

# The SAT<sup>®</sup>

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# Practice Test #3

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**Test begins on the next page.**

# Reading Test

65 MINUTES, 52 QUESTIONS

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

## DIRECTIONS

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

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

This passage is adapted from Saki, "The Schartz-Metterklume Method." Originally published in 1911.

Lady Carlotta stepped out on to the platform of the small wayside station and took a turn or two up and down its uninteresting length, to kill time till the train should be pleased to proceed on its way. Then, in the roadway beyond, she saw a horse struggling with a more than ample load, and a carter of the sort that seems to bear a sullen hatred against the animal that helps him to earn a living. Lady Carlotta promptly betook her to the roadway, and put rather a different complexion on the struggle. Certain of her acquaintances were wont to give her plentiful admonition as to the undesirability of interfering on behalf of a distressed animal, such interference being "none of her business." Only once had she put the doctrine of non-interference into practice, when one of its most eloquent exponents had been besieged for nearly three hours in a small and extremely uncomfortable may-tree by an angry boar-pig, while Lady Carlotta, on the other side of the fence, had proceeded with the water-colour sketch she was engaged on, and refused to interfere between the boar and his prisoner. It is to be feared that she lost the friendship of the ultimately rescued lady. On this occasion she merely lost the train, which gave way to the first sign of impatience it had shown throughout the journey, and steamed off without her. She bore the desertion with philosophical indifference; her

friends and relations were thoroughly well used to the fact of her luggage arriving without her.

30 She wired a vague non-committal message to her destination to say that she was coming on "by another train." Before she had time to think what her next move might be she was confronted by an imposingly attired lady, who seemed to be taking a

35 prolonged mental inventory of her clothes and looks. "You must be Miss Hope, the governess I've come to meet," said the apparition, in a tone that admitted of very little argument.

"Very well, if I must I must," said Lady Carlotta to herself with dangerous meekness.

40 "I am Mrs. Quabarl," continued the lady; "and where, pray, is your luggage?"

"It's gone astray," said the alleged governess, falling in with the excellent rule of life that the absent are always to blame; the luggage had, in point of fact, behaved with perfect correctitude. "I've just telegraphed about it," she added, with a nearer approach to truth.

45 "How provoking," said Mrs. Quabarl; "these railway companies are so careless. However, my maid can lend you things for the night," and she led the way to her car.

During the drive to the Quabarl mansion Lady Carlotta was impressively introduced to the nature of the charge that had been thrust upon her; she learned that Claude and Wilfrid were delicate, sensitive young people, that Irene had the artistic temperament highly developed, and that Viola was

something or other else of a mould equally  
60 commonplace among children of that class and type  
in the twentieth century.

“I wish them not only to be TAUGHT,” said Mrs. Quabarl, “but INTERESTED in what they learn. In their history lessons, for instance, you must try to  
65 make them feel that they are being introduced to the life-stories of men and women who really lived, not merely committing a mass of names and dates to memory. French, of course, I shall expect you to talk at meal-times several days in the week.”

70 “I shall talk French four days of the week and Russian in the remaining three.”

“Russian? My dear Miss Hope, no one in the house speaks or understands Russian.”

75 “That will not embarrass me in the least,” said Lady Carlotta coldly.

Mrs. Quabarl, to use a colloquial expression, was knocked off her perch. She was one of those imperfectly self-assured individuals who are magnificent and autocratic as long as they are not  
80 seriously opposed. The least show of unexpected resistance goes a long way towards rendering them cowed and apologetic. When the new governess failed to express wondering admiration of the large newly-purchased and expensive car, and lightly  
85 alluded to the superior advantages of one or two makes which had just been put on the market, the discomfiture of her patroness became almost abject. Her feelings were those which might have animated a general of ancient warfaring days, on beholding his  
90 heaviest battle-elephant ignominiously driven off the field by slingers and javelin throwers.

1

Which choice best summarizes the passage?

- A) A woman weighs the positive and negative aspects of accepting a new job.
- B) A woman does not correct a stranger who mistakes her for someone else.
- C) A woman impersonates someone else to seek revenge on an acquaintance.
- D) A woman takes an immediate dislike to her new employer.

2

In line 2, “turn” most nearly means

- A) slight movement.
- B) change in rotation.
- C) short walk.
- D) course correction.

3

The passage most clearly implies that other people regarded Lady Carlotta as

- A) outspoken.
- B) tactful.
- C) ambitious.
- D) unfriendly.

4

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

- A) Lines 10-14 (“Certain . . . business”)
- B) Lines 22-23 (“It is . . . lady”)
- C) Lines 23-26 (“On this . . . her”)
- D) Lines 30-32 (“She . . . train”)

5

The description of how Lady Carlotta “put the doctrine of non-interference into practice” (lines 14-15) mainly serves to

- A) foreshadow her capacity for deception.
- B) illustrate the subtle cruelty in her nature.
- C) provide a humorous insight into her character.
- D) explain a surprising change in her behavior.

6

In line 55, “charge” most nearly means

- A) responsibility.
- B) attack.
- C) fee.
- D) expense.

7

The narrator indicates that Claude, Wilfrid, Irene, and Viola are

- A) similar to many of their peers.
- B) unusually creative and intelligent.
- C) hostile to the idea of a governess.
- D) more educated than others of their age.

8

The narrator implies that Mrs. Quabarl favors a form of education that emphasizes

- A) traditional values.
- B) active engagement.
- C) artistic experimentation.
- D) factual retention.

9

As presented in the passage, Mrs. Quabarl is best described as

- A) superficially kind but actually selfish.
- B) outwardly imposing but easily defied.
- C) socially successful but irrationally bitter.
- D) naturally generous but frequently imprudent.

10

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

- A) Lines 49-50 (“How . . . careless”)
- B) Lines 62-68 (“I wish . . . memory”)
- C) Lines 70-73 (“I shall . . . Russian”)
- D) Lines 77-82 (“She was . . . apologetic”)

**Questions 11-20 are based on the following passage and supplementary material.**

This passage is adapted from Taras Grescoe, *Straphanger: Saving Our Cities and Ourselves from the Automobile*. ©2012 by Taras Grescoe.

Though there are 600 million cars on the planet, and counting, there are also seven billion people, which means that for the vast majority of us getting  
 Line around involves taking buses, ferryboats, commuter  
 5 trains, streetcars, and subways. In other words, traveling to work, school, or the market means being a straphanger: somebody who, by choice or necessity, relies on public transport, rather than a privately owned automobile.

10 Half the population of New York, Toronto, and London do not own cars. Public transport is how most of the people of Asia and Africa, the world's most populous continents, travel. Every day, subway systems carry 155 million passengers, thirty-four  
 15 times the number carried by all the world's airplanes, and the global public transport market is now valued at \$428 billion annually. A century and a half after the invention of the internal combustion engine, private car ownership is still an anomaly.

20 And yet public transportation, in many minds, is the opposite of glamour—a squalid last resort for those with one too many impaired driving charges, too poor to afford insurance, or too decrepit to get behind the wheel of a car. In much of North  
 25 America, they are right: taking transit is a depressing experience. Anybody who has waited far too long on a street corner for the privilege of boarding a lurching, overcrowded bus, or wrestled luggage onto subways and shuttles to get to a big city airport,  
 30 knows that transit on this continent tends to be underfunded, ill-maintained, and ill-planned. Given the opportunity, who wouldn't drive? Hopping in a car almost always gets you to your destination more quickly.

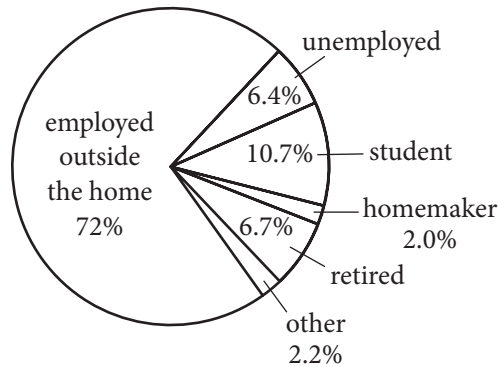
35 It doesn't have to be like this. Done right, public transport can be faster, more comfortable, and cheaper than the private automobile. In Shanghai, German-made magnetic levitation trains skim over elevated tracks at 266 miles an hour, whisking people  
 40 to the airport at a third of the speed of sound. In provincial French towns, electric-powered streetcars run silently on rubber tires, sliding through narrow streets along a single guide rail set into cobblestones. From Spain to Sweden, Wi-Fi equipped high-speed  
 45 trains seamlessly connect with highly ramified metro

networks, allowing commuters to work on laptops as they prepare for same-day meetings in once distant capital cities. In Latin America, China, and India, working people board fast-loading buses that move  
 50 like subway trains along dedicated busways, leaving the sedans and SUVs of the rich mired in dawn-to-dusk traffic jams. And some cities have transformed their streets into cycle-path freeways, making giant strides in public health and safety and  
 55 the sheer livability of their neighborhoods—in the process turning the workaday bicycle into a viable form of mass transit.

If you credit the demographers, this transit trend has legs. The “Millennials,” who reached adulthood  
 60 around the turn of the century and now outnumber baby boomers, tend to favor cities over suburbs, and are far more willing than their parents to ride buses and subways. Part of the reason is their ease with iPads, MP3 players, Kindles, and smartphones: you  
 65 can get some serious texting done when you're not driving, and earbuds offer effective insulation from all but the most extreme commuting annoyances. Even though there are more teenagers in the country than ever, only ten million have a driver's license  
 70 (versus twelve million a generation ago). Baby boomers may have been raised in Leave It to Beaver suburbs, but as they retire, a significant contingent is favoring older cities and compact towns where they have the option of walking and riding bikes. Seniors,  
 75 too, are more likely to use transit, and by 2025, there will be 64 million Americans over the age of sixty-five. Already, dwellings in older neighborhoods in Washington, D.C., Atlanta, and Denver, especially those near light-rail or subway stations, are  
 80 commanding enormous price premiums over suburban homes. The experience of European and Asian cities shows that if you make buses, subways, and trains convenient, comfortable, fast, and safe, a surprisingly large percentage of citizens will opt to  
 85 ride rather than drive.

**Figure 1**

Primary Occupation of Public Transportation Passengers in US Cities

**Figure 2**

Purpose of Public Transportation Trips in US Cities

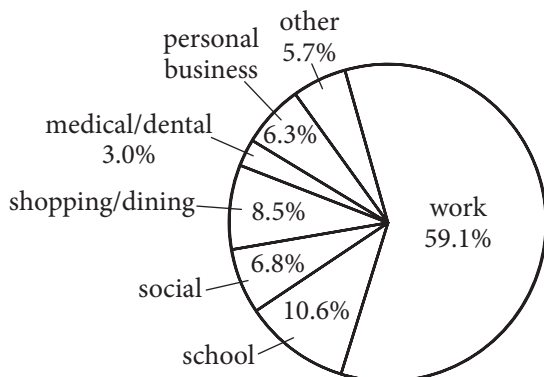


Figure 1 and figure 2 are adapted from the American Public Transportation Association, "A Profile of Public Transportation Passenger Demographics and Travel Characteristics Reported in On-Board Surveys." ©2007 by American Public Transportation Association.

11

What function does the third paragraph (lines 20-34) serve in the passage as a whole?

- A) It acknowledges that a practice favored by the author of the passage has some limitations.
- B) It illustrates with detail the arguments made in the first two paragraphs of the passage.
- C) It gives an overview of a problem that has not been sufficiently addressed by the experts mentioned in the passage.
- D) It advocates for abandoning a practice for which the passage as a whole provides mostly favorable data.

12

Which choice does the author explicitly cite as an advantage of automobile travel in North America?

- A) Environmental impact
- B) Convenience
- C) Speed
- D) Cost

13

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

- A) Lines 5-9 ("In . . . automobile")
- B) Lines 20-24 ("And . . . car")
- C) Lines 24-26 ("In . . . experience")
- D) Lines 32-34 ("Hopping . . . quickly")



14

The central idea of the fourth paragraph (lines 35-57) is that

- A) European countries excel at public transportation.
- B) some public transportation systems are superior to travel by private automobile.
- C) Americans should mimic foreign public transportation systems when possible.
- D) much international public transportation is engineered for passengers to work while on board.

15

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

- A) Line 35 (“It . . . this”)
- B) Lines 35-37 (“Done . . . automobile”)
- C) Lines 37-40 (“In . . . sound”)
- D) Lines 44-48 (“From . . . cities”)

16

As used in line 58, “credit” most nearly means

- A) endow.
- B) attribute.
- C) believe.
- D) honor.

17

As used in line 61, “favor” most nearly means

- A) indulge.
- B) prefer.
- C) resemble.
- D) serve.

18

Which choice best supports the conclusion that public transportation is compatible with the use of personal electronic devices?

- A) Lines 59-63 (“The . . . subways”)
- B) Lines 63-67 (“Part . . . annoyances”)
- C) Lines 68-70 (“Even . . . ago”)
- D) Lines 77-81 (“Already . . . homes”)

19

Which choice is supported by the data in the first figure?

- A) The number of students using public transportation is greater than the number of retirees using public transportation.
- B) The number of employed people using public transportation and the number of unemployed people using public transportation is roughly the same.
- C) People employed outside the home are less likely to use public transportation than are homemakers.
- D) Unemployed people use public transportation less often than do people employed outside the home.

20

Taken together, the two figures suggest that most people who use public transportation

- A) are employed outside the home and take public transportation to work.
- B) are employed outside the home but take public transportation primarily in order to run errands.
- C) use public transportation during the week but use their private cars on weekends.
- D) use public transportation only until they are able to afford to buy a car.

**Questions 21-30 are based on the following passage.**

This passage is adapted from Thor Hanson, *Feathers*.  
©2011 by Thor Hanson. Scientists have long debated how the ancestors of birds evolved the ability to fly. The ground-up theory assumes they were fleet-footed ground dwellers that captured prey by leaping and flapping their upper limbs. The tree-down theory assumes they were tree climbers that leapt and glided among branches.

At field sites around the world, Ken Dial saw a pattern in how young pheasants, quail, tinamous, and other ground birds ran along behind their  
Line parents. “They jumped up like popcorn,” he said,  
5 describing how they would flap their half-formed wings and take short hops into the air. So when a group of graduate students challenged him to come up with new data on the age-old ground-up-tree-down debate, he designed a project  
10 to see what clues might lie in how baby game birds learned to fly.

Ken settled on the Chukar Partridge as a model species, but he might not have made his discovery without a key piece of advice from the local  
15 rancher in Montana who was supplying him with birds. When the cowboy stopped by to see how things were going, Ken showed him his nice, tidy laboratory setup and explained how the birds’ first hops and flights would be measured. The rancher  
20 was incredulous. “He took one look and said, in pretty colorful language, ‘What are those birds doing on the ground? They hate to be on the ground! Give them something to climb on!’ ” At first it seemed unnatural—ground birds don’t like the ground? But  
25 as he thought about it Ken realized that all the species he’d watched in the wild preferred to rest on ledges, low branches, or other elevated perches where they were safe from predators. They really only used the ground for feeding and traveling. So he brought  
30 in some hay bales for the Chukars to perch on and then left his son in charge of feeding and data collection while he went away on a short work trip.

Barely a teenager at the time, young Terry Dial was visibly upset when his father got back. “I asked  
35 him how it went,” Ken recalled, “and he said,

“Terrible! The birds are cheating!” Instead of flying up to their perches, the baby Chukars were using their legs. Time and again Terry had watched them run right up the side of a hay bale, flapping all the  
40 while. Ken dashed out to see for himself, and that was the “aha” moment. “The birds were using their wings and legs cooperatively,” he told me, and that single observation opened up a world of possibilities.

Working together with Terry (who has since gone  
45 on to study animal locomotion), Ken came up with a series of ingenious experiments, filming the birds as they raced up textured ramps tilted at increasing angles. As the incline increased, the partridges began to flap, but they angled their wings differently from  
50 birds in flight. They aimed their flapping down and backward, using the force not for lift but to keep their feet firmly pressed against the ramp. “It’s like the spoiler on the back of a race car,” he explained, which is a very apt analogy. In Formula One racing,  
55 spoilers are the big aerodynamic fins that push the cars downward as they speed along, increasing traction and handling. The birds were doing the very same thing with their wings to help them scramble up otherwise impossible slopes.

60 Ken called the technique WAIR, for wing-assisted incline running, and went on to document it in a wide range of species. It not only allowed young birds to climb vertical surfaces within the first few weeks of life but also gave adults an energy-efficient  
65 alternative to flying. In the Chukar experiments, adults regularly used WAIR to ascend ramps steeper than 90 degrees, essentially running up the wall and onto the ceiling.

In an evolutionary context, WAIR takes on  
70 surprising explanatory powers. With one fell swoop, the Dials came up with a viable origin for the flapping flight stroke of birds (something gliding animals don’t do and thus a shortcoming of the tree-down theory) and an aerodynamic function for  
75 half-formed wings (one of the main drawbacks to the ground-up hypothesis).

21

Which choice best reflects the overall sequence of events in the passage?

- A) An experiment is proposed but proves unworkable; a less ambitious experiment is attempted, and it yields data that give rise to a new set of questions.
- B) A new discovery leads to reconsideration of a theory; a classic study is adapted, and the results are summarized.
- C) An anomaly is observed and simulated experimentally; the results are compared with previous findings, and a novel hypothesis is proposed.
- D) An unexpected finding arises during the early phase of a study; the study is modified in response to this finding, and the results are interpreted and evaluated.

22

As used in line 7, “challenged” most nearly means

- A) dared.
- B) required.
- C) disputed with.
- D) competed with.

23

Which statement best captures Ken Dial’s central assumption in setting up his research?

- A) The acquisition of flight in young birds sheds light on the acquisition of flight in their evolutionary ancestors.
- B) The tendency of certain young birds to jump erratically is a somewhat recent evolved behavior.
- C) Young birds in a controlled research setting are less likely than birds in the wild to require perches when at rest.
- D) Ground-dwelling and tree-climbing predecessors to birds evolved in parallel.

24

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

- A) Lines 1-4 (“At field . . . parents”)
- B) Lines 6-11 (“So when . . . fly”)
- C) Lines 16-19 (“When . . . measured”)
- D) Lines 23-24 (“At first . . . the ground”)

25

In the second paragraph (lines 12-32), the incident involving the local rancher mainly serves to

- A) reveal Ken Dial’s motivation for undertaking his project.
- B) underscore certain differences between laboratory and field research.
- C) show how an unanticipated piece of information influenced Ken Dial’s research.
- D) introduce a key contributor to the tree-down theory.

26

After Ken Dial had his “aha’ moment” (line 41), he

- A) tried to train the birds to fly to their perches.
- B) studied videos to determine why the birds no longer hopped.
- C) observed how the birds dealt with gradually steeper inclines.
- D) consulted with other researchers who had studied Chukar Partridges.

27

The passage identifies which of the following as a factor that facilitated the baby Chukars’ traction on steep ramps?

- A) The speed with which they climbed
- B) The position of their flapping wings
- C) The alternation of wing and foot movement
- D) Their continual hopping motions

28

As used in line 61, “document” most nearly means

- A) portray.
- B) record.
- C) publish.
- D) process.

29

What can reasonably be inferred about gliding animals from the passage?

- A) Their young tend to hop along beside their parents instead of flying beside them.
- B) Their method of locomotion is similar to that of ground birds.
- C) They use the ground for feeding more often than for perching.
- D) They do not use a flapping stroke to aid in climbing slopes.

