it is not explicitly stated that she is an elder, so (D) is also wrong.

28. (G) *Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Vocabulary.* While the word “great” often is an adjective to describe something “splendid,” (J), or “exuberant,” (H), here, it has a different meaning, since the distinctions between tribal nations are not meant to be shown as a “good” or “great” thing, but of something of “great” importance or significance, (G). As for (F), “excessive” means “more than necessary,” and a degree of importance is needed in this context, not a degree of quantity.
29. (D) *Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Explicit Detail.* In the fifth paragraph, when the author describes her Pueblo community and the others in New Mexico, she states that her “home pueblo is very different from the other pueblos . . . among which are several language groups” (lines 67–70), (D). The various Pueblo communities in New Mexico are in roughly in the same geographic location, New Mexico, so (A) is wrong, and there is no mention of a disparity in resources, so (B) is also wrong. As for (C), while it can be inferred that there are various approaches to parenting because of the cultural differences, this idea is not explicitly stated or used as evidence of the communities’ diversity, so it is also wrong.
30. (J) *Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Explicit Detail.* The concept of kivas is explained in the author’s analysis of McDermott’s book in the sixth paragraph: the boy in the story must prove himself by passing through many kivas—lions, serpents, and bees. The author’s experience with “kivas,” though, is different than the fighting elements in McDermott’s book. She knows “kivas are safe places of worship and instruction,” (J).

Passage IV

31. (B) *Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Main Idea.* This passage is concerned with the “vegetation that dominates the neglected interstices” (lines 4–5) in the city—the “[g]reenery that fills the vacant spaces between our roads, homes, and businesses” (lines 5–6). The passage then goes on to explain how, specifically, this type of vegetation that many consider weeds, grows in urban environments, (B). While the passage does note that people like to get rid of these types of plants because they are considered weeds, this is a detail in the second paragraph, not the main idea of the passage, so (A) is wrong. The passage clearly states that weeds grow in “neglected interstices” in cities already, not that there needs to be more, so (C) is wrong. As for (D), the author doesn’t discuss environmentalists’ changing attitudes toward so-called weeds; rather, it is concerned with understanding and explaining how these weeds thrive in urban environments.



Reviewing the first few paragraphs and the last paragraph can help identify the main idea of the passage quickly as the main idea is introduced in the beginning and brought to a conclusion in the end.

32. (H) *Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Application.* The second paragraph details several perspectives. From the utilitarian perspective, “a weed is any plant that grows on its own where people do not want it to grow” (lines 23–24); from the biological perspective, “weeds are opportunistic plants that are adapted to disturbance” (lines 26–27); from the agricultural perspective, “the competition of weeds with economic crops is the primary reason for controlling them” (lines 31–33), and from an urban or city dweller’s perspective, weeds are “perceived as ugly” or are “security concerns” (lines 37–38). Because this question asks for the perspective with which the author of the passage would agree, the description that matches the content in the rest of the passage needs to be identified. Paragraphs 3–5 detail the adaptations these types of plants must make to