30

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

- A) Lines 4-6 (“They jumped . . . air”)
- B) Lines 28-29 (“They really . . . traveling”)
- C) Lines 57-59 (“The birds . . . slopes”)
- D) Lines 72-74 (“something . . . theory”)

**Questions 31-41 are based on the following passages.**

Passage 1 is adapted from Talleyrand et al., *Report on Public Instruction*. Originally published in 1791. Passage 2 is adapted from Mary Wollstonecraft, *A Vindication of the Rights of Woman*. Originally published in 1792. Talleyrand was a French diplomat; the *Report* was a plan for national education. Wollstonecraft, a British novelist and political writer, wrote *Vindication* in response to Talleyrand.

**Passage 1**

That half the human race is excluded by the other half from any participation in government; that they are native by birth but foreign by law in the very land where they were born; and that they are

Line 5 property-owners yet have no direct influence or representation: are all political phenomena apparently impossible to explain on abstract principle. But on another level of ideas, the question changes and may be easily resolved. The purpose of

10 all these institutions must be the happiness of the greatest number. Everything that leads us farther from this purpose is in error; everything that brings us closer is truth. If the exclusion from public employments decreed against women leads to a

15 greater sum of mutual happiness for the two sexes, then this becomes a law that all Societies have been compelled to acknowledge and sanction.

Any other ambition would be a reversal of our primary destinies; and it will never be in women’s

20 interest to change the assignment they have received.

It seems to us incontestable that our common happiness, above all that of women, requires that they never aspire to the exercise of political rights and functions. Here we must seek their interests in

25 the wishes of nature. Is it not apparent, that their delicate constitutions, their peaceful inclinations, and the many duties of motherhood, set them apart from strenuous habits and onerous duties, and summon them to gentle occupations and the cares of the

30 home? And is it not evident that the great conserving principle of Societies, which makes the division of powers a source of harmony, has been expressed and revealed by nature itself, when it divided the functions of the two sexes in so obviously distinct a

35 manner? This is sufficient; we need not invoke principles that are inapplicable to the question. Let us not make rivals of life’s companions. You must, you truly must allow the persistence of a union that no interest, no rivalry, can possibly undo. Understand

40 that the good of all demands this of you.

**Passage 2**

Contending for the rights of woman, my main argument is built on this simple principle, that if she be not prepared by education to become the companion of man, she will stop the progress of  
 45 knowledge and virtue; for truth must be common to all, or it will be inefficacious with respect to its influence on general practice. And how can woman be expected to co-operate unless she know why she ought to be virtuous? unless freedom strengthen her  
 50 reason till she comprehend her duty, and see in what manner it is connected with her real good? If children are to be educated to understand the true principle of patriotism, their mother must be a patriot; and the love of mankind, from which  
 55 orderly train of virtues spring, can only be produced by considering the moral and civil interest of mankind; but the education and situation of woman, at present, shuts her out from such investigations. . . .

Consider, sir, dispassionately, these  
 60 observations—for a glimpse of this truth seemed to open before you when you observed, “that to see one half of the human race excluded by the other from all participation of government, was a political phenomenon that, according to abstract principles, it  
 65 was impossible to explain.” If so, on what does your constitution rest? If the abstract rights of man will bear discussion and explanation, those of woman, by a parity of reasoning, will not shrink from the same test: though a different opinion prevails in this  
 70 country, built on the very arguments which you use to justify the oppression of woman—prescription.

Consider—I address you as a legislator—whether, when men contend for their freedom, and to be allowed to judge for themselves respecting their  
 75 own happiness, it be not inconsistent and unjust to subjugate women, even though you firmly believe that you are acting in the manner best calculated to promote their happiness? Who made man the exclusive judge, if woman partake with him the gift  
 80 of reason?

In this style, argue tyrants of every denomination, from the weak king to the weak father of a family; they are all eager to crush reason; yet always assert that they usurp its throne only to be  
 85 useful. Do you not act a similar part, when you force all women, by denying them civil and political rights, to remain immured in their families groping in the dark?

31

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

- A) average.
- B) shared.
- C) coarse.
- D) similar.

32

It can be inferred that the authors of Passage 1 believe that running a household and raising children

- A) are rewarding for men as well as for women.
- B) yield less value for society than do the roles performed by men.
- C) entail very few activities that are difficult or unpleasant.
- D) require skills similar to those needed to run a country or a business.

33

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

- A) Lines 4-6 (“they are . . . representation”)
- B) Lines 13-17 (“If the . . . sanction”)
- C) Lines 25-30 (“Is it . . . home”)
- D) Lines 30-35 (“And . . . manner”)

34

According to the author of Passage 2, in order for society to progress, women must

- A) enjoy personal happiness and financial security.
- B) follow all currently prescribed social rules.
- C) replace men as figures of power and authority.
- D) receive an education comparable to that of men.

35

As used in line 50, “reason” most nearly means

- A) motive.
- B) sanity.
- C) intellect.
- D) explanation.

36

In Passage 2, the author claims that freedoms granted by society’s leaders have

- A) privileged one gender over the other.
- B) resulted in a general reduction in individual virtue.
- C) caused arguments about the nature of happiness.
- D) ensured equality for all people.

37

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

- A) Lines 41-45 (“Contending . . . virtue”)
- B) Lines 45-47 (“truth . . . practice”)
- C) Lines 65-66 (“If so . . . rest”)
- D) Lines 72-78 (“Consider . . . happiness”)

38

In lines 61-65, the author of Passage 2 refers to a statement made in Passage 1 in order to

- A) call into question the qualifications of the authors of Passage 1 regarding gender issues.
- B) dispute the assertion made about women in the first sentence of Passage 1.
- C) develop her argument by highlighting what she sees as flawed reasoning in Passage 1.
- D) validate the concluding declarations made by the authors of Passage 1 about gender roles.

39

Which best describes the overall relationship between Passage 1 and Passage 2?

- A) Passage 2 strongly challenges the point of view in Passage 1.
- B) Passage 2 draws alternative conclusions from the evidence presented in Passage 1.
- C) Passage 2 elaborates on the proposal presented in Passage 1.
- D) Passage 2 restates in different terms the argument presented in Passage 1.

40

The authors of both passages would most likely agree with which of the following statements about women in the eighteenth century?

- A) Their natural preferences were the same as those of men.
- B) They needed a good education to be successful in society.
- C) They were just as happy in life as men were.
- D) They generally enjoyed fewer rights than men did.

41

How would the authors of Passage 1 most likely respond to the points made in the final paragraph of Passage 2?

- A) Women are not naturally suited for the exercise of civil and political rights.
- B) Men and women possess similar degrees of reasoning ability.
- C) Women do not need to remain confined to their traditional family duties.
- D) The principles of natural law should not be invoked when considering gender roles.

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

This passage is adapted from Richard J. Sharpe and Lisa Heyden, "Honey Bee Colony Collapse Disorder is Possibly Caused by a Dietary Pyrethrum Deficiency." ©2009 by Elsevier Ltd. Colony collapse disorder is characterized by the disappearance of adult worker bees from hives.

Honey bees are hosts to the pathogenic large ectoparasitic mite *Varroa destructor* (Varroa mites).

Line These mites feed on bee hemolymph (blood) and can  
kill bees directly or by increasing their susceptibility  
5 to secondary infection with fungi, bacteria or viruses.  
Little is known about the natural defenses that keep  
the mite infections under control.

Pyrethrums are a group of flowering plants which  
include *Chrysanthemum coccineum*, *Chrysanthemum*  
10 *cinerariifolium*, *Chrysanthemum marschalli*, and  
related species. These plants produce potent  
insecticides with anti-mite activity. The naturally  
occurring insecticides are known as pyrethrums.

A synonym for the naturally occurring pyrethrums is  
15 pyrethrin and synthetic analogues of pyrethrums are  
known as pyrethroids. In fact, the human mite  
infestation known as scabies (*Sarcoptes scabiei*) is  
treated with a topical pyrethrum cream.

We suspect that the bees of commercial bee  
20 colonies which are fed mono-crops are nutritionally  
deficient. In particular, we postulate that the problem  
is a diet deficient in anti-mite toxins: pyrethrums,  
and possibly other nutrients which are inherent in  
such plants. Without, at least, intermittent feeding on  
25 the pyrethrum producing plants, bee colonies are  
susceptible to mite infestations which can become  
fatal either directly or due to a secondary infection of  
immunocompromised or nutritionally deficient bees.  
This secondary infection can be viral, bacterial or  
30 fungal and may be due to one or more pathogens.  
In addition, immunocompromised or nutritionally  
deficient bees may be further weakened when  
commercially produced insecticides are introduced  
into their hives by bee keepers in an effort to fight  
35 mite infestation. We further postulate that the proper  
dosage necessary to prevent mite infestation may be  
better left to the bees, who may seek out or avoid  
pyrethrum containing plants depending on the  
amount necessary to defend against mites and the  
40 amount already consumed by the bees, which in  
higher doses could be potentially toxic to them.

This hypothesis can best be tested by a trial  
wherein a small number of commercial honey bee  
colonies are offered a number of pyrethrum  
45 producing plants, as well as a typical bee food source  
such as clover, while controls are offered only the  
clover. Mites could then be introduced to each hive  
with note made as to the choice of the bees, and the  
effects of the mite parasites on the experimental  
50 colonies versus control colonies.

It might be beneficial to test wild-type honey bee  
colonies in this manner as well, in case there could be  
some genetic difference between them that affects the  
bees' preferences for pyrethrum producing flowers.

Pathogen Occurrence in Honey Bee Colonies With and  
Without Colony Collapse Disorder

Pathogen	Percent of colonies affected by pathogen	
	Colonies with colony collapse disorder (%)	Colonies without colony collapse disorder (%)
Viruses		
IAPV	83	5
KBV	100	76
Fungi		
<i>Nosema apis</i>	90	48
<i>Nosema ceranae</i>	100	81
All four pathogens	77	0

Adapted from Diana L. Cox-Foster et al., "A Metagenomic Survey of Microbes in Honey Bee Colony Collapse Disorder." ©2007 by American Association for the Advancement of Science.

The table above shows, for colonies with colony collapse disorder and for colonies without colony collapse disorder, the percent of colonies having honey bees infected by each of four pathogens and by all four pathogens together.

42

How do the words “can,” “may,” and “could” in the third paragraph (lines 19-41) help establish the tone of the paragraph?

- A) They create an optimistic tone that makes clear the authors are hopeful about the effects of their research on colony collapse disorder.
- B) They create a dubious tone that makes clear the authors do not have confidence in the usefulness of the research described.
- C) They create a tentative tone that makes clear the authors suspect but do not know that their hypothesis is correct.
- D) They create a critical tone that makes clear the authors are skeptical of claims that pyrethrums are inherent in mono-crops.

43

In line 42, the authors state that a certain hypothesis “can best be tested by a trial.” Based on the passage, which of the following is a hypothesis the authors suggest be tested in a trial?

- A) Honeybees that are exposed to both pyrethrums and mites are likely to develop a secondary infection by a virus, a bacterium, or a fungus.
- B) Beekeepers who feed their honeybee colonies a diet of a single crop need to increase the use of insecticides to prevent mite infestations.
- C) A honeybee diet that includes pyrethrums results in honeybee colonies that are more resistant to mite infestations.
- D) Humans are more susceptible to varroa mites as a result of consuming nutritionally deficient food crops.

44

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

- A) Lines 3-5 (“These mites . . . viruses”)
- B) Lines 16-18 (“In fact . . . cream”)
- C) Lines 19-21 (“We suspect . . . deficient”)
- D) Lines 24-28 (“Without . . . bees”)

45

The passage most strongly suggests that beekeepers’ attempts to fight mite infestations with commercially produced insecticides have what unintentional effect?

- A) They increase certain mite populations.
- B) They kill some beneficial forms of bacteria.
- C) They destroy bees’ primary food source.
- D) They further harm the health of some bees.

46

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

- A) Lines 1-2 (“Honey bees . . . mites”)
- B) Lines 6-7 (“Little . . . control”)
- C) Lines 31-35 (“In addition . . . infestation”)
- D) Lines 47-50 (“Mites . . . control colonies”)

47

As used in line 35, “postulate” most nearly means to

- A) make an unfounded assumption.
- B) put forth an idea or claim.
- C) question a belief or theory.
- D) conclude based on firm evidence.

48

The main purpose of the fourth paragraph (lines 42-50) is to

- A) summarize the results of an experiment that confirmed the authors’ hypothesis about the role of clover in the diets of wild-type honeybees.
- B) propose an experiment to investigate how different diets affect commercial honeybee colonies’ susceptibility to mite infestations.
- C) provide a comparative nutritional analysis of the honey produced by the experimental colonies and by the control colonies.
- D) predict the most likely outcome of an unfinished experiment summarized in the third paragraph (lines 19-41).



49

An unstated assumption made by the authors about clover is that the plants

- A) do not produce pyrethrums.
- B) are members of the *Chrysanthemum* genus.
- C) are usually located near wild-type honeybee colonies.
- D) will not be a good food source for honeybees in the control colonies.

50

Based on data in the table, in what percent of colonies with colony collapse disorder were the honeybees infected by all four pathogens?

- A) 0 percent
- B) 77 percent
- C) 83 percent
- D) 100 percent

51

Based on data in the table, which of the four pathogens infected the highest percentage of honeybee colonies without colony collapse disorder?

- A) IAPV
- B) KBV
- C) *Nosema apis*
- D) *Nosema ceranae*

52

Do the data in the table provide support for the authors' claim that infection with varroa mites increases a honeybee's susceptibility to secondary infections?

- A) Yes, because the data provide evidence that infection with a pathogen caused the colonies to undergo colony collapse disorder.
- B) Yes, because for each pathogen, the percent of colonies infected is greater for colonies with colony collapse disorder than for colonies without colony collapse disorder.
- C) No, because the data do not provide evidence about bacteria as a cause of colony collapse disorder.
- D) No, because the data do not indicate whether the honeybees had been infected with mites.

**STOP**

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

# Writing and Language Test

35 MINUTES, 44 QUESTIONS

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

## DIRECTIONS

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

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

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

Questions 1-11 are based on the following passage.

### Shed Some Light on the Workplace

Studies have shown that employees are happier, **1** healthier, and more productive when they work in an environment **2** in which temperatures are carefully controlled. New buildings may be designed with these studies in mind, but many older buildings were not, resulting in spaces that often depend primarily on artificial lighting. While employers may balk at the expense of reconfiguring such buildings to increase the amount of natural light, the investment has been shown to be well worth it in the long run—for both employees and employers.

1

- A) NO CHANGE
- B) healthy, and more
- C) healthier, and they are
- D) healthier, being more

2

Which choice provides the most appropriate introduction to the passage?

- A) NO CHANGE
- B) that affords them adequate amounts of natural light.
- C) that is thoroughly sealed to prevent energy loss.
- D) in which they feel comfortable asking managers for special accommodations.

For one thing, lack of exposure to natural light has a significant impact on employees' health. A study conducted in 2013 by Northwestern University in Chicago showed that inadequate natural light could result in eye strain, headaches, and fatigue, as well as interference with the body's circadian rhythms. **3** Circadian rhythms, which are controlled by the **4** bodies biological clocks, influence body temperature, hormone release, cycles of sleep and wakefulness, and other bodily functions. Disruptions of circadian rhythms have been linked to sleep disorders, diabetes, depression, and bipolar disorder. Like any other health problems, these ailments can increase employee absenteeism, which, in turn, **5** is costly for employers. Employees who feel less than 100 percent and are sleep deprived are also less prone to work at their maximal productivity. One company in California **6** gained a huge boost in its employees' morale when it moved from an artificially lit distribution facility to one with natural illumination.

3

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

Workers in offices with windows sleep an average of 46 minutes more per night than workers in offices without windows.

Should the writer make this addition here?

- A) Yes, because it supplies quantitative data that will be examined in the rest of the paragraph.
- B) Yes, because it explains the nature of the bodily functions referred to in the next sentence.
- C) No, because it interrupts the discussion of circadian rhythms.
- D) No, because it does not take into account whether workers were exposed to sunlight outside the office.

4

- A) NO CHANGE
- B) bodies' biological clocks',
- C) body's biological clocks,
- D) body's biological clock's,

5

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

6

Which choice best supports the statement made in the previous sentence?

- A) NO CHANGE
- B) saw a 5 percent increase in productivity
- C) saved a great deal on its operational costs
- D) invested large amounts of time and capital

7 Artificial light sources are also costly aside from lowering worker productivity. They typically constitute anywhere from 25 to 50 percent of a building's energy use. When a plant in Seattle, Washington, was redesigned for more natural light, the company was able to enjoy annual electricity cost reductions of \$500,000 8 each year.

7

In context, which choice best combines the underlined sentences?

- A) Aside from lowering worker productivity, artificial light sources are also costly, typically constituting anywhere from 25 to 50 percent of a building's energy use.
- B) The cost of artificial light sources, aside from lowering worker productivity, typically constitutes anywhere from 25 to 50 percent of a building's energy use.
- C) Typically constituting 25 to 50 percent of a building's energy use, artificial light sources lower worker productivity and are costly.
- D) Artificial lights, which lower worker productivity and are costly, typically constitute anywhere from 25 to 50 percent of a building's energy use.

8

- A) NO CHANGE
- B) every year.
- C) per year.
- D) DELETE the underlined portion and end the sentence with a period.

Among the possibilities to reconfigure a building's lighting is the installation of full-pane windows to allow the greatest degree of sunlight to reach office interiors.

**9** Thus, businesses can install light tubes, **10** these are pipes placed in workplace roofs to capture and funnel sunlight down into a building's interior. Glass walls and dividers can also be used to replace solid walls as a means **11** through distributing natural light more freely. Considering the enormous costs of artificial lighting, both in terms of money and productivity, investment in such improvements should be a natural choice for businesses.

9

- A) NO CHANGE
- B) Nevertheless,
- C) Alternatively,
- D) Finally,

10

- A) NO CHANGE
- B) they are
- C) which are
- D) those being

11

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

Questions 12-22 are based on the following passage.

### Transforming the American West Through Food and Hospitality

Just as travelers taking road trips today may need to take a break for food at a rest area along the highway, settlers traversing the American West by train in the mid-1800s often found **12** themselves in need of refreshment. However, food available on rail lines was generally of terrible quality. **13** Despite having worked for railroad companies, Fred Harvey, an English-born **14** entrepreneur. He decided to open his own restaurant business to serve rail customers. Beginning in the 1870s, he opened dozens of restaurants in rail stations and dining cars. These Harvey Houses, which constituted the first restaurant chain in the United States, **15** was unique for its high standards of service and quality. The menu was modeled after those of fine restaurants, so the food was leagues beyond the **16** sinister fare travelers were accustomed to receiving in transit.

12

- A) NO CHANGE
- B) himself or herself
- C) their selves
- D) oneself

13

Which choice provides the most logical introduction to the sentence?

- A) NO CHANGE
- B) He had lived in New York and New Orleans, so
- C) To capitalize on the demand for good food,
- D) DELETE the underlined portion.

14

- A) NO CHANGE
- B) entrepreneur:
- C) entrepreneur; he
- D) entrepreneur,

15

- A) NO CHANGE
- B) were unique for their
- C) was unique for their
- D) were unique for its

16

Which choice best maintains the tone established in the passage?

- A) NO CHANGE
- B) surly
- C) abysmal
- D) icky

His restaurants were immediately successful, but Harvey was not content to follow conventional business practices. **17** Although women did not traditionally work in restaurants in the nineteenth century, Harvey decided to try employing women as waitstaff. In 1883, he placed an advertisement seeking educated, well-mannered, articulate young women between the ages of 18 and 30. **18** Response to the advertisement was overwhelming, even tremendous, and Harvey soon replaced the male servers at his restaurants with women. Those who were hired as “Harvey Girls” joined an elite group of workers, who were expected to complete a 30-day training program and follow a strict code of rules for conduct and curfews. In the workplace, the women donned identical black-and-white uniforms and carried out their duties with precision. Not only were such regulations meant to ensure the efficiency of the business and the safety of the workers, **19** but also helped to raise people’s generally low opinion of the restaurant industry.

17

The writer is considering deleting the previous sentence. Should the writer make this change?

- A) Yes, because it introduces information that is irrelevant at this point in the passage.
- B) Yes, because it does not logically follow from the previous paragraph.
- C) No, because it provides a logical introduction to the paragraph.
- D) No, because it provides a specific example in support of arguments made elsewhere in the passage.

18

- A) NO CHANGE
- B) Response to the advertisement was overwhelming,
- C) Overwhelming, even tremendous, was the response to the advertisement,
- D) There was an overwhelming, even tremendous, response to the advertisement,

19

- A) NO CHANGE
- B) but also helping
- C) also helping
- D) but they also helped

In return for the servers' work, the position paid quite well for the time: \$17.50 a month, plus tips, meals, room and board, laundry service, and travel expenses. **20**

For as long as Harvey Houses served rail travelers through the mid-twentieth century, working there was a steady and lucrative position for women. Living independently and demonstrating an intense work **21** ethic; the Harvey Girls became known as a transformative force in the American **22** West. Advancing the roles of women in the restaurant industry and the American workforce as a whole, the Harvey Girls raised the standards for restaurants and blazed a trail in the fast-changing landscape of the western territories.

20

Which choice most logically follows the previous sentence?

- A) The growth of Harvey's business coincided with the expansion of the Santa Fe Railway, which served large sections of the American West.
- B) Harvey would end up opening dozens of restaurants and dining cars, plus 15 hotels, over his lucrative career.
- C) These benefits enabled the Harvey Girls to save money and build new and exciting lives for themselves in the so-called Wild West.
- D) The compensation was considered excellent at the time, though it may not seem like much money by today's standards.

21

- A) NO CHANGE
- B) ethic:
- C) ethic, and
- D) ethic,

22

The writer is considering revising the underlined portion of the sentence to read:

West, inspiring books, documentaries, and even a musical.

Should the writer add this information here?

- A) Yes, because it provides examples of the Harvey Girls' influence.
- B) Yes, because it serves as a transitional point in the paragraph.
- C) No, because it should be placed earlier in the passage.
- D) No, because it contradicts the main claim of the passage.



Questions 23-33 are based on the following passage and supplementary material.

### How Do You Like Those Apples?

Marketed as SmartFresh, the chemical 1-MCP (1-methylcyclopropene) has been used by fruit growers since 2002 in the United States and elsewhere to preserve the crispness and lengthen the storage life of apples and other fruit, which often must travel long distances before being eaten by consumers. **23** 1-MCP lengthens storage life by three to four times when applied to apples. This extended life allows producers to sell their apples in the off-season, months after the apples have been harvested. And at a cost of about one cent per pound of apples, 1-MCP is a highly cost-effective treatment. However, 1-MCP is not a panacea for fruit producers or sellers: there are problems and limitations associated with its use.

23

Which choice most effectively combines the underlined sentences?

- A) When applied to apples, 1-MCP lengthens storage life by three to four times, allowing producers to sell their apples in the off-season, months after the apples have been harvested.
- B) Producers are allowed to sell their apples months after they have been harvested—in the off-season—because 1-MCP, when applied to apples, lengthens their storage life by three to four times.
- C) 1-MCP lengthens storage life, when applied to apples, by three to four times, allowing producers to sell their apples months after the apples have been harvested in the off-season.
- D) Months after apples have been harvested, producers are allowed to sell their apples, in the off-season, because 1-MCP lengthens storage life when applied to apples by three to four times.

[1] 1-MCP works by limiting a fruit's production of ethylene, **24** it is a chemical that causes fruit to ripen and eventually rot. [2] While 1-MCP keeps apples **25** tight and crisp for months, it also limits **26** their scent production. [3] This may not be much of a problem with certain kinds of apples that are not naturally very fragrant, such as Granny Smith, but for apples that are prized for their fruity fragrance, such as McIntosh, this can be a problem with consumers, **27** that will reject apples lacking the expected aroma. [4] But some fruits do not respond as well to 1-MCP as others **28** did, and some even respond adversely. [5] Furthermore, some fruits, particularly those that naturally produce a large

24

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

25

- A) NO CHANGE
- B) firm
- C) stiff
- D) taut

26

- A) NO CHANGE
- B) there
- C) its
- D) it's

27

- A) NO CHANGE
- B) they
- C) which
- D) who

28

- A) NO CHANGE
- B) do,
- C) have,
- D) will,

amount of ethylene, do not respond as well to 1-MCP treatment. [6] Take Bartlett **29** pears, for instance, unless they are treated with exactly the right amount of 1-MCP at exactly the right time, they will remain hard and green until they rot, and consumers who experience this will be unlikely to purchase them again. **30**

**29**

- A) NO CHANGE
- B) pears, for instance:
- C) pears for instance,
- D) pears. For instance,

**30**

To make this paragraph most logical, sentence 4 should be placed

- A) where it is now.
- B) after sentence 1.
- C) after sentence 2.
- D) after sentence 5.

Finally, researchers have found that 1-MCP actually increases susceptibility to some pathologies in certain apple varieties. For example, Empire apples are prone to a condition that causes the flesh of the apple to turn brown. Traditionally, apple producers have dealt with this problem by leaving the apples in the open air for three weeks before storing them in a controlled atmosphere with tightly regulated temperature, humidity, and carbon dioxide levels. As the graph shows, the flesh of untreated Empire apples that are first stored in the open air undergoes **31** roughly five percent less browning than the flesh of untreated Empire apples that are immediately put into storage in a controlled environment. However, when Empire apples are treated with 1-MCP, **32** their flesh turns brown when the apples are first stored in the open air, though not under other conditions. Although

31

Which choice offers an accurate interpretation of the data in the graph?

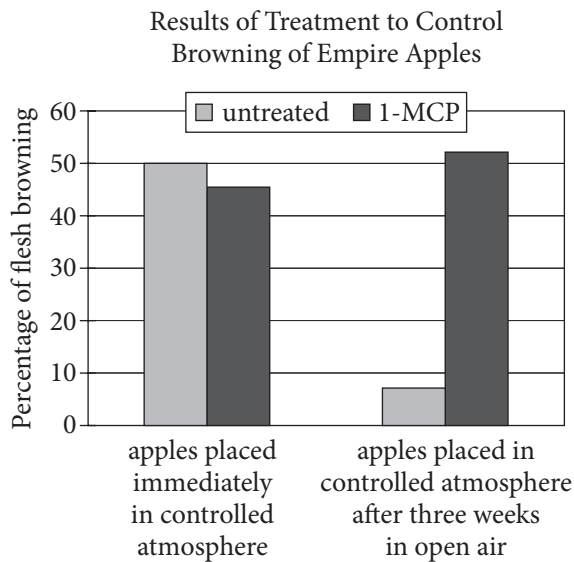
- A) NO CHANGE
- B) slightly more browning than
- C) twice as much browning as
- D) substantially less browning than

32

Which choice offers an accurate interpretation of the data in the graph?

- A) NO CHANGE
- B) roughly half of their flesh turns brown, regardless of whether the apples are first stored in the open air.
- C) their flesh browns when they are put directly into a controlled atmosphere but not when they are first stored in the open air.
- D) their flesh turns brown when they are first stored in the open air, though not as quickly as the apple flesh in an untreated group does.

researchers continue to search for the right combination of factors that will keep fruits fresh and attractive, **33** the problem may be that consumers are overly concerned with superficial qualities rather than the actual freshness of the fruit.



Adapted from Hannah J. James, Jacqueline F. Nock, and Chris B. Watkins, "The Failure of Postharvest Treatments to Control Firm Flesh Browning in Empire Apples." ©2010 by The New York State Horticultural Society.

33

The writer wants a conclusion that conveys how the shortcomings of 1-MCP presented in the passage affect the actions of people in the fruit industry. Which choice best accomplishes this goal?

- A) NO CHANGE
- B) many of the improvements to fruit quality they have discovered so far have required trade-offs in other properties of the fruit.
- C) for now many fruit sellers must weigh the relative values of aroma, color, and freshness when deciding whether to use 1-MCP.
- D) it must be acknowledged that 1-MCP, despite some inadequacies, has enabled the fruit industry to ship and store fruit in ways that were impossible before.

Questions 34-44 are based on the following passage.

### More than One Way to Dress a Cat

From Michelangelo's *David* to Vincent van Gogh's series of self-portraits to Grant Wood's iconic image of a farming couple in *American Gothic*, **34** Gothic. These works by human artists have favored representations of members of their own species to those of other species. Indeed, when we think about animals depicted in well-known works of art, the image of dogs playing poker—popularized in a series of paintings by American artist C. M. **35** Coolidge, may be the first and only one that comes to mind. Yet some of the earliest known works of art, including paintings and drawings tens of thousands of years old found on cave walls in Spain and France, **36** portrays animals. Nor has artistic homage to our fellow creatures entirely died out in the millennia since, **37** despite the many years that have passed between then and now.

34

- A) NO CHANGE
- B) *Gothic*. Works
- C) *Gothic*; these works
- D) *Gothic*, works

35

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

36

- A) NO CHANGE
- B) portraying
- C) portray
- D) has portrayed

37

The writer wants to link the first paragraph with the ideas that follow. Which choice best accomplishes this goal?

- A) NO CHANGE
- B) with special attention being paid to domestic animals such as cats.
- C) even though most paintings in museums are of people, not animals.
- D) as the example of one museum in Russia shows.

[1] The State Hermitage Museum in St. Petersburg, one of Russia's greatest art museums, has long had a productive partnership with a much loved animal: the cat. [2] For centuries, cats have guarded this famous museum, ridding it of mice, rats, and other rodents that could damage the art, not to mention **38** scared off visitors. [3] Peter the Great introduced the first cat to the Hermitage in the early eighteenth century. [4] Later Catherine the Great declared the cats to be official guardians of the galleries. [5] Continuing the tradition, Peter's daughter Elizaveta introduced the best and strongest cats in Russia to the Hermitage. [6] Today, the museum holds a yearly festival honoring these faithful workers. **39**

**38**

- A) NO CHANGE
- B) scaring
- C) scare
- D) have scared

**39**

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

- A) where it is now.
- B) after sentence 1.
- C) after sentence 3.
- D) after sentence 6.

These cats are so cherished by the museum that officials recently **40** decreed original paintings to be made of six of them. In each, a cat is depicted upright in a humanlike pose and clothed in imperial-era Russian attire. The person chosen for this **41** task, digital artist, Eldar Zakirov painted the cats in the style traditionally used by portrait artists, in so doing **42** presenting the cats as noble individuals worthy of respect. One portrait, *The Hermitage Court Chamber Herald Cat*, includes an

40

- A) NO CHANGE
- B) commissioned
- C) forced
- D) licensed

41

- A) NO CHANGE
- B) task, digital artist, Eldar Zakirov,
- C) task digital artist Eldar Zakirov,
- D) task, digital artist Eldar Zakirov,

42

Which choice most effectively sets up the examples that follow?

- A) NO CHANGE
- B) managing to capture unique characteristics of each cat.
- C) commenting on the absurdity of dressing up cats in royal robes.
- D) indicating that the cats were very talented mouse catchers.



aristocratic tilt of feline ears as well as a stately sweep of tail emerging from the stiff scarlet and gold of royal court dress. The wise, thoughtful green eyes of the subject of *The Hermitage Court Outrunner Cat* mimic those of a trusted royal advisor. **43** Some may find it peculiar to observe cats portrayed in formal court poses, but these felines, by **44** mastering the art of killing mice and rats, are benefactors of the museum as important as any human.

43

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

The museum occupies six historic buildings, including the Winter Palace, a former residence of Russian emperors.

Should the writer make this addition here?

- A) Yes, because it shows the link between Peter the Great and the cat paintings.
- B) Yes, because it helps explain why Russian art celebrates animals.
- C) No, because it fails to indicate why the Winter Palace became an art museum.
- D) No, because it provides background information that is irrelevant to the paragraph.

44

- A) NO CHANGE
- B) acting as the lead predator in the museum's ecosystem,
- C) hunting down and killing all the mice and rats one by one,
- D) protecting the museum's priceless artworks from destructive rodents,

## STOP

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



# Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

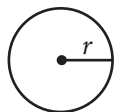
## DIRECTIONS

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

## NOTES

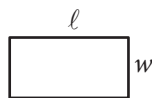
- The use of a calculator **is not permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated,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

## REFERENCE

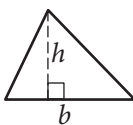


$$A = \pi r^2$$

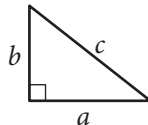
$$C = 2\pi r$$



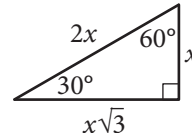
$$A = \ell w$$



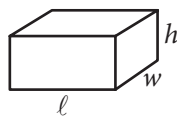
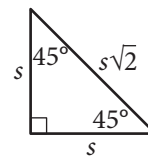
$$A = \frac{1}{2}bh$$



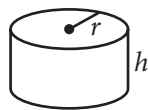
$$c^2 = a^2 + b^2$$



Special Right Triangles



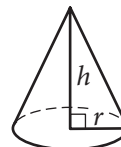
$$V = \ell wh$$



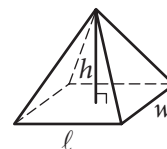
$$V = \pi r^2 h$$



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



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



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

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

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

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



1

A painter will paint  $n$  walls with the same size and shape in a building using a specific brand of paint. The painter's fee can be calculated by the expression  $nK\ell h$ , where  $n$  is the number of walls,  $K$  is a constant with units of dollars per square foot,  $\ell$  is the length of each wall in feet, and  $h$  is the height of each wall in feet. If the customer asks the painter to use a more expensive brand of paint, which of the factors in the expression would change?

- A)  $h$
- B)  $\ell$
- C)  $K$
- D)  $n$

2

If  $3r = 18$ , what is the value of  $6r + 3$  ?

- A) 6
- B) 27
- C) 36
- D) 39

3

Which of the following is equal to  $a^{\frac{2}{3}}$ , for all values of  $a$  ?

- A)  $\sqrt{\frac{1}{a^3}}$
- B)  $\sqrt{a^3}$
- C)  $\sqrt[3]{\frac{1}{a^2}}$
- D)  $\sqrt[3]{a^2}$

4

The number of states that joined the United States between 1776 and 1849 is twice the number of states that joined between 1850 and 1900. If 30 states joined the United States between 1776 and 1849 and  $x$  states joined between 1850 and 1900, which of the following equations is true?

- A)  $30x = 2$
- B)  $2x = 30$
- C)  $\frac{x}{2} = 30$
- D)  $x + 30 = 2$



5

If  $\frac{5}{x} = \frac{15}{x+20}$ , what is the value of  $\frac{x}{5}$  ?

- A) 10
- B) 5
- C) 2
- D)  $\frac{1}{2}$

6

$$\begin{aligned} 2x - 3y &= -14 \\ 3x - 2y &= -6 \end{aligned}$$

If  $(x, y)$  is a solution to the system of equations above, what is the value of  $x - y$  ?

- A) -20
- B) -8
- C) -4
- D) 8

7

$x$	$f(x)$
0	3
2	1
4	0
5	-2

The function  $f$  is defined by a polynomial. Some values of  $x$  and  $f(x)$  are shown in the table above. Which of the following must be a factor of  $f(x)$  ?

- A)  $x - 2$
- B)  $x - 3$
- C)  $x - 4$
- D)  $x - 5$

8

The line  $y = kx + 4$ , where  $k$  is a constant, is graphed in the  $xy$ -plane. If the line contains the point  $(c, d)$ , where  $c \neq 0$  and  $d \neq 0$ , what is the slope of the line in terms of  $c$  and  $d$  ?

- A)  $\frac{d-4}{c}$
- B)  $\frac{c-4}{d}$
- C)  $\frac{4-d}{c}$
- D)  $\frac{4-c}{d}$



9

$$kx - 3y = 4$$

$$4x - 5y = 7$$

In the system of equations above,  $k$  is a constant and  $x$  and  $y$  are variables. For what value of  $k$  will the system of equations have no solution?

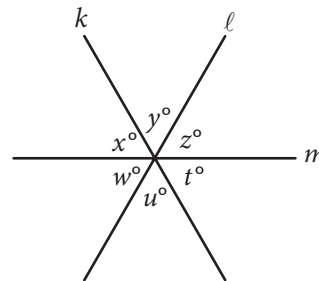
- A)  $\frac{12}{5}$   
 B)  $\frac{16}{7}$   
 C)  $-\frac{16}{7}$   
 D)  $-\frac{12}{5}$

10

In the  $xy$ -plane, the parabola with equation  $y = (x - 11)^2$  intersects the line with equation  $y = 25$  at two points,  $A$  and  $B$ . What is the length of  $\overline{AB}$ ?

- A) 10  
 B) 12  
 C) 14  
 D) 16

11



Note: Figure not drawn to scale.

In the figure above, lines  $k$ ,  $l$ , and  $m$  intersect at a point. If  $x + y = u + w$ , which of the following must be true?

- I.  $x = z$   
 II.  $y = w$   
 III.  $z = t$
- A) I and II only  
 B) I and III only  
 C) II and III only  
 D) I, II, and III

12

$$y = a(x - 2)(x + 4)$$

In the quadratic equation above,  $a$  is a nonzero constant. The graph of the equation in the  $xy$ -plane is a parabola with vertex  $(c, d)$ . Which of the following is equal to  $d$ ?

- A)  $-9a$   
 B)  $-8a$   
 C)  $-5a$   
 D)  $-2a$



13

The equation  $\frac{24x^2 + 25x - 47}{ax - 2} = -8x - 3 - \frac{53}{ax - 2}$  is

true for all values of  $x \neq \frac{2}{a}$ , where  $a$  is a constant.

What is the value of  $a$  ?

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

14

What are the solutions to  $3x^2 + 12x + 6 = 0$  ?

- A)  $x = -2 \pm \sqrt{2}$
- B)  $x = -2 \pm \frac{\sqrt{30}}{3}$
- C)  $x = -6 \pm \sqrt{2}$
- D)  $x = -6 \pm 6\sqrt{2}$

15

$$C = \frac{5}{9}(F - 32)$$

The equation above shows how a temperature  $F$ , measured in degrees Fahrenheit, relates to a temperature  $C$ , measured in degrees Celsius. Based on the equation, which of the following must be true?

- I. A temperature increase of 1 degree Fahrenheit is equivalent to a temperature increase of  $\frac{5}{9}$  degree Celsius.
- II. A temperature increase of 1 degree Celsius is equivalent to a temperature increase of 1.8 degrees Fahrenheit.
- III. A temperature increase of  $\frac{5}{9}$  degree Fahrenheit is equivalent to a temperature increase of 1 degree Celsius.