- flourish in cities, which is most aligned with the biological perspective of weeds adapting to disturbance, (H).
33. **(B) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Implied Idea.** This question asks for the choice that is most unlike the main ideas of the passage. The author in the passage is most concerned with urban plants, “spontaneous vegetation” (line 4), and the author provides several examples of these types of plants, so students must find the type of plant that doesn’t belong in that category. (C) details the overall category of vegetation with which the author is concerned, so it can quickly be eliminated. The first paragraph lists many examples of this type of vegetation, among them “common ragweed,” and in the fourth paragraph the author lists urban plants studied in a book called *The Ecology of Urban Habitats*, including “calcium-loving grassland species,” so both (A) and (D) are also wrong. As indicated in line 32, economic crops are in direct competition with weeds, and is the main reason why weeds need to be controlled, so these types of plants are the most unlike the urban plants or spontaneous vegetation, (B).
34. **(G) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Application.** The passage overall explains how weeds are plants that have learned to thrive under harsh conditions. It states that “if left undisturbed long enough they may even develop into mature woodlands” (lines 20–21) and their “pervasiveness in the urban environment is simply a reflection of the continual disruption that characterizes that [urban] habitat (lines 28–30). If it is the conditions of the urban environment that cause the growth of weeds, then weeds have been wrongly blamed for contributing to certain deterioration, (G). The author is not concerned with removing weeds or changing people’s minds about them, only with understanding how they grow in the city, so (F) and (H) are wrong, and there is no comparison of city vegetation with cultivated plants, so (J) is also wrong.
35. **(C) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Vocabulary.** In line 5, “greenery” is used to introduce the plants that “fill the vacant spaces” in urban environments, such as sidewalk cracks, in ditches, etc. These are the types of plants that, as stated in the second paragraph, are often seen as weeds (lines 22–23), (C).
36. **(F) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Explicit Detail.** Finding the correct answer to this question is actually quite easy. Gilbert’s book is introduced directly after the explanation of Lundholm and Marlin’s study, and the sentence that makes this connection starts with “similarly,” so the studies must be complementary, (F). Because the studies are “similar” or came to similar results, they are not contrasting, (G), or irrelevant, (J) to each other. The author also does not state that Lundholm and Marlin used Gilbert’s ideas for their study, so the studies are not interdependent, (H), either.
37. **(D) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Implied Idea.** The italicized words in the last paragraph reveal the author’s attitude toward so-called weeds in urban areas: They are “flexible” (line 72), “opportunistic” (line 73), and “tolerant” (line 76). These are not words that describe alarm, (A), concern, (B), or annoyance, (C); however, they do show an attitude of respect for their ability to thrive in myriad challenging conditions, (D).
38. **(F) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Explicit Detail.** A quick scan of the passage for “Norway maple” helps find the correct answer: “Chicory, Japanese knotweed, and Norway maple, were brought in intentionally or unintentionally by people” (lines 11–13), (F).
39. **(B) Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Vocabulary.** In this section of the passage, the author is detailing the various “spontaneous vegetation” that has found its way into cities. Some were present before humans (lines 8–11), some were brought, intentionally or unintentionally by humans (lines 11–13), and others “arrived on their own, dispersed by wind, water, or wild animals” (lines 15–16). The first examples were already there, the second were brought by people, and the third were brought by natural elements such as wind, water, and animals, so the phrase must

mean without help or human aid, (B). Plants are not humans so they cannot voluntarily move grow anywhere, nor can they propel themselves, so (C) and (D) are wrong. As for (A), “on their own” refers to a process being done solitarily, not a quantity of one.

40. (J) *Reading/Key Ideas and Details, Craft and Structure, Integration of Knowledge and Ideas/Explicit Detail.* This answer is found at the end of the first paragraph: Weeds can “provide important ecological services at very little cost to tax payers, and if left undisturbed long enough they may even develop into mature woodlands,” (J). The passage states that weeds are in competition with agricultural crops, but these plants are “controlled” (line 33) not left alone, so (F) is wrong. There is no mention in the passage of the “spontaneous vegetation” in urban environments enhancing gardens (since most people find them ugly) or of them drying out the soil (in fact, they are able to grow despite other factors affecting the soil), so both (G) and (H) are also wrong.



ACT SCIENCE TEST EXPLANATIONS

Passage I

- (A) Science/Interpretation of Data/Analysis.** Although it is not stated, atomic radius is proportional to atomic size with larger atoms naturally having a larger atomic radius. According to Student 4, the atoms listed from smallest to largest (based on the fact that larger bond angles indicate larger atoms) are F, Cl, Br, and I. And as the size of the atom increases, the atomic mass (Table 2) increases.
- (H) Science/Evaluation of Models/Comprehension.** According to the students' descriptions of the molecular shapes of the four molecules, Students 1, 3, and 4 all state that the As atom has a lone pair. Only Student 2 states that the As atom does not have a lone pair.
- (C) Science/Evaluation of Models/Comprehension.** Student 1 states that the As atom lies in the same plane as the As and F atoms. Student 2 also agrees that all the atoms in AsF_3 lie in the same plane. Students 3 and 4 believe the molecules have the shape of a trigonal pyramid, which doesn't have all the atoms in the same plane. So, only Students 1 and 2 would agree that all 4 atoms in an AsF_3 molecule lie in the same plane.
- (J) Science/Evaluation of Models/Comprehension.** Student 1 states that there are 2 unique bond angles. Students 2, 3, and 4 state that there is 1 unique bond angle. Therefore, the claim that there are 3 unique bond angles in an AsF_3 atom is not consistent with any of the student descriptions.
- (A) Science/Evaluation of Models/Analysis.** Both Students 1 and 2 state that the 4 atoms in each of the 4 molecules lie in a plane. This would cause the bond angles to form a circle with angles adding up to 360° . By adding the specific angles mentioned by each student, it can be confirmed that both Students 1 and 2 believe the sum of the bond angles is 360° . Student 1 says there one 180° angle and two 90° angles: $180^\circ + 2(90^\circ) = 360^\circ$. Student 2 says that there are 3 120° angles: $3(120^\circ) = 360^\circ$. Students 3 and 4 believe the shape is trigonal pyramidal, in which the angle between the 3 F atoms is equal, but since the 3 F atoms and the As atom do not line on the same plane, the 3 angles do not necessarily sum to 360° . Student 3 states the angle is 109° each, summing to $3(109^\circ) = 327^\circ$. Student 4 states that the angle depends on the size of the atom bound to the As atom, so the sum of 3 such angles is not necessarily 360° . Therefore, only Students 1 and 2 would likely agree the sum of the 3 bond angles in an AsI_3 molecule is 360° .
- (J) Science/Evaluation of Models/Application.** Students 2 and 3 primarily differ in opinion because Student 2 did not include a lone pair in their description and Student 3 did. Because of this lone pair and its ability to repel, Student 3 described a trigonal pyramidal arrangement whereas Student 2 described a trigonal planar arrangement. The question mentions that the N atom has a lone pair with an ability to repel. This is consistent with Student 3's description.
- (D) Science/Evaluation of Models/Analysis.** The information in Table 1 indicates that each of the 4 molecules has 1 unique angle and it increases as the size of the atoms bound to the As atom increase. This is consistent with the description given by Student 4: "[the unique] bond angle depends on the size of the atom that is bound to the As atom: the larger the atom...the larger the bond angle."

Passage II

8. **(F) Science/Interpretation of Data/Analysis.** According to Table 1, the genotype *BBEE* results in black-coated offspring, so it is a reasonable hypothesis to suppose that two parents with this genotype could produce the black-coated offspring shown in Table 2 from Cross 1. According to Table 2, all 8 of the offspring after Cross 1 had black coats. Therefore, the hypothesis that each of the parents in Cross 1 had genotype *BBEE* is consistent with the results of Cross 1.
9. **(D) Science/Interpretation of Data/Comprehension.** According to Table 1, a brown coat results from either a *bbEE* genotype or a *bbEe* genotype.
10. **(H) Science/Interpretation of Data/Analysis.** According to Table 1, the genotypes that have 1 or more copies of the *E* allele of Gene E result in either a black coat or a brown coat. According to Table 2, Cross 3 resulted in 2 black-coated offspring, 2 brown-coated offspring, and 2 yellow-coated offspring. Therefore, the fraction of the offspring of Cross 3 that had 1 or more copies of the *E* allele of Gene E is the total number of black and brown offspring divided by the total number of offspring: $\frac{2+2}{2+2+2} = \frac{4}{6} = \frac{2}{3}$.
11. **(B) Science/Interpretation of Data/Application.** Recessive alleles are indicated with lowercase letters. Dominant alleles are indicated with capital letters. According to Table 1, the coat color from a genotype of all lowercase letters (recessive for Gene B and Gene E) is yellow. The only crosses that produced a yellow coat color were Crosses 2 and 3.

TIP *This item requires some basic science knowledge about recessive and dominant alleles, or versions of a gene. Dominant alleles are always indicated by capital letters and recessive alleles are indicated by lowercase letters. The genotype is the set of genes responsible for a particular trait. The phenotype is the physical characteristic of that trait. If an individual has both a dominant and a recessive allele of a gene, the recessive allele's effects are masked and the phenotype resembles only the dominant allele.*

12. **(J) Science/Evaluation of Models/Application.** Yellow coated offspring could have the genotypes: *Bbee*, *Bbee*, or *bbee*. Therefore, the factor that seems to indicate yellow coat color is having two recessive alleles (lowercase *e*) for Gene E. If we cross two individuals with yellow coats, each individual can only contribute recessive alleles (lowercase *e*) to the offspring. Therefore, all offspring will also only have recessive alleles (lowercase *e*) and will all have yellow coats.
13. **(C) Science/Evaluation of Models/Application.** When gametes are created, they each get one copy of each gene. Since this individual has both a dominant (*B*) and a recessive (*b*) allele for Gene B, it can make gametes with either allele. Half of the gametes will have the dominant allele and half will have the recessive allele. Therefore, 50% of the normal gametes produced by a dog with the genotype *BbEE* will contain the *B* allele.