- A) I only
- B) II only
- C) III only
- D) I and II only

**DIRECTIONS**

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

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

Write answer in boxes. →

Grid in result. ←

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

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

← Fraction line

Answer: 2.5

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

← Decimal point

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

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

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

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

Answer: 201 – either position is correct

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

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

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



16

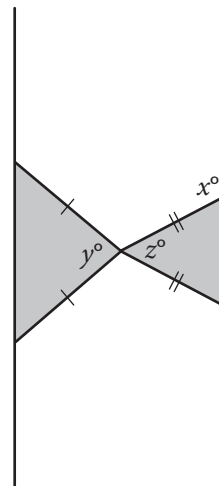
$$x^3(x^2 - 5) = -4x$$

If  $x > 0$ , what is one possible solution to the equation above?

17

If  $\frac{7}{9}x - \frac{4}{9}x = \frac{1}{4} + \frac{5}{12}$ , what is the value of  $x$ ?

18



Note: Figure not drawn to scale.

Two isosceles triangles are shown above. If  $180 - z = 2y$  and  $y = 75$ , what is the value of  $x$ ?





19

At a lunch stand, each hamburger has 50 more calories than each order of fries. If 2 hamburgers and 3 orders of fries have a total of 1700 calories, how many calories does a hamburger have?

20

In triangle  $ABC$ , the measure of  $\angle B$  is  $90^\circ$ ,  $BC = 16$ , and  $AC = 20$ . Triangle  $DEF$  is similar to triangle  $ABC$ , where vertices  $D$ ,  $E$ , and  $F$  correspond to vertices  $A$ ,  $B$ , and  $C$ , respectively, and each side of triangle  $DEF$  is  $\frac{1}{3}$  the length of the corresponding side of triangle  $ABC$ . What is the value of  $\sin F$  ?

**STOP**

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



# Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

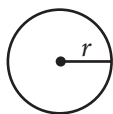
## DIRECTIONS

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

## NOTES

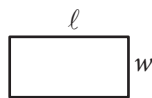
- The use of a calculator is permitted.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated, the domain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

## REFERENCE

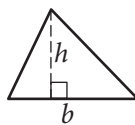


$$A = \pi r^2$$

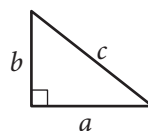
$$C = 2\pi r$$



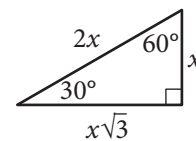
$$A = \ell w$$



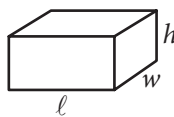
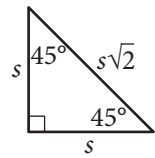
$$A = \frac{1}{2}bh$$



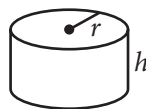
$$c^2 = a^2 + b^2$$



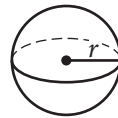
Special Right Triangles



$$V = \ell wh$$



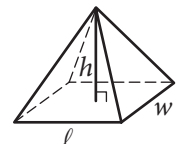
$$V = \pi r^2 h$$



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



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



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

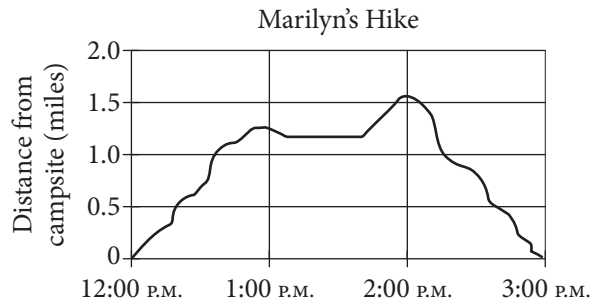
The number of degrees of arc in a circle is 360.

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

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



1



The graph above shows Marilyn's distance from her campsite during a 3-hour hike. She stopped for 30 minutes during her hike to have lunch. Based on the graph, which of the following is closest to the time she finished lunch and continued her hike?

- A) 12:40 P.M.
- B) 1:10 P.M.
- C) 1:40 P.M.
- D) 2:00 P.M.

2

Gender	Age		Total
	Under 40	40 or older	
Male	12	2	14
Female	8	3	11
Total	20	5	25

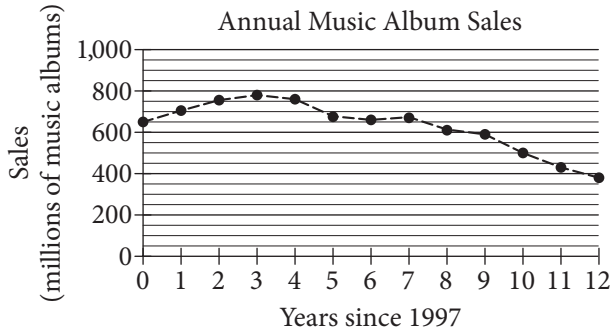
The table above shows the distribution of age and gender for 25 people who entered a contest. If the contest winner will be selected at random, what is the probability that the winner will be either a female under age 40 or a male age 40 or older?

- A)  $\frac{4}{25}$
- B)  $\frac{10}{25}$
- C)  $\frac{11}{25}$
- D)  $\frac{16}{25}$



3

The graph below shows the total number of music album sales, in millions, each year from 1997 through 2009.



Based on the graph, which of the following best describes the general trend in music album sales from 1997 through 2009?

- A) Sales generally increased each year since 1997.
- B) Sales generally decreased each year since 1997.
- C) Sales increased until 2000 and then generally decreased.
- D) Sales generally remained steady from 1997 through 2009.

4

$n$	1	2	3	4
$f(n)$	-2	1	4	7

The table above shows some values of the linear function  $f$ . Which of the following defines  $f$ ?

- A)  $f(n) = n - 3$
- B)  $f(n) = 2n - 4$
- C)  $f(n) = 3n - 5$
- D)  $f(n) = 4n - 6$

5

At Lincoln High School, approximately 7 percent of enrolled juniors and 5 percent of enrolled seniors were inducted into the National Honor Society last year. If there were 562 juniors and 602 seniors enrolled at Lincoln High School last year, which of the following is closest to the total number of juniors and seniors at Lincoln High School last year who were inducted into the National Honor Society?

- A) 140
- B) 69
- C) 39
- D) 30

6

$$3x^2 - 5x + 2$$

$$5x^2 - 2x - 6$$

Which of the following is the sum of the two polynomials shown above?

- A)  $8x^2 - 7x - 4$
- B)  $8x^2 + 7x - 4$
- C)  $8x^4 - 7x^2 - 4$
- D)  $8x^4 + 7x^2 - 4$



7

If  $\frac{3}{5}w = \frac{4}{3}$ , what is the value of  $w$ ?

- A)  $\frac{9}{20}$
- B)  $\frac{4}{5}$
- C)  $\frac{5}{4}$
- D)  $\frac{20}{9}$

8

The average number of students per classroom at Central High School from 2000 to 2010 can be modeled by the equation  $y = 0.56x + 27.2$ , where  $x$  represents the number of years since 2000, and  $y$  represents the average number of students per classroom. Which of the following best describes the meaning of the number 0.56 in the equation?

- A) The total number of students at the school in 2000
- B) The average number of students per classroom in 2000
- C) The estimated increase in the average number of students per classroom each year
- D) The estimated difference between the average number of students per classroom in 2010 and in 2000

9

Nate walks 25 meters in 13.7 seconds. If he walks at this same rate, which of the following is closest to the distance he will walk in 4 minutes?

- A) 150 meters
- B) 450 meters
- C) 700 meters
- D) 1,400 meters



Questions 10 and 11 refer to the following information.

Planet	Acceleration due to gravity $\left(\frac{\text{m}}{\text{sec}^2}\right)$
Mercury	3.6
Venus	8.9
Earth	9.8
Mars	3.8
Jupiter	26.0
Saturn	11.1
Uranus	10.7
Neptune	14.1

The chart above shows approximations of the acceleration due to gravity in meters per second squared  $\left(\frac{\text{m}}{\text{sec}^2}\right)$  for the eight planets in our solar system. The weight of an object on a given planet can be found by using the formula  $W = mg$ , where  $W$  is the weight of the object measured in newtons,  $m$  is the mass of the object measured in kilograms, and  $g$  is the acceleration due to gravity on the planet measured in  $\frac{\text{m}}{\text{sec}^2}$ .

10

What is the weight, in newtons, of an object on Mercury with a mass of 90 kilograms?

- A) 25
- B) 86
- C) 101
- D) 324

11

An object on Earth has a weight of 150 newtons. On which planet would the same object have an approximate weight of 170 newtons?

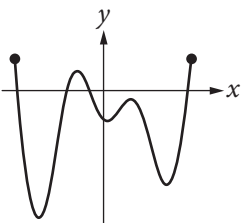
- A) Venus
- B) Saturn
- C) Uranus
- D) Neptune



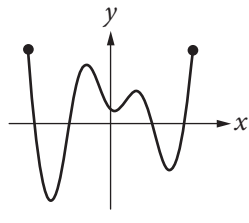
12

If the function  $f$  has five distinct zeros, which of the following could represent the complete graph of  $f$  in the  $xy$ -plane?

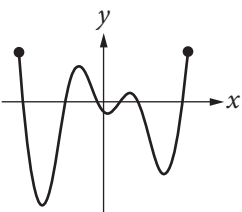
A)



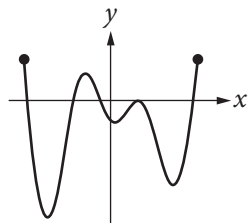
B)



C)



D)



13

$$h = -16t^2 + vt + k$$

The equation above gives the height  $h$ , in feet, of a ball  $t$  seconds after it is thrown straight up with an initial speed of  $v$  feet per second from a height of  $k$  feet. Which of the following gives  $v$  in terms of  $h$ ,  $t$ , and  $k$ ?

A)  $v = h + k - 16t$

B)  $v = \frac{h - k + 16}{t}$

C)  $v = \frac{h + k}{t} - 16t$

D)  $v = \frac{h - k}{t} + 16t$

14

The cost of using a telephone in a hotel meeting room is \$0.20 per minute. Which of the following equations represents the total cost  $c$ , in dollars, for  $h$  hours of phone use?

A)  $c = 0.20(60h)$

B)  $c = 0.20h + 60$

C)  $c = \frac{60h}{0.20}$

D)  $c = \frac{0.20h}{60}$

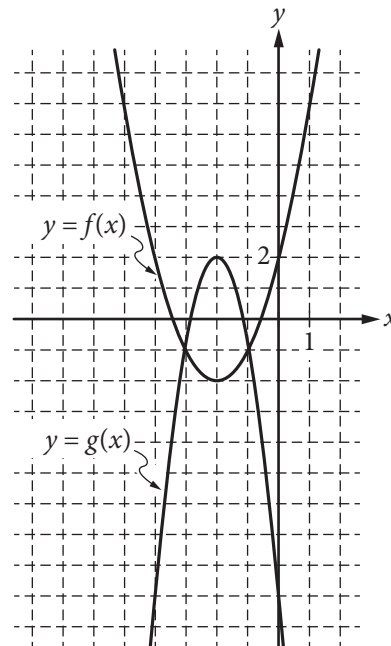


15

In order to determine if treatment X is successful in improving eyesight, a research study was conducted. From a large population of people with poor eyesight, 300 participants were selected at random. Half of the participants were randomly assigned to receive treatment X, and the other half did not receive treatment X. The resulting data showed that participants who received treatment X had significantly improved eyesight as compared to those who did not receive treatment X. Based on the design and results of the study, which of the following is an appropriate conclusion?

- A) Treatment X is likely to improve the eyesight of people who have poor eyesight.
- B) Treatment X improves eyesight better than all other available treatments.
- C) Treatment X will improve the eyesight of anyone who takes it.
- D) Treatment X will cause a substantial improvement in eyesight.

16



Graphs of the functions  $f$  and  $g$  are shown in the  $xy$ -plane above. For which of the following values of  $x$  does  $f(x) + g(x) = 0$  ?

- A)  $-3$
- B)  $-2$
- C)  $-1$
- D)  $0$





Questions 17 and 18 refer to the following information.

$$S(P) = \frac{1}{2}P + 40$$

$$D(P) = 220 - P$$

The quantity of a product supplied and the quantity of the product demanded in an economic market are functions of the price of the product. The functions above are the estimated supply and demand functions for a certain product. The function  $S(P)$  gives the quantity of the product supplied to the market when the price is  $P$  dollars, and the function  $D(P)$  gives the quantity of the product demanded by the market when the price is  $P$  dollars.

17

How will the quantity of the product supplied to the market change if the price of the product is increased by \$10?

- A) The quantity supplied will decrease by 5 units.
- B) The quantity supplied will increase by 5 units.
- C) The quantity supplied will increase by 10 units.
- D) The quantity supplied will increase by 50 units.

18

At what price will the quantity of the product supplied to the market equal the quantity of the product demanded by the market?

- A) \$90
- B) \$120
- C) \$133
- D) \$155

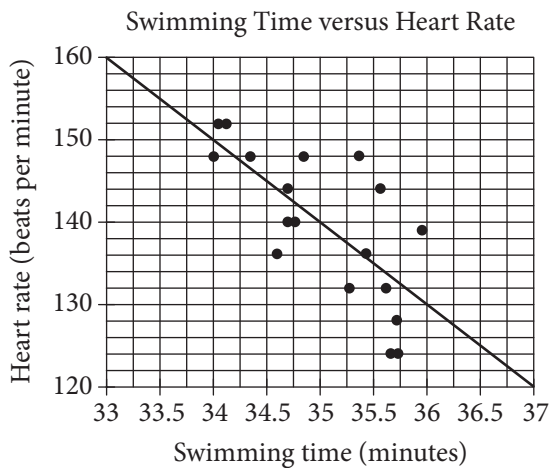
19

Graphene, which is used in the manufacture of integrated circuits, is so thin that a sheet weighing one ounce can cover up to 7 football fields. If a football field has an area of approximately  $1\frac{1}{3}$  acres, about how many acres could 48 ounces of graphene cover?

- A) 250
- B) 350
- C) 450
- D) 1,350



20



Michael swam 2,000 yards on each of eighteen days. The scatterplot above shows his swim time for and corresponding heart rate after each swim. The line of best fit for the data is also shown. For the swim that took 34 minutes, Michael's actual heart rate was about how many beats per minutes less than the rate predicted by the line of best fit?

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

21

Of the following four types of savings account plans, which option would yield exponential growth of the money in the account?

- A) Each successive year, 2% of the initial savings is added to the value of the account.
- B) Each successive year, 1.5% of the initial savings and \$100 is added to the value of the account.
- C) Each successive year, 1% of the current value is added to the value of the account.
- D) Each successive year, \$100 is added to the value of the account.

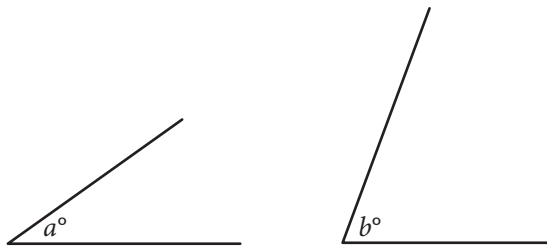
22

The sum of three numbers is 855. One of the numbers,  $x$ , is 50% more than the sum of the other two numbers. What is the value of  $x$  ?

- A) 570
- B) 513
- C) 214
- D) 155



23



Note: Figures not drawn to scale.

The angles shown above are acute and  $\sin(a^\circ) = \cos(b^\circ)$ . If  $a = 4k - 22$  and  $b = 6k - 13$ , what is the value of  $k$ ?

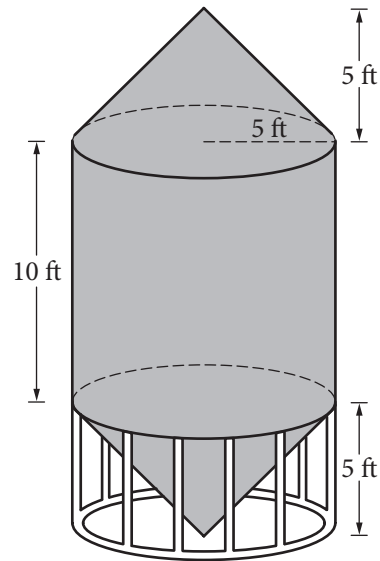
- A) 4.5
- B) 5.5
- C) 12.5
- D) 21.5

24

Mr. Kohl has a beaker containing  $n$  milliliters of solution to distribute to the students in his chemistry class. If he gives each student 3 milliliters of solution, he will have 5 milliliters left over. In order to give each student 4 milliliters of solution, he will need an additional 21 milliliters. How many students are in the class?

- A) 16
- B) 21
- C) 23
- D) 26

25



A grain silo is built from two right circular cones and a right circular cylinder with internal measurements represented by the figure above. Of the following, which is closest to the volume of the grain silo, in cubic feet?

- A) 261.8
- B) 785.4
- C) 916.3
- D) 1,047.2



26

In the  $xy$ -plane, the line determined by the points  $(2, k)$  and  $(k, 32)$  passes through the origin. Which of the following could be the value of  $k$  ?

- A) 0
- B) 4
- C) 8
- D) 16

27

A rectangle was altered by increasing its length by 10 percent and decreasing its width by  $p$  percent. If these alterations decreased the area of the rectangle by 12 percent, what is the value of  $p$  ?

- A) 12
- B) 15
- C) 20
- D) 22

28

In planning maintenance for a city's infrastructure, a civil engineer estimates that, starting from the present, the population of the city will decrease by 10 percent every 20 years. If the present population of the city is 50,000, which of the following expressions represents the engineer's estimate of the population of the city  $t$  years from now?

- A)  $50,000(0.1)^{20t}$
- B)  $50,000(0.1)^{\frac{t}{20}}$
- C)  $50,000(0.9)^{20t}$
- D)  $50,000(0.9)^{\frac{t}{20}}$



29

Gender	Handedness	
	Left	Right
Female		
Male		
Total	18	122

The incomplete table above summarizes the number of left-handed students and right-handed students by gender for the eighth-grade students at Keisel Middle School. There are 5 times as many right-handed female students as there are left-handed female students, and there are 9 times as many right-handed male students as there are left-handed male students. If there is a total of 18 left-handed students and 122 right-handed students in the school, which of the following is closest to the probability that a right-handed student selected at random is female? (Note: Assume that none of the eighth-grade students are both right-handed and left-handed.)

- A) 0.410
- B) 0.357
- C) 0.333
- D) 0.250

30

$$3x + b = 5x - 7$$

$$3y + c = 5y - 7$$

In the equations above,  $b$  and  $c$  are constants.

If  $b$  is  $c$  minus  $\frac{1}{2}$ , which of the following is true?

- A)  $x$  is  $y$  minus  $\frac{1}{4}$ .
- B)  $x$  is  $y$  minus  $\frac{1}{2}$ .
- C)  $x$  is  $y$  minus 1.
- D)  $x$  is  $y$  plus  $\frac{1}{2}$ .

**DIRECTIONS**

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

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

Write answer in boxes. →

← Fraction line

← Decimal point

Grid in result.

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

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

Answer: 2.5

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

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

	2	/	3
.	/	•	•
1	1	1	1
2	•	2	2
3	3	3	•
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8

.	6	6	6
.	/	/	•
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	•	•	•
7	7	7	7
8	8	8	8

.	6	6	7
.	/	/	•
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	•	•	•
7	7	7	•
8	8	8	8

Answer: 201 – either position is correct

	2	0	1
.	/	/	•
1	1	1	•
2	•	2	2
3	3	3	3

2	0	1	
.	/	/	•
1	1	•	1
•	2	2	2
3	3	3	3

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



31

Tickets for a school talent show cost \$2 for students and \$3 for adults. If Chris spends at least \$11 but no more than \$14 on  $x$  student tickets and 1 adult ticket, what is one possible value of  $x$  ?