TIP *This item requires some basic science knowledge about reproductive cells. A gamete is a reproductive cell (sperm or egg cell) that contains half the genetic material necessary to form a complete organism. When two gametes unite, offspring will have the correct total amount of genes since each gamete contributed one of the two required copies of each gene.*

Passage III

14. **(J) Science/Interpretation of Data/Comprehension.** Figures 1 and 2 show the ratios of average wet strength to average dry strength as percentages, so the data is indicative of the average wet strength of the paper towels (PTs), with higher bars indicating greater average wet strength. The results for



Experiment 2 are shown in Figure 2. For PTs submerged in water for 10 minutes (solid bars), the highest bar corresponds to PTs that had been heated in an oven at 140°C.

15. **(A) Science/Interpretation of Data/Analysis.** In Figure 2, the striped bars correspond to the PTs that were submerged in water for 2 hours. According to Figure 2, as the oven temperature increases from 110°C through 140°C, the corresponding values of $\frac{W}{D}$ increase only (from approximately 22% to 48%).
16. **(F) Science/Science Investigation/Comprehension.** According to the description of Experiment 1, the PT that was submerged in water (Step 1) and then heated in an oven for 3 minutes at 25°C (Step 3) was the control PT. Note that the control data for both experiments is marked with an asterisk in the corresponding graph.
17. **(D) Science/Science Investigation/Comprehension.** Steps 1–5, as described in Experiment 1, are repeated for Experiment 2 with one difference: the test solutions in Experiment 1 contained only glutaraldehyde (GLA) and the test solutions in Experiment 2 contained both GLA and zinc nitrate. According to Step 4, the PTs were submerged in water for 10 minutes, 2 hours, or 24 hours, after which the wet strength of the PTs were measured. No PTs were submerged in water for a total of 18 hours in either experiment.
18. **(G) Science/Interpretation of Data/Analysis.** A quick glance at the answer choices provides an idea of what to look for in Figure 1, which summarizes the $\frac{W}{D}$ data for Experiment 1: compare the $\frac{W}{D}$ value at 2 hours (striped bars) with the $\frac{W}{D}$ value at 10 minutes (solid bars) as a function of oven temperature. According to Figure 1, the $\frac{W}{D}$ value at 2 hours is less than the $\frac{W}{D}$ value at 10 minutes for all oven temperatures.
19. **(C) Science/Interpretation of Data/Analysis.** The PTs are treated with only GLA in Experiment 1 and both GLA and zinc nitrate in Experiment 2. So, compare the bars in Figure 1 with the corresponding bars in Figure 2—but don't include the control data (marked with an asterisk) in the comparison. Remember, you should compare a specific time/temperature combination with its counterpart in the other graph. In Figure 1, the $\frac{W}{D}$ value for 10 min and 110°C is approximately 17%. In Figure 2, the corresponding value is approximately 25%. Therefore, Experiment 2 demonstrates that the wet strengths of PTs increase after treating with both GLA and zinc nitrate, which refutes the prediction given in the item stem.
20. **(G) Science/Interpretation of Data/Analysis.** The data presented in the graphs is equal to the ratio of wet strength W to dry strength D , multiplied by 100: this represents the percentage of D that W is equal to. In both Figures 1 and 2, the percentages are all less than 100%. This means that $\frac{W}{D}$ is less than 1, which means that W is less than D . In other words, wet is less strong than dry.

TIP You can also use your common sense to immediately eliminate two of the answer choices: are wet paper towels stronger or weaker than dry paper towels? Experience should tell you that dry paper towels are stronger, which eliminates (H) and (J). Note that answer choices (F) and (I) don't make logical sense since the first part and the second part of each choice contradict each other. For example, (F) says that dry has greater strength, but (F) also says that each wet strength was greater than the dry strength, which is illogical.

Passage IV

21. (B) **Science/Scientific Investigation/Comprehension.** The data in Tables 2 and 3 give the average final mass of the frogs as a function of diet. A scale, such as an electronic balance, must be used to measure the mass of each frog. A graduated cylinder measures liquid volumes; a metric ruler measures distances; and a calorimeter measures the amount of heat involved in a chemical reaction or other process.

TIP *This item requires basic knowledge of tools used in scientific experiments. You should be familiar with common laboratory items such as graduated cylinders, beakers, Bunsen burners, electronic balances, rulers, thermometers, calorimeters, etc., and the function of these tools.*

22. (F) **Science/Interpretation of Data/Analysis.** According to Table 1, the percent by mass of protein increased with each successive diet for Diets 1–5. According to Table 2, for each successive diet for Diets 1–5, the average final mass of the frogs increased.

23. (B) **Science/Scientific Investigation/Comprehension.** This item asks about the experimental method: why is fine wire mesh placed across the tanks? Check each statement: (I) is likely true because you wouldn't want predators to enter the tanks and (III) is similarly likely true because you wouldn't want the frogs to leave the tanks. Since the description of Experiment 1 states that the tanks were covered with fine wire mesh *after* the frogs were placed in each tank, (II) is not likely because the mesh wasn't used to put the frogs into the tanks.

24. (H) **Science/Interpretation of Data/Analysis.** According to Table 1, the calories per gram increased with each successive diet for Diets 6–10. According to Table 3, for each successive diet for Diets 6–8, the average final mass of the frogs increased; then the average final mass decreases for Diet 9 and decreases again for Diet 10.

25. (C) **Science/Scientific Investigation/Comprehension.** The first sentence of the passage states that “[t]he tiger frog, *Rana rugulosa*, is a species of frog that is commercially farmed.” Therefore, all the frogs used in the experiment belong to the same species, so (II) is true, which eliminates (A) and (D). To choose between (B) and (C), you need to know what “genus” means. A genus is a principal taxonomic category that ranks above species and below family. Since the frogs belonged to the same species, they must also belong to the same genus, so (I) is also true.

TIP *This item requires basic knowledge of the taxonomy ranks for classifying organisms in biology. The hierarchy has eight major ranks: domain, kingdom, phylum, class, order, family, genus, and species.*

26. (G) **Science/Scientific Investigation/Comprehension.** According to the experiment descriptions, Experiment 1 used frogs that each weighed 3.3 grams and Experiment 2 used frogs that each weighed 7.9 grams. Therefore, the initial mass of each frog was greater in Experiment 2 than in Experiment 1. Note that the frogs in Experiment 1 were each fed 1,000 mg of food twice per day, while the frogs in Experiment 2 were each fed 2,000 mg of food once per day, so the frogs were fed the same amount per day in both experiments.

27. (D) **Science/Scientific Investigation/Comprehension.** According to Table 1, the calories per gram is increased for each successive diet for Diets 6–10 (while the percent by mass of protein is held constant). Therefore, the farmer would compare the results of Diets 6–10 because those diets varied in the number of calories per gram but not in the percent by mass of protein.