32

Ages of the First 12 United States Presidents at the Beginning of Their Terms in Office

President	Age (years)	President	Age (years)
Washington	57	Jackson	62
Adams	62	Van Buren	55
Jefferson	58	Harrison	68
Madison	58	Tyler	51
Monroe	59	Polk	50
Adams	58	Taylor	65

The table above lists the ages of the first 12 United States presidents when they began their terms in office. According to the table, what was the mean age, in years, of these presidents at the beginning of their terms? (Round your answer to the nearest tenth.)

33

$$(-3x^2 + 5x - 2) - 2(x^2 - 2x - 1)$$

If the expression above is rewritten in the form  $ax^2 + bx + c$ , where  $a$ ,  $b$ , and  $c$  are constants, what is the value of  $b$  ?

34

In a circle with center  $O$ , central angle  $AOB$  has a measure of  $\frac{5\pi}{4}$  radians. The area of the sector formed by central angle  $AOB$  is what fraction of the area of the circle?



35

An online store receives customer satisfaction ratings between 0 and 100, inclusive. In the first 10 ratings the store received, the average (arithmetic mean) of the ratings was 75. What is the least value the store can receive for the 11th rating and still be able to have an average of at least 85 for the first 20 ratings?

36

$$y \leq -15x + 3000$$

$$y \leq 5x$$

In the  $xy$ -plane, if a point with coordinates  $(a, b)$  lies in the solution set of the system of inequalities above, what is the maximum possible value of  $b$  ?





---

**Questions 37 and 38 refer to the following information.**

If shoppers enter a store at an average rate of  $r$  shoppers per minute and each stays in the store for an average time of  $T$  minutes, the average number of shoppers in the store,  $N$ , at any one time is given by the formula  $N = rT$ . This relationship is known as Little's law.

The owner of the Good Deals Store estimates that during business hours, an average of 3 shoppers per minute enter the store and that each of them stays an average of 15 minutes. The store owner uses Little's law to estimate that there are 45 shoppers in the store at any time.

37

Little's law can be applied to any part of the store, such as a particular department or the checkout lines. The store owner determines that, during business hours, approximately 84 shoppers per hour make a purchase and each of these shoppers spends an average of 5 minutes in the checkout line. At any time during business hours, about how many shoppers, on average, are waiting in the checkout line to make a purchase at the Good Deals Store?

38

The owner of the Good Deals Store opens a new store across town. For the new store, the owner estimates that, during business hours, an average of 90 shoppers per hour enter the store and each of them stays an average of 12 minutes. The average number of shoppers in the new store at any time is what percent less than the average number of shoppers in the original store at any time? (Note: Ignore the percent symbol when entering your answer. For example, if the answer is 42.1%, enter 42.1)

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**STOP**

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

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# The SAT<sup>®</sup>

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# Practice Essay #3

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It's one of the best ways to get ready  
for the SAT Essay.

For information on scoring your essay, view  
the SAT Essay scoring rubric at [sat.org/essay](https://sat.org/essay).



As you read the passage below, consider how Eliana Dockterman uses

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

**Adapted from Eliana Dockterman, “The Digital Parent Trap.” ©2013 by Time Inc. Originally published August 19, 2013.**

- 1 By all measures, this generation of American kids (ages 3 to 18) is the tech-savviest in history: 27% of them use tablets, 43% use smartphones, and 52% use laptops. And in just a few weeks they will start the most tech-saturated school year ever: Los Angeles County alone will spend \$30 million on classroom iPads this year, outfitting 640,000 kids by late 2014.
- 2 Yet, according to the latest findings from the research firm Grunwald Associates, barely half of U.S. parents agree that mobile technology should play a more prominent role in schools. Some are even paying as much as \$24,000 to send their kids to monthlong “digital detox” programs like the one at Capio Nightingale Hospital in the U.K. . . .
- 3 So who’s right—the mom trying to protect her kids from the perils of new technology or the dad who’s coaching his kids to embrace it? It’s an urgent question at a time when more than 80% of U.S. school districts say they are on the cusp of incorporating Web-enabled tablets into everyday curriculums.
- 4 For years, the Parental Adage was simple: The less time spent with screens, the better. That thinking stems from, among other things, reports about the rise of cyberbullying . . . as well as the fact that social media—specifically the sight of others looking happy in photos—can make kids feel depressed and insecure.
- 5 There’s also a fundamental aversion to sitting kids in front of screens, thanks to decades of studies proving that watching too much TV can lead to obesity, violence and attention-deficit/hyperactivity disorder.
- 6 In that vein, the Waldorf Schools—a consortium of private K-12 schools in North America designed to “connect children to nature” and “ignite passion for lifelong learning”—limit tech in the classroom and bar the use of smartphones, laptops, televisions and even radios at home. “You could say some computer games develop creativity,” says Lucy Wurtz, an administrator at the Waldorf School in Los Altos, Calif., minutes from Silicon Valley. “But I don’t see any benefit. Waldorf kids knit and build things and paint—a lot of really practical and creative endeavors.”
- 7 But it’s not that simple. While there are dangers inherent in access to Facebook, new research suggests that social-networking sites also offer unprecedented learning opportunities. “Online, kids can engage with specialized communities of interest,”

says Mimi Ito, an anthropologist at the University of California at Irvine who's studying how technology affects young adults. "They're no longer limited by what's offered in school."

- 8 Early tech use has cognitive benefits as well. Although parenting experts have questioned the value of educational games—as Jim Taylor, author of *Raising Generation Tech*, puts it, "they're a load of crap . . . meant to make money"—new studies have shown they can add real value. In a recent study by SRI, a nonprofit research firm, kids who played games like Samorost (solving puzzles) did 12% better on logic tests than those who did not. And at MIT's Education Arcade, playing the empire-building game Civilization piqued students' interest in history and was directly linked to an improvement in the quality of their history-class reports.
- 9 The reason: engagement. On average, according to research cited by MIT, students can remember only 10% of what they read, 20% of what they hear and 50% of what they see demonstrated. But when they're actually doing something themselves—in the virtual worlds on iPads or laptops—that retention rate skyrockets to 90%.
- 10 This is a main reason researchers like Ito say the American Academy of Pediatrics' recommendation of a two-hour screen-time limit is an outdated concept: actively browsing pages on a computer or tablet is way more brain-stimulating than vegging out in front of the TV.
- 11 The most convincing argument for early-age tech fluency, however, is more basic: staying competitive. "If you look at applying for college or a job, that's on the computer," says Shawn Jackson, principal of Spencer Tech, a public school in one of Chicago's lower-income neighborhoods. Ditto the essential skills for jobs in fast-growing sectors such as programming, engineering and biotechnology. "If we're not exposing our students to this stuff early," Jackson continues, "they're going to be left behind." . . .
- 12 None of this means kids deserve unfettered access to the gadget of their choice—especially if, as McGrath notes, they've already been caught abusing it. As with any childhood privilege, monitoring is key. But parents should keep an open mind about the benefits of tech fluency.

Write an essay in which you explain how Eliana Dockterman builds an argument to persuade her audience that there are benefits to early exposure to technology. In your essay, analyze how Dockterman uses one or more of the features listed in the box above (or features of your own choice) to strengthen the logic and persuasiveness of her argument. Be sure that your analysis focuses on the most relevant features of the passage.

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

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## Answer Explanations

# SAT Practice Test #3

## Section 1: Reading Test

### QUESTION 1

**Choice B is the best answer.** In the passage, Lady Carlotta is approached by the “imposingly attired lady” Mrs. Quabarl while standing at a train station (lines 32-35). Mrs. Quabarl assumes Lady Carlotta is her new nanny, Miss Hope: “You must be Miss Hope, the governess I’ve come to meet” (lines 36-37). Lady Carlotta does not correct Mrs. Quabarl’s mistake and replies, “Very well, if I must I must” (line 39).

Choices A, C, and D are incorrect because the passage is not about a woman weighing a job choice, seeking revenge on an acquaintance, or disliking her new employer.

### QUESTION 2

**Choice C is the best answer.** In lines 1-3, the narrator states that Lady Carlotta “stepped out on to the platform of the small wayside station and took a turn or two up and down its uninteresting length” in order to “kill time.” In this context, Lady Carlotta was taking a “turn,” or a short walk, along the platform while waiting for the train to leave the station.

Choices A, B, and D are incorrect because in this context “turn” does not mean slight movement, change in rotation, or course correction. While Lady Carlotta may have had to rotate her body while moving across the station, “took a turn” implies that Lady Carlotta took a short walk along the platform’s length.

### QUESTION 3

**Choice A is the best answer.** In lines 10-14, the narrator states that some of Lady Carlotta’s acquaintances would often admonish, or criticize, Lady Carlotta for meddling in or openly expressing her opinion on other people’s affairs.

---

Choices B, C, and D are incorrect because the narrator does not suggest that other people viewed Lady Carlotta as tactful, ambitious, or unfriendly.

#### QUESTION 4

**Choice A is the best answer.** In lines 10-14, the narrator states that people often criticized Lady Carlotta and suggested that she not interfere in other people's affairs, which were "none of her business." The fact that people often were critical of Lady Carlotta's behavior provides evidence that Lady Carlotta was outspoken.

Choices B, C, and D do not provide the best evidence that Lady Carlotta was outspoken. Choices B, C, and D mention Lady Carlotta, but do not specify how others view her.

#### QUESTION 5

**Choice C is the best answer.** Lines 4-10 establish that Lady Carlotta intervened on the part of a struggling horse, the kind of behavior for which, lines 10-14 indicate, she received "plentiful admonition" from "certain of her acquaintances," who believed that she should mind her own business. Lines 14-22 indicate that Lady Carlotta had "only once . . . put the doctrine of non-interference into practice," and that was when "one of its most eloquent exponents" had been "besieged for nearly three hours in a small and extremely uncomfortable may-tree by an angry boar-pig" while Lady Carlotta blithely ignored the other woman's hypocritical pleas for interference. This incident provides insight into Lady Carlotta's character and also evokes humor through language choice (e.g., the droll understatement of "it is to be feared that [Lady Carlotta] lost the friendship of the ultimately rescued lady"; lines 22-23) and the sense that, narratively speaking, justice has been served.

Choice A is incorrect because nothing about the incident suggests deception on Lady Carlotta's part. Choice B is incorrect because there is nothing subtle about Lady Carlotta leaving another woman stuck in a tree for nearly three hours. Moreover, the passage does not suggest that this was an act of cruelty on Lady Carlotta's part; rather, the passage suggests that Lady Carlotta was justified in giving the woman stuck in a tree exactly what the woman had so often asked for: noninterference. Choice D is incorrect because the passage indicates that Lady Carlotta was acting consistently with her beliefs and only invoked the doctrine to teach a hypocritical person a lesson.

#### QUESTION 6

**Choice A is the best answer.** The narrator explains that Mrs. Quabarl told Lady Carlotta about the "nature of the charge" when she gave Lady Carlotta details about the Quabarl children (line 53-61). Since Lady Carlotta is pretending to be a governess, the term "charge" refers to her responsibilities, or job duties, when caring for the Quabarl children.

Choices B, C, and D are incorrect because in this context “charge” does not mean attack, fee, or expense.

## QUESTION 7

**Choice A is the best answer.** Lady Carlotta learns about Mrs. Quabarl’s children Claude, Wilfrid, and Irene (lines 53-58). The narrator then describes Mrs. Quabarl’s child Viola as “something or other else of a mould equally commonplace among children of that class and type in the twentieth century” (lines 58-61). This statement about Viola implies that all of the Quabarl children have skills typical, or “of a mould equally commonplace,” to other peers in their social class.

Choices B, C, and D are incorrect because the narrator does not indicate that all of the Quabarl children are unusually creative and intelligent, hostile to the idea of having a governess, or more educated than their peers.

## QUESTION 8

**Choice B is the best answer.** In lines 62-69, Mrs. Quabarl explains to Lady Carlotta that she wants her children to actively participate in their education, and that Lady Carlotta should not create lessons that require her children to simply memorize historical figures and dates. Mrs. Quabarl emphasizes an education centered on active engagement when she states that her children should “not only be TAUGHT . . . but INTERESTED in what they learn.”

Choices A, C, and D are incorrect because the narrator does not suggest that Mrs. Quabarl favors an education that emphasizes traditional values, artistic experimentation, or factual retention.

## QUESTION 9

**Choice B is the best answer.** In lines 77-82, the narrator describes Mrs. Quabarl as appearing “magnificent and autocratic,” or outwardly domineering, but easily “cowed and apologetic” when someone challenges, or defies, her authority.

Choices A, C, and D are incorrect because the narrator does not describe Mrs. Quabarl as selfish, bitter, or frequently imprudent.

## QUESTION 10

**Choice D is the best answer.** In lines 77-82, the narrator provides evidence that Mrs. Quabarl appears imposing, or autocratic, but is easily defied, or opposed: “She was one of those imperfectly self-assured individuals who are magnificent and autocratic as long as they are not seriously opposed. The least show of unexpected resistance goes a long way towards rendering them cowed and apologetic.”

---

Choices A, B, and C do not provide the best evidence that Mrs. Quabarl appears imposing but is easily defied. Choices A and B are incorrect because they present Mrs. Quabarl's opinions on railway companies and education, and choice C is incorrect because it focuses on Lady Carlotta, not Mrs. Quabarl.

### QUESTION 11

**Choice A is the best answer.** While the author predominantly supports the use of public transportation, in the third paragraph he recognizes some limitations to the public transportation system: it is a “depressing experience” (lines 25-26) and “underfunded, ill-maintained, and ill-planned” (line 31).

Choices B, C, and D are incorrect because the third paragraph does not expand upon an argument made in the first two paragraphs, provide an overview of a problem, or advocate ending the use of public transportation.

### QUESTION 12

**Choice C is the best answer.** The author notes that in North America “hopping in a car almost always gets you to your destination more quickly” (lines 32-34). This statement suggests that speed is one advantage to driving in North America.

Choices A, B, and D are incorrect because the author does not cite environmental impact, convenience, or cost as advantages of driving in North America.

### QUESTION 13

**Choice D is the best answer.** In lines 32-34, the author provides evidence that speed is one advantage to driving in North America, because driving “almost always gets you to your destination more quickly.”

Choices A, B, and C do not provide the best evidence that speed is one advantage to driving in North America. Choices A and B are incorrect because they offer general information about using public transportation. Choice C is incorrect because although these lines mention North America, they focus on the disadvantages of public transportation.

### QUESTION 14

**Choice B is the best answer.** The author argues in the fourth paragraph that public transportation “can be faster, more comfortable, and cheaper than the private automobile” (lines 36-37) and provides examples of fast and convenient public transportation systems.

Choices A, C, and D are incorrect because they focus on points made in the fourth paragraph rather than the paragraph's central idea.



## QUESTION 15

**Choice B is the best answer.** In lines 35-37, the author provides evidence that some public transportation systems are superior to driving, because public transportation “can be faster, more comfortable, and cheaper than the private automobile.”

Choices A, C, and D do not provide the best evidence that some public transportation systems are superior to driving, as they highlight points made in the fourth paragraph rather than the paragraph’s central idea.

## QUESTION 16

**Choice C is the best answer.** In the last paragraph, the author explains the trend that people who became adults around the end of the twentieth century are more willing to use public transportation than people from older generations. The author notes, “If you credit the demographers, this transit trend has legs” (lines 58-59). In this context, “credit” means to believe the demographers’ claims about the trend.

Choices A, B, and D are incorrect because in this context, “credit” does not mean endow, attribute, or honor.

## QUESTION 17

**Choice B is the best answer.** In lines 59-63, the author explains the trend of people who became adults around the end of the twentieth century “tend[ing] to favor cities over suburbs.” In this context, these adults “favor,” or prefer, cities over suburbs.

Choices A, C, and D are incorrect because in this context “favor” does not mean indulge, resemble, or serve.

## QUESTION 18

**Choice B is the best answer.** In lines 63-67, the author explains that while riding on public transportation, people can use personal electronic devices, such as “iPads, MP3 players, Kindles, and smartphones.”

Choices A, C, and D are incorrect because they do not show that public transportation is compatible with the use of personal electronic devices.

## QUESTION 19

**Choice A is the best answer.** Figure 1 shows that 10.7% of public transportation passengers are students and 6.7% of public transportation passengers are retirees. Thus, more students than retirees use public transportation.

Choices B and C are incorrect because figure 1 shows that more employed than unemployed people use public transportation and that more employed people than homemakers use public transportation.

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Choice D is incorrect because figure 1 does not explain how frequently passengers use public transportation; it only identifies public transportation passengers by their primary occupation.

### QUESTION 20

**Choice A is the best answer.** Figure 1 shows that 72% of public transportation passengers are “employed outside the home,” and figure 2 indicates that 59.1% of public transportation trips are for “work.” It can be inferred from these figures that many public transportation passengers take public transportation to their place of employment.

Choices B, C, and D are incorrect because figure 1 and figure 2 do not indicate that public transportation passengers primarily use the system to run errands, use their own car on weekends, or are planning to purchase a car.

### QUESTION 21

**Choice D is the best answer.** The author explains that Ken Dial created an experiment to study the evolution of flight by observing how baby Chukars learn to fly. During the experiment, Dial noticed the unusual way Chukars use their “wings and legs cooperatively” to scale hay bales (lines 38-43), and he created “a series of ingenious experiments” (line 46) to study this observation. After his additional experiments, Dial determined that these baby birds angle “their wings differently from birds in flight” (lines 49-50).

Choices A, B, and C are incorrect because they do not accurately reflect the sequence of events in the passage.

### QUESTION 22

**Choice A is the best answer.** In lines 6-9, the author explains that Dial was “challenged,” or dared, by graduate students to develop “new data” on a long-standing scientific debate (the “ground-up-tree-down” theory).

Choices B, C, and D are incorrect because in this context “challenged” does not mean required, disputed with, or competed with.

### QUESTION 23

**Choice A is the best answer.** The author explains that Dial created his initial experiment to try and create “new data on the age-old ground-up-tree-down debate,” and that he looked for “clues” in “how baby game birds learned to fly” (lines 8-11). The note at the beginning of

the passage explains the “age-old ground-up-tree down debate” and offers two different theories on how birds evolved to fly. Finally, the last paragraph of the passage discusses WAIR in an evolutionary context.

Choices B, C, and D are incorrect because they do not identify Dial’s central assumption in setting up his research.

## QUESTION 24

**Choice B is the best answer.** In lines 6-11, the author provides evidence that Dial’s central assumption in setting up his research is that the acquisition of flight in young birds is linked to the acquisition of flight in their ancestors. The author notes that Dial created a project to “come up with new data on the age-old ground-up-tree-down debate.”

Choices A, C, and D do not provide the best evidence that Dial’s central assumption in setting up his research is that the acquisition of flight in young birds is linked to the acquisition of flight in their ancestors. Choices A, C, and D are incorrect because they focus on Dial’s experiment and his observations on ground birds.

## QUESTION 25

**Choice C is the best answer.** When a rancher observed Dial’s laboratory setup, he was “incredulous” that the Chukars were living on the ground, and he advised Dial to give the birds “something to climb on” (lines 16-23). This “key piece of advice” (line 14) led Dial to add hay bales to his laboratory. Dial later noticed that the Chukars were using their legs and wings to scale the hay bales, and this observation became the focal point of his research.

Choices A, B, and D are incorrect because the incident with the local rancher did not serve to reveal Dial’s motivation for creating the project, emphasize differences in laboratory and field research, or introduce a contributor to a scientific theory.