Passage V

28. (F) **Science/Interpretation of Data/Analysis.** In Figure 3, the soil depth is represented by the y -axis and the water content is represented by the x -axis. According to Figure 3, the water content values for each of the 4 date lines are closest in value for a soil depth of 30 cm.
29. (A) **Science/Scientific Investigation/Comprehension.** According to the first paragraph of the study description, “[t]he slots near one end of the steel pipe of the diffusion well allowed only soil gas to enter the pipe.”
30. (J) **Science/Interpretation of Data/Comprehension.** The introduction to the study states that CO_2 is produced in soil by two processes: respiration in plant roots and bacterial decomposition of organic matter. And the average CO_2 content of soil gas as a function of soil depth is given in Figure 2, while the average water content of soil as a function of soil depth is given in Figure 3. However, nothing in the study results indicates what percentage of the CO_2 in each soil gas sample was due to respiration in plant roots versus decomposition of organic matter.
31. (B) **Science/Interpretation of Data/Comprehension.** According to the x -axis label of Figure 2, the average CO_2 content of soil gas is given in percent by volume. Remember, the collected gas samples only contained soil gas. They did not contain water or soil. Therefore, the CO_2 content was found by dividing the volume of CO_2 by the volume of the gas sample.
32. (J) **Science/Interpretation of Data/Analysis.** The data trends in Figure 3 are complicated, so the best approach to this item is to eliminate the answer choices with descriptions of the data that don’t match Figure 3. Eliminate both (F) and (G) because the data for the October 26 and November 9 dates clearly do not follow the same trends as the other two dates. As for (H), the data for October 26 (solid squares) shows that the average water content of the soil, as a function of depth, first decreases slightly, then increases slightly, and then decreases—so, overall, it generally decreases. The same is true of the data for November 9 (empty squares). Conversely, the data for November 23 (solid circles) generally increases, as does the data for December 7 (empty circles). Therefore, the average water content generally decreased with depth on October 26 and November 9, whereas it generally increased with depth on November 23 and December 7.
33. (D) **Science/Interpretation of Data/Analysis.** This question asks for the probable average CO_2 content of the soil gas at a depth of 145 cm on November 23, which is an extrapolation of the data in Figure 2 beyond a depth of 140 cm for the solid circle data points. The reading for 140 cm on November 23 is 0.40% by volume and since that data is shown to increase as a function of soil depth, the expectation is that the reading at 145 cm would be greater than 0.40% by volume.
34. (G) **Science/Interpretation of Data/Analysis.** According to Figure 3, the average water content of soil at a depth of 60 cm on November 23 (solid circle) was 20% by mass. Therefore, if the mass of the sample was 10 g, the mass of the water in the sample was $0.2(10 \text{ g}) = 2 \text{ g}$.

Passage VI

35. (D) **Science/Interpretation of Data/Analysis.** This item asks for an extrapolation of the motor oil data in Figure 3 to a time of 50 msec. The depth data for the ball in motor oil increases with increasing time, so at 50 msec, the depth of the ball would likely be greater than 2.00 mm. Of the answer choices, only 2.10 mm is greater than 2.00 mm.
36. (G) **Science/Evaluation of Models/Comprehension.** The first paragraph of the passage states that “[a]n object falling through a liquid has 3 forces acting on it: gravity, a buoyant force, and drag (a force that

opposes motion).” Since the ball is falling, its motion is down, which means the drag force is up. This eliminates (F) and (J). Furthermore, the force of gravity is down, which eliminates (H). By the process of elimination, (G) must be the correct choice. Indeed, a buoyant force is an upward force exerted by a fluid that opposes the force of gravity on an object immersed in fluid.

37. **(C) Science/Interpretation of Data/Analysis.** According to the first paragraph of the passage, “[i]f the net upward force on the object is equal in magnitude to the net downward force on the object, then the object will fall with terminal speed.” The implication is that terminal speed is an unchanging value. The speed of the falling steel balls is represented by the left-hand y -axes in Figures 1 and 2. According to Figure 1, the steel ball in motor oil reached a terminal speed (the solid speed line stopped increasing) of approximately 48 mm/sec after more than 25 msec. According to Figure 2, the steel ball in glycerin reached a terminal speed of approximately 10.5 mm/sec after less than 10 msec. Therefore, the steel ball required less time to reach terminal speed in glycerin: less than 10 msec in glycerin as compared with more than 25 msec in motor oil.
38. **(F) Science/Interpretation of Data/Analysis.** As the explanation to the previous item describes, the ball’s terminal speed in motor oil (Figure 1) was approximately 48 mm/sec, while the ball’s terminal speed in glycerin (Figure 2) was approximately 10.5 mm/sec. Therefore, the ball’s terminal speed was greater in motor oil (48 mm/sec) than in glycerin (10.5 mm/sec).
39. **(C) Science/Evaluation of Models/Analysis.** According to Figure 3, the depth of the ball (in both motor oil and glycerin) increased only with increasing time. According to Figures 1 and 2, the drag on the ball (in both motor oil and glycerin) increased and then approached a constant value (the dashed lines stopped increasing). Therefore, it is not reasonable to conclude that the drag on the steel ball was directly proportional to the depth of the ball.
40. **(H) Science/Interpretation of Data/Analysis.** To determine the drag on the ball in motor oil at a depth of 0.50 mm, use Figure 3 to determine the time at which the ball was at a depth of 0.50 mm in motor oil (solid line): 15 msec. According to Figure 1, at 15 msec, the drag (right-hand y -axis) on the ball was approximately 270 μ N.