## QUESTION 26

**Choice C is the best answer.** The author explains that Dial’s “aha moment” came when he determined the Chukars used “their legs and wings cooperatively” to scale the hay bales (lines 40-42). Dial then created additional experiments to study how the birds dealt with gradually steeper inclines: “[he filmed] the birds as they raced up textured ramps tilted at increasing angles” (lines 46-48).

Choices A, B, and D are incorrect because Dial’s “aha moment” was not followed by Dial teaching the birds to fly, studying videos to find out why the birds no longer hopped, or consulting with other researchers.

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## QUESTION 27

**Choice B is the best answer.** Dial observed that as the Chukars raced up steep ramps, they “began to flap” and “aimed their flapping down and backward, using the force . . . to keep their feet firmly pressed against the ramp” (lines 49-53). Dial determined that the position of their flapping wings facilitated the baby Chukars’ traction on the steep ramps.

Choices A, C, and D are incorrect because the passage does not indicate that the Chukars’ speed, alternation of wing and foot movement, or continual hopping motions facilitated their traction on steep ramps.

## QUESTION 28

**Choice B is the best answer.** In lines 61-63, the author explains that Dial named his scientific finding “WAIR, for wing-assisted incline running, and went on to document it in a wide range of species.” In this context, Dial “documented,” or recorded, the existence of WAIR in numerous bird species.

Choices A, C, and D are incorrect because in this context, “document” does not mean to portray, publish, or process.

## QUESTION 29

**Choice D is the best answer.** In lines 70-74, the author explains that gliding animals do not use a “flapping flight stroke,” or WAIR, wing-assisted incline running. Since Chukars, a ground bird, use WAIR to help scale steep inclines, it can be reasonably inferred that gliding animals do not use WAIR to aid in climbing slopes.

Choices A, B, and C are incorrect because the passage does not include information on gliding animals’ offspring, their method of locomotion, or their feeding habits.

## QUESTION 30

**Choice D is the best answer.** In lines 73-75, the author provides evidence that “the flapping flight stroke” is “something gliding animals don’t do.”

Choices A, B, and C do not provide the best evidence that gliding animals do not use a flapping stroke to aid in climbing slopes. These choices do not contain information about gliding animals.

## QUESTION 31

**Choice B is the best answer.** In lines 21-24, the authors of Passage 1 state society’s “common happiness” is dependent on women never becoming involved in politics. In this context, the authors of Passage 1 are suggesting that all members of society can have a “common,” or shared, happiness.

Choices A, C, and D are incorrect because in this context, “common” does not mean average, coarse, or similar.

### QUESTION 32

**Choice C is the best answer.** In lines 25-30, the authors of Passage 1 state that women should seek “gentle occupations and the cares of the home” so they can avoid performing difficult, or “strenuous,” and unpleasant, or “onerous,” tasks.

Choices A, B, and D are incorrect because the authors of Passage 1 do not suggest that running a household and raising children are rewarding for both sexes, yield less value for society, or require professional or political skills.

### QUESTION 33

**Choice C is the best answer.** In lines 25-30, the authors of Passage 1 provide evidence that women should run households and raise children because these roles do not require “strenuous habits and onerous duties.”

Choices A, B, and D do not provide the best evidence that running a household and raising children entail very few activities that are difficult or unpleasant; rather, these lines offer general information about the differences between the sexes.

### QUESTION 34

**Choice D is the best answer.** In lines 41-46, Wollstonecraft argues that if women do not receive an education “to become the companion of man,” or one that is comparable to men’s education, then society will not progress in “knowledge and virtue.”

Choices A, B, and C are incorrect because Wollstonecraft does not suggest that society can progress only if women have happiness and financial security, follow societal rules, or replace men as figures of power.

### QUESTION 35

**Choice C is the best answer.** Wollstonecraft argues that women should be granted an education comparable to men’s so that truth is “common to all” (lines 41-46). Wollstonecraft states that education will “strengthen [women’s] reason till she comprehend her duty” (lines 49-50). In this context, Wollstonecraft is arguing that education will improve women’s “reason,” or intellect, and allow women to consider their role in society.

Choices A, B, and D are incorrect because in this context “reason” does not mean motive, sanity, or explanation.

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## QUESTION 36

**Choice A is the best answer.** In lines 72-78, Wollstonecraft argues that the laws passed by society’s leaders allow men to “contend for their freedom” but serve to “subjugate women.” In this context, “subjugate” means to control. Wollstonecraft is arguing that society’s leaders grant men freedoms that are denied to women.

Choices B, C, and D are incorrect because Wollstonecraft does not claim that society’s leaders have granted freedoms that created a general reduction in individual virtue, caused arguments about happiness, or ensured equality for all people.

## QUESTION 37

**Choice D is the best answer.** In lines 72-75, Wollstonecraft provides evidence that society’s leaders grant freedoms that privilege men. She argues that while society’s leaders believe they “are acting in the manner best calculated to promote [women’s] happiness,” their decisions don’t allow women to “contend for their freedom.”

Choices A, B, and C do not provide the best evidence that society’s leaders grant freedoms that privilege men over women.

## QUESTION 38

**Choice C is the best answer.** Wollstonecraft cites the statement made by the authors of Passage 1 that excluding women from political participation is “according to abstract principles . . . impossible to explain” (lines 61-65). Wollstonecraft then states that if the authors of Passage 1 can discuss “the abstract rights of man” they should be able to discuss the abstract rights of women (lines 66-69). In these lines, Wollstonecraft is developing her argument by highlighting a flaw in the reasoning presented by the authors of Passage 1.

Choices A, B, and D are incorrect because Wollstonecraft does not refer to the statement made in Passage 1 to call into question the authors’ qualifications, dispute the assertion that women are excluded by their own government (sentence one of Passage 1), or validate the authors’ conclusions on gender roles.

## QUESTION 39

**Choice A is the best answer.** The authors of Passage 1 argue that while restricting women’s freedoms may be “impossible to explain” (line 7), this restriction is necessary for society’s overall happiness (lines 13-17). Wollstonecraft, however, strongly challenges this argument, asking the authors of Passage 1, “Who made man the exclusive judge” of which freedoms are granted to women, and likening society’s male leaders to tyrants as they deny women their “civil and political rights” and leave them “groping in the dark” (lines 78-88).

Choices B, C, and D are incorrect because they do not characterize the overall relationship between Passage 1 and Passage 2.

## QUESTION 40

**Choice D is the best answer.** The authors of Passage 1 admit that women are “excluded by the other half [men] from any participation in government” (lines 1-2), and Wollstonecraft states that society’s male leaders create laws that deny women “civil and political rights” (line 86).

Choices A, B, and C are incorrect because the authors of both passages would not agree that women had the same preferences as men, required a good education, or were as happy as men.

## QUESTION 41

**Choice A is the best answer.** Wollstonecraft argues in the final paragraph of Passage 2 that society’s male leaders are like “tyrants” that deny women “civil and political rights” (lines 81-88). The authors of Passage 1 would most likely argue that allowing women these rights would be “a reversal of [society’s] primary destinies” as society’s leaders should only seek women’s interests as they pertain to the “wishes of nature,” such as women’s role as mothers (lines 18-30). The authors of Passage 1 clarify that “nature” created two sexes for a particular reason, so while men can exercise civil and political rights, women are not naturally suited to these activities (lines 30-36).

Choices B and C are incorrect because they are not supported by information in Passage 1. Choice D is incorrect because the authors of Passage 1 do not mention “natural law,” only the “wishes of nature.”

## QUESTION 42

**Choice C is the best answer.** When discussing problems with bee colonies, the authors use phrases like “we suspect” (line 19) and “we postulate” (line 21) to show they are hypothesizing reasons for bee colonies’ susceptibility to mite infestations. The use of “can,” “may,” and “could” creates a tentative tone and provides further evidence that the authors believe, but are not certain, that their hypothesis is correct.

Choices A, B, and D are incorrect because the authors’ use of “can,” “may,” and “could” does not create an optimistic, dubious, or critical tone.

## QUESTION 43

**Choice C is the best answer.** In lines 24-28, the authors hypothesize that bee colonies will be susceptible to mite infestations if they do not occasionally feed on pyrethrum producing plants. In lines 42-46, they suggest creating a trial where a “small number of commercial honey bee colonies are offered a number of pyrethrum producing plants” to test their hypothesis.

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Choices A, B, and D are incorrect because the authors do not hypothesize that honeybees' exposure to both pyrethrums and mites will cause the honeybees to develop secondary infections, that beekeepers should increase their use of insecticides, or that humans are more susceptible to varroa mites.

### QUESTION 44

**Choice D is the best answer.** In lines 24-28, the authors provide evidence that a bee colony may be more resistant to mite infections if the bees eat pyrethrums because this diet may help prevent bees from becoming "immunocompromised or nutritionally deficient." In lines 42-50, the authors suggest testing this hypothesis in a trial on honeybees.

Choices A, B, and C do not describe any of the authors' hypotheses.

### QUESTION 45

**Choice D is the best answer.** The authors explain that when beekeepers use commercially produced insecticides to fight mite infections, they may "further weaken" bees that are "immunocompromised or nutritionally deficient" (lines 31-35).

Choices A, B, and C are incorrect because the authors do not suggest that beekeepers' use of commercially produced insecticides increases mite populations, kills bacteria, or destroys bees' primary food source.

### QUESTION 46

**Choice C is the best answer.** In lines 31-35, the authors provide evidence that beekeepers' use of commercially produced insecticides may cause further harm to "immunocompromised or nutritionally deficient bees."

Choices A, B, and D are incorrect because they do not provide the best evidence that beekeepers' use of commercially produced insecticides may be harmful to bees; choices A, B, and D focus on mite infestations' impact on honeybees.

### QUESTION 47

**Choice B is the best answer.** In lines 31-35, the authors argue that beekeepers' use of insecticides to control mite infestations may be harmful to some bees. The authors then state, "We further postulate that the proper dosage necessary to prevent mite infestation may be better left to the bees" (lines 35-37). In this context, the authors "postulate," or put forth the idea that the bees may naturally control mite infestations better than insecticides.

Choices A, C, and D are incorrect because in this context, "postulate" does not mean to make an unfounded assumption, question a belief or theory, or conclude based on firm evidence.



## QUESTION 48

**Choice B is the best answer.** In the fourth paragraph the authors propose a trial to study if honeybees' consumption of pyrethrum producing plants helps the honeybees defend against mite infestations. In the experiment, the authors plan to offer honey bee colonies both pyrethrum producing plants and "a typical bee food source such as clover" to determine if these different diets affect the bees' susceptibility to mite infestations.

Choices A, C, and D are incorrect because the main purpose of the fourth paragraph is not to summarize the results of an experiment, provide a comparative nutritional analysis, or predict an outcome of an unfinished experiment.

## QUESTION 49

**Choice A is the best answer.** In lines 43-45, the authors propose a scientific trial in which honeybees are "offered a number of pyrethrum producing plants, as well as a typical bee food source such as clover." Since the authors contrast the "pyrethrum producing plants" with clover, a "typical bee food source," it can be assumed that clover does not produce pyrethrums.

Choice B is incorrect because it is stated in the passage. Choices C and D are incorrect because they are not assumptions made by the authors.

## QUESTION 50

**Choice B is the best answer.** The table shows that 77 percent of the honeybee colonies with colony collapse disorder were infected by all four pathogens.

Choices A, C, and D are incorrect because they do not identify the percent of honeybee colonies with colony collapse disorder that were infected by all four pathogens as based on data in the table.

## QUESTION 51

**Choice D is the best answer.** The table shows that 81 percent of colonies without colony collapse disorder were affected by the pathogen *Nosema ceranae*.

Choices A, B, and C are incorrect because they do not identify the pathogen that infected the highest percentage of honeybee colonies without colony collapse disorder as based on data in the table.

## QUESTION 52

**Choice D is the best answer.** The table discusses pathogen occurrence in honeybee colonies, but it includes no information as to whether these honeybees were infected with mites. Because the table does not

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suggest mites infested the honeybee colonies, no conclusions can be made as to whether mites increased the honeybees' "susceptibility to secondary infection with fungi, bacteria or viruses" (lines 4-5).

Choices A, B, and C are incorrect because the table provides no information about whether these honeybees were infected with mites.

## Section 2: Writing and Language Test

### QUESTION 1

**Choice A is the best answer** because by providing the comparative adjective "healthier" and the word "more" to make "productive" comparative, it creates a parallel structure within the list that begins with "happier."

Choices B, C, and D are incorrect because none creates a parallel structure within the list of qualities.

### QUESTION 2

**Choice B is the best answer.** The ways in which exposure to natural light affects employees is the main subject of the passage.

Choices A, C, and D are incorrect because none introduces the topic discussed in the remainder of the passage.

### QUESTION 3

**Choice C is the best answer.** It accurately notes that the proposed sentence would be placed directly between the first mention of circadian rhythms and the explanation of the term.

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

### QUESTION 4

**Choice C is the best answer.** It provides the correct possessive construction for "body," which must be a singular noun when discussed in general terms as in this sentence. Choice C also provides the correct plural construction for "clocks."

Choices A, B, and D are incorrect because each applies either a possessive or a plural construction in a place where it doesn't belong.

### QUESTION 5

**Choice A is the best answer.** The singular verb "is" agrees with the singular noun "absenteeism."

Choices B, C, and D are incorrect because each provides a verb that either fails to agree with the singular subject "absenteeism" or introduces redundancy.

## QUESTION 6

**Choice B is the best answer.** It contains a direct reference to productivity, the topic introduced in the previous sentence.

Choices A, C, and D are incorrect because none directly addresses employee productivity, the primary subject of the previous sentence.

## QUESTION 7

**Choice A is the best answer.** It opens with a reference to lowered worker productivity, creating a transition from the previous paragraph, and clearly positions the high energy costs of artificial light sources as an additional disadvantage.

Choices B, C, and D are incorrect because none of the choices offers an adequate transition from the previous paragraph: Each awkwardly inserts the issue of lower worker productivity into a statement about the high energy costs of artificial light sources.

## QUESTION 8

**Choice D is the best answer.** The word “annual” is adequate to communicate that the savings occurred every year.

Choices A, B, and C are incorrect because each proposes an option that would result in a redundancy with “annual.”

## QUESTION 9

**Choice C is the best answer.** It provides a transitional adverb that accurately communicates that this sentence describes an option that companies could choose (“light tubes”) instead of the option described in the previous sentence (“full-pane windows”).

Choices A, B, and D are incorrect because each proposes a transitional adverb that does not accurately reflect the relationship between this sentence and the one preceding it.

## QUESTION 10

**Choice C is the best answer.** It provides the correct relative pronoun to correspond with the plural referent “light tubes” and the correct verb to introduce the definition that follows.

Choices A, B, and D are incorrect because each offers a pronoun inappropriate for opening a dependent clause defining “light tubes.”

## QUESTION 11

**Choice B is the best answer.** The preposition “of” idiomatically follows the noun “means,” particularly as a way to connect it to another noun or verb.

Choices A, C, and D are incorrect because each results in nonstandard phrasing with “means.”

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## QUESTION 12

**Choice A is the best answer.** The plural reflexive pronoun “themselves” corresponds with the plural noun “settlers.”

Choices B, C, and D are incorrect because each provides either a nonstandard phrase or a singular pronoun that does not correspond with “settlers.”

## QUESTION 13

**Choice C is the best answer.** It creates a transition from the poor food quality mentioned in the previous sentence to the information about Harvey in the remainder of the sentence.

Choices A, B, and D are incorrect because none offers a transition from the previous sentence or a detail that corresponds precisely with the information in the remainder of the sentence.

## QUESTION 14

**Choice D is the best answer.** It correctly provides a comma to close the modifying clause “an English-born entrepreneur,” which opens with a comma.

Choices A, B, and C are incorrect because each proposes punctuation that creates an inappropriately strong separation between the subject “Fred Harvey” and the verb “decided.”

## QUESTION 15

**Choice B is the best answer.** It provides the plural verb and plural possessive pronoun that grammatically correspond to the plural referent “Harvey Houses.”

Choices A, C, and D are incorrect because each either fails to provide a verb that corresponds with the plural referent “Harvey Houses” or fails to provide the appropriate possessive pronoun.

## QUESTION 16

**Choice C is the best answer.** It accurately echoes an earlier characterization of the food as being of “terrible quality,” while maintaining the established tone of the passage.

Choices A, B, and D are incorrect either because the word is less formal than the established tone of the passage (“icky”) or because it illogically attributes agency to food (“sinister,” “surly”).

## QUESTION 17

**Choice C is the best answer.** It accurately interprets “not content to follow conventional business practices” as logically introducing the new practice of “employing women” described in the following sentences.

Choices A, B, and D are incorrect because none recognizes why the sentence is relevant to this particular location in the passage.

### QUESTION 18

**Choice B is the best answer.** It is concise and free of redundancies.

Choices A, C, and D are incorrect because each pairs “overwhelming” and “tremendous,” adjectives so close in meaning that together they present a redundancy.

### QUESTION 19

**Choice D is the best answer.** It contains the pronoun “they,” a necessary reference to “such regulations” in the previous clause.

Choices A, B, and C are incorrect because each lacks a necessary subject, such as a pronoun or noun.

### QUESTION 20

**Choice C is the best answer.** It refers directly to benefits for the restaurants’ female employees, the subject of the previous sentence.

Choices A, B, and D are incorrect because none logically builds upon the sentence that precedes it.

### QUESTION 21

**Choice D is the best answer.** It provides punctuation that indicates that the opening dependent clause modifies the subject “Harvey Girls.”

Choices A, B, and C are incorrect because each uses the punctuation for a dependent clause (“Living independently and demonstrating an intense work ethic”) as if it were an independent clause.

### QUESTION 22

**Choice A is the best answer.** It recognizes that the new information supports the previous sentence’s claim that “the Harvey Girls became known as a transformative force.”

Choices B, C, and D are incorrect because each misinterprets the relationship between the proposed text and the passage.

### QUESTION 23

**Choice A is the best answer.** It opens with a clause that identifies how 1-MCP affects apples, which focuses the sentence on 1-MCP as the subject and allows the ideas in the sentence to progress logically.

Choices B, C, and D are incorrect because each displays awkward or flawed modification and progression of ideas or creates redundancy.

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## QUESTION 24

**Choice D is the best answer.** Only the comma is necessary to separate “ethylene” from the appositive noun phrase that defines it.

Choices A, B, and C are incorrect because each creates a comma splice and/or adds unnecessary words.

## QUESTION 25

**Choice B is the best answer.** It offers an adjective that accurately describes fresh apples.

Choices A, C, and D are incorrect because each proposes an adjective that does not describe a plausible fruit texture.

## QUESTION 26

**Choice A is the best answer.** The plural possessive pronoun “their” corresponds with the plural referent “apples.”

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

## QUESTION 27

**Choice D is the best answer.** It provides the pronoun “who,” which accurately identifies the referent “consumers” as people and appropriately begins the relative clause.

Choices A, B, and C are incorrect because each contains a pronoun that either does not correspond with the human referent “consumers” or does not correctly begin the relative clause.

## QUESTION 28

**Choice B is the best answer.** It provides the present tense verb “do,” which corresponds to the present tense established earlier in the sentence.

Choices A, C, and D are incorrect because each contains a verb that deviates from the simple present tense established in the sentence.

## QUESTION 29

**Choice B is the best answer.** It provides a colon to appropriately introduce the clause that follows, an elaboration on the preceding claim that Bartlett pears are an example of fruit that “do not respond as well to 1-MCP treatment.”

Choices A, C, and D are incorrect because each either creates a comma splice or uses a transitional phrase (“For instance”) illogically.

### QUESTION 30

**Choice B is the best answer.** Sentence 4 begins with “But,” indicating a contrast with a previous idea, and goes on to mention that 1-MCP can have negative effects. Sentence 1 continues the discussion of benefits of 1-MCP, and sentence 2 names the adverse effect of limiting scent production, so the most logical spot for sentence 4 is between these sentences.

Choices A, C, and D are incorrect because each proposes placing the sentence at a point where it would compromise the logical development of ideas in the paragraph.

### QUESTION 31

**Choice D is the best answer.** It most accurately reflects the data in the graph, which shows a steep decrease in percentage of flesh browning when untreated apples are left in the open air for three weeks rather than placed immediately into a controlled atmosphere.

Choices A, B, and C are incorrect because each presents an inaccurate interpretation of the data in the graph.

### QUESTION 32

**Choice B is the best answer.** It accurately interprets the data as indicating that “roughly half of their flesh turns brown” when apples are treated with 1-MCP: both bars representing 1-MCP treatment are near the 50% line.

Choices A, C, and D are incorrect because each proposes an inaccurate interpretation of the data.

### QUESTION 33

**Choice C is the best answer.** It describes an action, weighing the relative values, that fruit sellers must take as a result of 1-MCP’s limitations.

Choices A, B, and D are incorrect because none specifically connects the shortcomings of 1-MCP with any action on the part of fruit sellers.

### QUESTION 34

**Choice D is the best answer.** It clearly communicates that the preceding dependent clause modifies “works by human artists.”

Choices A, B, and C are incorrect because each fails to link the preceding dependent clause to an independent clause, resulting in an incomplete sentence.

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## QUESTION 35

**Choice B is the best answer.** It provides the necessary em dash to close the aside about artist C.M. Coolidge, which opens with an em dash.

Choices A, C, and D are incorrect because each provides closing punctuation for the aside that does not correspond with the opening punctuation.

## QUESTION 36

**Choice C is the best answer.** The plural verb “portray” corresponds with the plural noun “works of art.”

Choices A, B, and D are incorrect because none provides the plural verb in the present tense that the sentence requires.

## QUESTION 37

**Choice D is the best answer.** It names a “museum in Russia,” which is the subject of the next paragraph.

Choices A, B, and C are incorrect because each provides an overly general phrase that does not specifically link to the paragraph that follows.

## QUESTION 38

**Choice C is the best answer.** It creates parallelism with the verb “could damage” that appears earlier in the clause (“rodents that could damage . . . [and could] scare off visitors”).

Choices A, B, and D are incorrect because each presents a verb tense that is inconsistent with the sentence’s other present tense verb (“could damage”) that shares “mice, rats, and other rodents” as its subject.

## QUESTION 39

**Choice C is the best answer.** Sentence 5, which discusses Peter the Great’s daughter continuing his tradition, most logically follows the sentence about Peter the Great.

Choices A, B, and D are incorrect because each presents a placement that would compromise the logical development of the paragraph.

## QUESTION 40

**Choice B is the best answer.** “Commissioned” describes the act of hiring an artist to create a specific work.

Choices A, C, and D are incorrect because each provides a word that does not correspond logically with the context.



## QUESTION 41

**Choice D is the best answer.** It provides punctuation that clearly places the noun phrase “digital artist Eldar Zakirov” as an appositive identifying the person mentioned in the previous phrase, “The person chosen for this task.”

Choices A, B, and C are incorrect because each fails to open and close the uninterrupted appositive noun phrase “digital artist Eldar Zakirov” with commas.

## QUESTION 42

**Choice A is the best answer.** The phrase “noble individuals” corresponds with the subsequent examples of portraits where the cats are depicted as “aristocratic,” “stately,” and like a “trusted royal advisor.”

Choices B, C, and D are incorrect because each provides a statement that does not logically connect to the examples that follow.

## QUESTION 43

**Choice D is the best answer.** It accurately states that the information in the proposed additional sentence is not related to formal portraits of cats, the main topic of the paragraph.

Choices A, B, and C are incorrect because each fails to recognize that the proposed sentence interrupts the logical development of the paragraph.

## QUESTION 44

**Choice D is the best answer.** The tone corresponds with that established in the passage, and the phrasing appropriately focuses on the cats’ contribution to protecting artwork rather than on simply killing rodents.

Choices A, B, and C are incorrect because none makes explicit the link between the cats’ hunting activities and the service to the museum.

## Section 3: Math Test – No Calculator

### QUESTION 1

**Choice C is correct.** The painter’s fee is given by  $nK\ell h$ , where  $n$  is the number of walls,  $K$  is a constant with units of dollars per square foot,  $\ell$  is the length of each wall in feet, and  $h$  is the height of each wall in feet. Examining this equation shows that  $\ell$  and  $h$  will be used to determine the area of each wall. The variable  $n$  is the number of walls, so  $n$  times the area of each wall will give the amount of area that will need to be painted. The only remaining variable is  $K$ , which represents

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the cost per square foot and is determined by the painter's time and the price of paint. Therefore,  $K$  is the only factor that will change if the customer asks for a more expensive brand of paint.

Choice A is incorrect because a more expensive brand of paint would not cause the height of each wall to change. Choice B is incorrect because a more expensive brand of paint would not cause the length of each wall to change. Choice D is incorrect because a more expensive brand of paint would not cause the number of walls to change.

## QUESTION 2

**Choice D is correct.** Dividing each side of the equation  $3r = 18$  by 3 gives  $r = 6$ . Substituting 6 for  $r$  in the expression  $6r + 3$  gives  $6(6) + 3 = 39$ .

Alternatively, the expression  $6r + 3$  can be rewritten as  $2(3r) + 3$ . Substituting 18 for  $3r$  in the expression  $2(3r) + 3$  yields  $2(18) + 3$ , or  $36 + 3 = 39$ .

Choice A is incorrect because 6 is the value of  $r$ ; however, the question asks for the value of the expression  $6r + 3$ . Choices B and C are incorrect because if  $6r + 3$  were equal to either of these values, then it would not be possible for  $3r$  to be equal to 18, as stated in the question.

## QUESTION 3

**Choice D is correct.** By definition,  $a^{\frac{m}{n}} = \sqrt[n]{a^m}$  for any positive integers  $m$  and  $n$ . It follows, therefore, that  $a^{\frac{2}{3}} = \sqrt[3]{a^2}$ .

Choice A is incorrect. By definition,  $a^{\frac{1}{n}} = \sqrt[n]{a}$  for any positive integer  $n$ . Applying this definition as well as the power property of exponents to the expression  $\sqrt{a^{\frac{1}{3}}}$  yields  $\sqrt{a^{\frac{1}{3}}} = \left(a^{\frac{1}{3}}\right)^{\frac{1}{2}} = a^{\frac{1}{6}}$ . Because  $a^{\frac{1}{6}} \neq a^{\frac{2}{3}}$ ,  $\sqrt{a^{\frac{1}{3}}}$  is not the correct answer. Choice B is incorrect. By definition,  $a^{\frac{1}{n}} = \sqrt[n]{a}$  for any positive integer  $n$ . Applying this definition as well as the power property of exponents to the expression  $\sqrt{a^3}$  yields  $\sqrt{a^3} = \left(a^3\right)^{\frac{1}{2}} = a^{\frac{3}{2}}$ . Because  $a^{\frac{3}{2}} \neq a^{\frac{2}{3}}$ ,  $\sqrt{a^3}$  is not the correct answer. Choice C is incorrect. By definition,  $a^{\frac{1}{n}} = \sqrt[n]{a}$  for any positive integer  $n$ . Applying this definition as well as the power property of exponents to the expression  $\sqrt[3]{a^{\frac{1}{2}}}$  yields  $\sqrt[3]{a^{\frac{1}{2}}} = \left(a^{\frac{1}{2}}\right)^{\frac{1}{3}} = a^{\frac{1}{6}}$ . Because  $a^{\frac{1}{6}} \neq a^{\frac{2}{3}}$ ,  $\sqrt[3]{a^{\frac{1}{2}}}$  is not the correct answer.

## QUESTION 4

**Choice B is correct.** To fit the scenario described, 30 must be twice as large as  $x$ . This can be written as  $2x = 30$ .

Choices A, C, and D are incorrect. These equations do not correctly relate the numbers and variables described in the stem. For example, the expression in choice C states that 30 is half as large as  $x$ , not twice as large as  $x$ .

**QUESTION 5**

**Choice C is correct.** Multiplying each side of  $\frac{5}{x} = \frac{15}{x+20}$  by  $x(x+20)$  gives  $5(x+20) = 15x$ . Using the distributive property to eliminate the parentheses yields  $5x + 100 = 15x$ , and then subtracting  $5x$  from each side of the equation  $5x + 100 = 15x$  gives  $100 = 10x$ . Finally, dividing both sides of the equation  $100 = 10x$  by 10 gives  $10 = x$ . Therefore, the value of  $\frac{x}{5}$  is  $\frac{10}{5} = 2$ .

Choice A is incorrect because it is the value of  $x$ , not  $\frac{x}{5}$ . Choices B and D are incorrect and may be the result of errors in arithmetic operations on the given equation.

**QUESTION 6**

**Choice C is correct.** Multiplying each side of the equation  $2x - 3y = -14$  by 3 gives  $6x - 9y = -42$ . Multiplying each side of the equation  $3x - 2y = -6$  by 2 gives  $6x - 4y = -12$ . Then, subtracting the sides of  $6x - 4y = -12$  from the corresponding sides of  $6x - 9y = -42$  gives  $-5y = -30$ . Dividing each side of the equation  $-5y = -30$  by  $-5$  gives  $y = 6$ . Finally, substituting 6 for  $y$  in  $2x - 3y = -14$  gives  $2x - 3(6) = -14$ , or  $x = 2$ . Therefore, the value of  $x - y$  is  $2 - 6 = -4$ .

Alternatively, adding the corresponding sides of  $2x - 3y = -14$  and  $3x - 2y = -6$  gives  $5x - 5y = -20$ , from which it follows that  $x - y = -4$ .

Choices A and B are incorrect and may be the result of an arithmetic error when solving the system of equations. Choice D is incorrect and may be the result of finding  $x + y$  instead of  $x - y$ .

**QUESTION 7**

**Choice C is correct.** If  $x - b$  is a factor of  $f(x)$ , then  $f(b)$  must equal 0. Based on the table,  $f(4) = 0$ . Therefore,  $x - 4$  must be a factor of  $f(x)$ .

Choice A is incorrect because  $f(2) \neq 0$ . Choice B is incorrect because no information is given about the value of  $f(3)$ , so  $x - 3$  may or may not be a factor of  $f(x)$ . Choice D is incorrect because  $f(5) \neq 0$ .

**QUESTION 8**

**Choice A is correct.** The linear equation  $y = kx + 4$  is in slope-intercept form, and so the slope of the line is  $k$ . Since the line contains the point  $(c, d)$ , the coordinates of this point satisfy the equation  $y = kx + 4$ ; therefore,  $d = kc + 4$ . Solving this equation for the slope,  $k$ , gives  $k = \frac{d-4}{c}$ .

Choices B, C, and D are incorrect and may be the result of errors in substituting the coordinates of  $(c, d)$  in  $y = kx + 4$  or of errors in solving for  $k$  in the resulting equation.

## QUESTION 9

**Choice A is correct.** If a system of two linear equations has no solution, then the lines represented by the equations in the coordinate plane are parallel. The equation  $kx - 3y = 4$  can be rewritten as  $y = \frac{k}{3}x - \frac{4}{3}$ , where  $\frac{k}{3}$  is the slope of the line, and the equation  $4x - 5y = 7$  can be rewritten as  $y = \frac{4}{5}x - \frac{7}{5}$ , where  $\frac{4}{5}$  is the slope of the line. If two lines are parallel, then the slopes of the lines are equal. Therefore,  $\frac{4}{5} = \frac{k}{3}$ , or  $k = \frac{12}{5}$ . (Since the  $y$ -intercepts of the lines represented by the equations are  $-\frac{4}{3}$  and  $-\frac{7}{5}$ , the lines are parallel, not identical.)

Choices B, C, and D are incorrect and may be the result of a computational error when rewriting the equations or solving the equation representing the equality of the slopes for  $k$ .

## QUESTION 10

**Choice A is correct.** Substituting 25 for  $y$  in the equation  $y = (x - 11)^2$  gives  $25 = (x - 11)^2$ . It follows that  $x - 11 = 5$  or  $x - 11 = -5$ , so the  $x$ -coordinates of the two points of intersection are  $x = 16$  and  $x = 6$ , respectively. Since both points of intersection have a  $y$ -coordinate of 25, it follows that the two points are  $(16, 25)$  and  $(6, 25)$ . Since these points lie on the horizontal line  $y = 25$ , the distance between these points is the positive difference of the  $x$ -coordinates:  $16 - 6 = 10$ .

Alternatively, since a translation is a rigid motion, the distance between points  $A$  and  $B$  would be the same as the distance between the points of intersection of the line  $y = 25$  and the parabola  $y = x^2$ . Since those graphs intersect at  $(0, 5)$  and  $(0, -5)$ , the distance between the two points, and thus the distance between  $A$  and  $B$ , is 10.

Choices B, C, and D are incorrect and may be the result of an error in solving the quadratic equation that results when substituting 25 for  $y$  in the given quadratic equation.

## QUESTION 11

**Choice B is correct.** Since the angles marked  $y^\circ$  and  $u^\circ$  are vertical angles,  $y = u$ . Substituting  $y$  for  $u$  in the equation  $x + y = u + w$  gives  $x = w$ . Since the angles marked  $w^\circ$  and  $z^\circ$  are vertical angles,  $w = z$ . Therefore, by the transitive property,  $x = z$ , and so I must be true.

The equation in II need not be true. For example, if  $x = w = z = t = 70$  and  $y = u = 40$ , then all three pairs of vertical angles in the figure have equal measure and the given condition  $x + y = u + w$  holds. But it is not true in this case that  $y$  is equal to  $w$ . Therefore, II need not be true.

Since the top three angles in the figure form a straight angle, it follows that  $x + y + z = 180$ . Similarly,  $w + u + t = 180$ , and so  $x + y + z = w + u + t$ . Subtracting the sides of the given equation  $x + y = u + w$  from the corresponding sides of  $x + y + z = w + u + t$  gives  $z = t$ . Therefore, III must be true. Since only I and III must be true, the correct answer is choice B.

Choices A, C, and D are incorrect because each of these choices includes II, which need not be true.

## QUESTION 12

**Choice A is correct.** The parabola with equation  $y = a(x - 2)(x + 4)$  crosses the  $x$ -axis at the points  $(-4, 0)$  and  $(2, 0)$ . By symmetry, the  $x$ -coordinate of the vertex of the parabola is halfway between the  $x$ -coordinates of  $(-4, 0)$  and  $(2, 0)$ . Thus, the  $x$ -coordinate of the vertex is  $\frac{-4 + 2}{2} = -1$ . This is the value of  $c$ . To find the  $y$ -coordinate of the vertex, substitute  $-1$  for  $x$  in  $y = a(x - 2)(x + 4)$ :

$$y = a(x - 2)(x + 4) = a(-1 - 2)(-1 + 4) = a(-3)(3) = -9a$$

Therefore, the value of  $d$  is  $-9a$ .

Choice B is incorrect because the value of the constant term in the equation is not the  $y$ -coordinate of the vertex, unless there were no linear terms in the quadratic. Choice C is incorrect and may be the result of a sign error in finding the  $x$ -coordinate of the vertex. Choice D is incorrect because the negative of the coefficient of the linear term in the quadratic equation is not the  $y$ -coordinate of the vertex.

## QUESTION 13

**Choice B is correct.** Since  $24x^2 + 25x - 47$  divided by  $ax - 2$  is equal to  $-8x - 3$  with remainder  $-53$ , it is true that  $(-8x - 3)(ax - 2) - 53 = 24x^2 + 25x - 47$ . (This can be seen by multiplying each side of the given equation by  $ax - 2$ ). This can be rewritten as  $-8ax^2 + 16x - 3ax + 6 - 53 = 24x^2 + 25x - 47$ . Since the coefficients of the  $x^2$ -term have to be equal on both sides of the equation,  $-8a = 24$ , or  $a = -3$ .

Choices A, C, and D are incorrect and may be the result of either a conceptual misunderstanding or a computational error when trying to solve for the value of  $a$ .

## QUESTION 14

**Choice A is correct.** Dividing each side of the given equation by 3 gives the equivalent equation  $x^2 + 4x + 2 = 0$ . Then using the quadratic formula,  $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$  with  $a = 1$ ,  $b = 4$ , and  $c = 2$ , gives the solutions  $x = -2 \pm \sqrt{2}$ .

Choices B, C, and D are incorrect and may be the result of errors when applying the quadratic formula.

## QUESTION 15

**Choice D is correct.** If  $C$  is graphed against  $F$ , the slope of the line is equal to  $\frac{5}{9}$  degrees Celsius/degrees Fahrenheit, which means that for an increase of 1 degree Fahrenheit, the increase is  $\frac{5}{9}$  of 1 degree Celsius. Thus, statement I is true. This is the equivalent to saying that an increase of 1 degree Celsius is equal to an increase of  $\frac{9}{5}$  degrees Fahrenheit.

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Since  $\frac{9}{5} = 1.8$ , statement II is true. On the other hand, statement III is not true, since a temperature increase of  $\frac{9}{5}$  degrees Fahrenheit, not  $\frac{5}{9}$  degree Fahrenheit, is equal to a temperature increase of 1 degree Celsius. Choices A, B, and C are incorrect because each of these choices omits a true statement or includes a false statement.

### QUESTION 16

**The correct answer is either 1 or 2.** The given equation can be rewritten as  $x^5 - 5x^3 + 4x = 0$ . Since the polynomial expression on the left has no constant term, it has  $x$  as a factor:  $x(x^4 - 5x^2 + 4) = 0$ . The expression in parentheses is a quadratic equation in  $x^2$  that can be factored, giving  $x(x^2 - 1)(x^2 - 4) = 0$ . This further factors as  $x(x - 1)(x + 1)(x - 2)(x + 2) = 0$ . The solutions for  $x$  are  $x = 0$ ,  $x = 1$ ,  $x = -1$ ,  $x = 2$ , and  $x = -2$ . Since it is given that  $x > 0$ , the possible values of  $x$  are  $x = 1$  and  $x = 2$ . Either 1 or 2 may be gridded as the correct answer.

### QUESTION 17

**The correct answer is 2.** First, clear the fractions from the given equation by multiplying each side of the equation by 36 (the least common multiple of 4, 9, and 12). The equation becomes  $28x - 16x = 9 + 15$ . Combining like terms on each side of the equation yields  $12x = 24$ . Finally, dividing both sides of the equation by 12 yields  $x = 2$ .

Alternatively, since  $\frac{7}{9}x - \frac{4}{9}x = \frac{3}{9}x = \frac{1}{3}x$  and  $\frac{1}{4} + \frac{5}{12} = \frac{3}{12} + \frac{5}{12} = \frac{8}{12} = \frac{2}{3}$ , the given equation simplifies to  $\frac{1}{3}x = \frac{2}{3}$ . Multiplying each side of  $\frac{1}{3}x = \frac{2}{3}$  by 3 yields  $x = 2$ .

### QUESTION 18

**The correct answer is 105.** Since  $180 - z = 2y$  and  $y = 75$ , it follows that  $180 - z = 150$ , and so  $z = 30$ . Thus, each of the base angles of the isosceles triangle on the right has measure  $\frac{180^\circ - 30^\circ}{2} = 75^\circ$ . Therefore, the measure of the angle marked  $x^\circ$  is  $180^\circ - 75^\circ = 105^\circ$ , and so the value of  $x$  is 105.

### QUESTION 19

**The correct answer is 370.** A system of equations can be used where  $h$  represents the number of calories in a hamburger and  $f$  represents the number of calories in an order of fries. The equation  $2h + 3f = 1700$  represents the fact that 2 hamburgers and 3 orders of fries contain a total of 1700 calories, and the equation  $h = f + 50$  represents the fact

that one hamburger contains 50 more calories than an order of fries. Substituting  $f + 50$  for  $h$  in  $2h + 3f = 1700$  gives  $2(f + 50) + 3f = 1700$ . This equation can be solved as follows:

$$2f + 100 + 3f = 1700$$

$$5f + 100 = 1700$$

$$5f = 1600$$

$$f = 320$$

The number of calories in an order of fries is 320, so the number of calories in a hamburger is 50 more than 320, or 370.

## QUESTION 20

**The correct answer is  $\frac{3}{5}$  or .6.** Triangle  $ABC$  is a right triangle with its right angle at  $B$ . Thus,  $\overline{AC}$  is the hypotenuse of right triangle  $ABC$ , and  $\overline{AB}$  and  $\overline{BC}$  are the legs of right triangle  $ABC$ . By the Pythagorean theorem,  $AB = \sqrt{20^2 - 16^2} = \sqrt{400 - 256} = \sqrt{144} = 12$ . Since triangle  $DEF$  is similar to triangle  $ABC$ , with vertex  $F$  corresponding to vertex  $C$ , the measure of angle  $F$  equals the measure of angle  $C$ . Thus,  $\sin F = \sin C$ . From the side lengths of triangle  $ABC$ ,  $\sin C = \frac{\text{opposite side}}{\text{hypotenuse}} = \frac{AB}{AC} = \frac{12}{20} = \frac{3}{5}$ . Therefore,  $\sin F = \frac{3}{5}$ . Either  $\frac{3}{5}$  or its decimal equivalent, .6, may be gridded as the correct answer.

## Section 4: Math Test – Calculator

### QUESTION 1

**Choice C is correct.** Marilyn's distance from her campsite remained the same during the time she ate lunch. This is represented by a horizontal segment in the graph. The only horizontal segment in the graph starts at a time of about 1:10 P.M. and ends at about 1:40 P.M. Therefore, Marilyn finished her lunch and continued her hike at about 1:40 P.M.

Choices A, B, and D are incorrect and may be the result of a misinterpretation of the graph. For example, choice B is the time Marilyn started her lunch, and choice D is the time Marilyn was at the maximum distance from her campsite.

### QUESTION 2

**Choice B is correct.** Of the 25 people who entered the contest, there are 8 females under age 40 and 2 males age 40 or older. Because there is no overlap in the categories, the probability that the contest winner will be either a female under age 40 or a male age 40 or older is

$$\frac{8}{25} + \frac{2}{25} = \frac{10}{25}$$

Choice A is incorrect and may be the result of dividing 8 by 2, instead of adding 8 to 2, to find the probability. Choice C is incorrect; it is the probability that the contest winner will be either a female under

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age 40 or a female age 40 or older. Choice D is incorrect and may be the result of multiplying 8 and 2, instead of adding 8 and 2, to find the probability.

### QUESTION 3

**Choice C is correct.** Based on the graph, sales increased in the first 3 years since 1997, which is until year 2000, and then generally decreased thereafter.

Choices A, B, and D are incorrect; each of these choices contains inaccuracies in describing the general trend of music album sales from 1997 through 2009.

### QUESTION 4

**Choice C is correct.** The graph of  $y = f(n)$  in the coordinate plane is a line that passes through each of the points given in the table. From the table, one can see that an increase of 1 unit in  $n$  results in an increase of 3 units in  $f(n)$ ; for example,  $f(2) - f(1) = 1 - (-2) = 3$ . Therefore, the graph of  $y = f(n)$  in the coordinate plane is a line with slope 3. Only choice C is a line with slope 3. The y-intercept of the line is the value of  $f(0)$ . Since an increase of 1 unit in  $n$  results in an increase of 3 units in  $f(n)$ , it follows that  $f(1) - f(0) = 3$ . Since  $f(1) = -2$ , it follows that  $f(0) = f(1) - 3 = -5$ . Therefore, the y-intercept of the graph of  $f(n)$  is  $-5$ , and the equation in slope-intercept form that defined  $f$  is  $f(n) = 3n - 5$ .

Choices A, B, and D are incorrect because each equation has the incorrect slope of the line (the y-intercept in each equation is also incorrect).

### QUESTION 5

**Choice B is correct.** Since 7 percent of the 562 juniors is  $0.07(562)$  and 5 percent of the 602 seniors is  $0.05(602)$ , the expression  $0.07(562) + 0.05(602)$  can be evaluated to determine the total number of juniors and seniors inducted into the National Honor Society. Of the given choices, 69 is closest to the value of the expression.

Choice A is incorrect and may be the result of adding the number of juniors and seniors and the percentages given and then using the expression  $(0.07 + 0.05)(562 + 602)$ . Choices C and D are incorrect and may be the result of finding either only the number of juniors inducted or only the number of seniors inducted.

### QUESTION 6

**Choice A is correct.** The sum of the two polynomials is  $(3x^2 - 5x + 2) + (5x^2 - 2x - 6)$ . This can be rewritten by combining like terms:

$$(3x^2 - 5x + 2) + (5x^2 - 2x - 6) = (3x^2 + 5x^2) + (-5x - 2x) + (2 - 6) = 8x^2 - 7x - 4$$



Choice B is incorrect and may be the result of a sign error when combining the coefficients of the  $x$ -term. Choice C is incorrect and may be the result of adding the exponents, as well as the coefficients, of like terms. Choice D is incorrect and may be the result of a combination of the errors described in choice B and choice C.

## QUESTION 7

**Choice D is correct.** To solve the equation for  $w$ , multiply both sides of the equation by the reciprocal of  $\frac{3}{5}$ , which is  $\frac{5}{3}$ . This gives  $\left(\frac{5}{3}\right) \cdot \frac{3}{5} w = \frac{4}{3} \cdot \left(\frac{5}{3}\right)$ , which simplifies to  $w = \frac{20}{9}$ .

Choices A, B, and C are incorrect and may be the result of errors in arithmetic when simplifying the given equation.

## QUESTION 8

**Choice C is correct.** In the equation  $y = 0.56x + 27.2$ , the value of  $x$  increases by 1 for each year that passes. Each time  $x$  increases by 1,  $y$  increases by 0.56 since 0.56 is the slope of the graph of this equation. Since  $y$  represents the average number of students per classroom in the year represented by  $x$ , it follows that, according to the model, the estimated increase each year in the average number of students per classroom at Central High School is 0.56.

Choice A is incorrect because the total number of students in the school in 2000 is the product of the average number of students per classroom and the total number of classrooms, which would appropriately be approximated by the  $y$ -intercept (27.2) times the total number of classrooms, which is not given. Choice B is incorrect because the average number of students per classroom in 2000 is given by the  $y$ -intercept of the graph of the equation, but the question is asking for the meaning of the number 0.56, which is the slope. Choice D is incorrect because 0.56 represents the estimated yearly change in the average number of students per classroom. The estimated difference between the average number of students per classroom in 2010 and 2000 is 0.56 times the number of years that have passed between 2000 and 2010, that is,  $0.56 \times 10 = 5.6$ .

## QUESTION 9

**Choice B is correct.** Because Nate walks 25 meters in 13.7 seconds, and 4 minutes is equal to 240 seconds, the proportion

$\frac{25 \text{ meters}}{13.7 \text{ sec}} = \frac{x \text{ meters}}{240 \text{ sec}}$  can be used to find out how many meters,  $x$ ,

Nate walks in 4 minutes. The proportion can be simplified to

$\frac{25}{13.7} = \frac{x}{240}$ , because the units of meters per second cancel,

and then each side of the equation can be multiplied by 240,

giving  $\frac{(240)(25)}{13.7} = x \approx 438$ . Therefore, of the given options, 450 meters

is closest to the distance Nate will walk in 4 minutes.

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Choice A is incorrect and may be the result of setting up the proportion as  $\frac{13.7 \text{ sec}}{25 \text{ meters}} = \frac{x \text{ meters}}{240 \text{ sec}}$  and finding that  $x \approx 132$ , which is close to 150. Choices C and D are incorrect and may be the result of errors in calculation.

### QUESTION 10

**Choice D is correct.** On Mercury, the acceleration due to gravity is  $3.6 \text{ m/sec}^2$ . Substituting 3.6 for  $g$  and 90 for  $m$  in the formula  $W = mg$  gives  $W = 90(3.6) = 324$  newtons.

Choice A is incorrect and may be the result of dividing 90 by 3.6. Choice B is incorrect and may be the result of subtracting 3.6 from 90 and rounding to the nearest whole number. Choice C is incorrect because an object with a weight of 101 newtons on Mercury would have a mass of about 28 kilograms, not 90 kilograms.

### QUESTION 11

**Choice B is correct.** On Earth, the acceleration due to gravity is  $9.8 \text{ m/sec}^2$ . Thus, for an object with a weight of 150 newtons, the formula  $W = mg$  becomes  $150 = m(9.8)$ , which shows that the mass of an object with a weight of 150 newtons on Earth is about 15.3 kilograms. Substituting this mass into the formula  $W = mg$  and now using the weight of 170 newtons gives  $170 = 15.3g$ , which shows that the second planet's acceleration due to gravity is about  $11.1 \text{ m/sec}^2$ . According to the table, this value for the acceleration due to gravity holds on Saturn.

Choices A, C, and D are incorrect. Using the formula  $W = mg$  and the values for  $g$  in the table shows that an object with a weight of 170 newtons on these planets would not have the same mass as an object with a weight of 150 newtons on Earth.

### QUESTION 12

**Choice D is correct.** A zero of a function corresponds to an  $x$ -intercept of the graph of the function in the  $xy$ -plane. Therefore, the complete graph of the function  $f$ , which has five distinct zeros, must have five  $x$ -intercepts. Only the graph in choice D has five  $x$ -intercepts, and therefore, this is the only one of the given graphs that could be the complete graph of  $f$  in the  $xy$ -plane.

Choices A, B, and C are incorrect. The number of  $x$ -intercepts of each of these graphs is not equal to five; therefore, none of these graphs could be the complete graph of  $f$ , which has five distinct zeros.

### QUESTION 13

**Choice D is correct.** Starting with the original equation,  $h = -16t^2 + vt + k$ , in order to get  $v$  in terms of the other variables,  $-16t^2$  and  $k$  need to be subtracted from each side. This yields  $vt = h + 16t^2 - k$ , which when

divided by  $t$  will give  $v$  in terms of the other variables. However, the equation  $v = \frac{h + 16t^2 - k}{t}$  is not one of the options, so the right side needs to be further simplified. Another way to write the previous equation is  $v = \frac{h - k}{t} + \frac{16t^2}{t}$ , which can be simplified to  $v = \frac{h - k}{t} + 16t$ . Choices A, B, and C are incorrect and may be the result of arithmetic errors when rewriting the original equation to express  $v$  in terms of  $h$ ,  $t$ , and  $k$ .

## QUESTION 14

**Choice A is correct.** The hotel charges \$0.20 per minute to use the meeting-room phone. This per-minute rate can be converted to the hourly rate using the conversion 1 hour = 60 minutes, as shown below.

$$\frac{\$0.20}{\text{minute}} \times \frac{60 \text{ minutes}}{1 \text{ hour}} = \frac{\$(0.20 \times 60)}{\text{hour}}$$

Thus, the hotel charges  $\$(0.20 \times 60)$  per hour to use the meeting-room phone. Therefore, the cost  $c$ , in dollars, for  $h$  hours of use is  $c = (0.20 \times 60)h$ , which is equivalent to  $c = 0.20(60h)$ .

Choice B is incorrect because in this expression the per-minute rate is multiplied by  $h$ , the number of hours of phone use. Furthermore, the equation indicates that there is a flat fee of \$60 in addition to the per-minute or per-hour rate. This is not the case. Choice C is incorrect because the expression indicates that the hotel charges  $\left(\frac{60}{0.20}\right)$  per hour for use of the meeting-room phone, not  $\$0.20(60)$  per hour. Choice D is incorrect because the expression indicates that the hourly rate is  $\frac{1}{60}$  times the per-minute rate, not 60 times the per-minute rate.

## QUESTION 15

**Choice A is the correct answer.** Experimental research is a method used to study a small group of people and generalize the results to a larger population. However, in order to make a generalization involving cause and effect:

- The population must be well defined.
- The participants must be selected at random.
- The participants must be randomly assigned to treatment groups.

When these conditions are met, the results of the study can be generalized to the population with a conclusion about cause and effect. In this study, all conditions are met and the population from which the participants were selected are people with poor eyesight. Therefore, a general conclusion can be drawn about the effect of Treatment X on the population of people with poor eyesight.

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Choice B is incorrect. The study did not include all available treatments, so no conclusion can be made about the relative effectiveness of all available treatments. Choice C is incorrect. The participants were selected at random from a large population of people with poor eyesight. Therefore, the results can be generalized only to that population and not to anyone in general. Also, the conclusion is too strong: an experimental study might show that people are likely to be helped by a treatment, but it cannot show that anyone who takes the treatment will be helped. Choice D is incorrect. This conclusion is too strong. The study shows that Treatment X is likely to improve the eyesight of people with poor eyesight, but it cannot show that the treatment definitely will cause improvement in eyesight for every person. Furthermore, since the people undergoing the treatment in the study were selected from people with poor eyesight, the results can be generalized only to this population, not to all people.

### QUESTION 16

**Choice B is correct.** The graphs of  $y = f(x)$  and  $y = g(x)$  are given. In order for  $f(x) + g(x)$  to be 0, there must be one or more values of  $x$  for which the  $y$ -coordinates of the graphs are opposites. Looking at the graphs, one can see that this occurs at  $x = -2$ : the point  $(-2, -2)$  lies on the graph of  $f$ , and the point  $(-2, 2)$  lies on the graph of  $g$ . Thus, at  $x = -2$ , the value of  $f(x) + g(x)$  is  $-2 + 2 = 0$ .

Choices A, C, and D are incorrect because none of these  $x$ -values satisfies the given equation,  $f(x) + g(x) = 0$ .

### QUESTION 17

**Choice B is correct.** The quantity of the product supplied to the market is given by the function  $S(P) = \frac{1}{2}P + 40$ . If the price  $P$  of the product increases by \$10, the effect on the quantity of the product supplied can be determined by substituting  $P + 10$  for  $P$  in the function  $S(P) = \frac{1}{2}P + 40$ . This gives  $S(P + 10) = \frac{1}{2}(P + 10) + 40 = \frac{1}{2}P + 45$ , which shows that  $S(P + 10) = S(P) + 5$ . Therefore, the quantity supplied to the market will increase by 5 units when the price of the product is increased by \$10.

Alternatively, look at the coefficient of  $P$  in the linear function  $S$ . This is the slope of the graph of the function, where  $P$  is on the horizontal axis and  $S(P)$  is on the vertical axis. Since the slope is  $\frac{1}{2}$ , for every increase of 1 in  $P$ , there will be an increase of  $\frac{1}{2}$  in  $S(P)$ , and therefore, an increase of 10 in  $P$  will yield an increase of 5 in  $S(P)$ .

Choice A is incorrect. If the quantity supplied decreases as the price of the product increases, the function  $S(P)$  would be decreasing, but  $S(P) = \frac{1}{2}P + 40$  is an increasing function. Choice C is incorrect and may be the result of assuming the slope of the graph of  $S(P)$  is

equal to 1. Choice D is incorrect and may be the result of confusing the y-intercept of the graph of  $S(P)$  with the slope, and then adding 10 to the y-intercept.

### QUESTION 18

**Choice B is correct.** The quantity of the product supplied to the market will equal the quantity of the product demanded by the market if  $S(P)$  is equal to  $D(P)$ , that is, if  $\frac{1}{2}P + 40 = 220 - P$ . Solving this equation gives  $P = 120$ , and so \$120 is the price at which the quantity of the product supplied will equal the quantity of the product demanded.

Choices A, C, and D are incorrect. At these dollar amounts, the quantities given by  $S(P)$  and  $D(P)$  are not equal.

### QUESTION 19

**Choice C is correct.** It is given that 1 ounce of graphene covers 7 football fields. Therefore, 48 ounces can cover  $7 \times 48 = 336$  football fields. If each football field has an area of  $1\frac{1}{3}$  acres, then 336 football fields have a total area of  $336 \times 1\frac{1}{3} = 448$  acres. Therefore, of the choices given, 450 acres is closest to the number of acres 48 ounces of graphene could cover.

Choice A is incorrect and may be the result of dividing, instead of multiplying, the number of football fields by  $1\frac{1}{3}$ . Choice B is incorrect and may be the result of finding the number of football fields, not the number of acres, that can be covered by 48 ounces of graphene. Choice D is incorrect and may be the result of setting up the expression  $\frac{7 \times 48 \times 4}{3}$  and then finding only the numerator of the fraction.

### QUESTION 20

**Choice B is correct.** To answer this question, find the point in the graph that represents Michael's 34-minute swim and then compare the actual heart rate for that swim with the expected heart rate as defined by the line of best fit. To find the point that represents Michael's swim that took 34 minutes, look along the vertical line of the graph that is marked "34" on the horizontal axis. That vertical line intersects only one point in the scatterplot, at 148 beats per minute. On the other hand, the line of best fit intersects the vertical line representing 34 minutes at 150 beats per minute. Therefore, for the swim that took 34 minutes, Michael's actual heart rate was  $150 - 148 = 2$  beats per minute less than predicted by the line of best fit.

Choices A, C, and D are incorrect and may be the result of misreading the graph.

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## QUESTION 21

**Choice C is correct.** Linear growth is characterized by an increase of a quantity at a constant rate. Exponential growth is characterized by an increase of a quantity at a relative rate; that is, an increase by the same factor over equal increments of time. In choice C, the value of the account increases by 1% each year; that is, the value is multiplied by the same factor, 1.01, each year. Therefore, the value described in choice C grows exponentially.

Choices A and B are incorrect because the rate depends only on the initial value, and thus the value increases by the same amount each year. Both options A and B describe linear growth. Choice D is incorrect; it is also a description of linear growth, as the increase is constant each year.

## QUESTION 22

**Choice B is correct.** One of the three numbers is  $x$ ; let the other two numbers be  $y$  and  $z$ . Since the sum of three numbers is 855, the equation  $x + y + z = 855$  is true. The statement that  $x$  is 50% more than the sum of the other two numbers can be represented as  $x = 1.5(y + z)$ , or  $x = \frac{3}{2}(y + z)$ . Multiplying both sides of the equation  $x = \frac{3}{2}(y + z)$  by  $\frac{2}{3}$  gives  $\frac{2}{3}x = y + z$ . Substituting  $\frac{2}{3}x$  in  $x + y + z = 855$  gives  $x + \frac{2}{3}x = 855$ , or  $\frac{5x}{3} = 855$ . Therefore,  $x$  equals  $\frac{3}{5} \times 855 = 513$ .

Choices A, C, and D are incorrect and may be the result of computational errors.

## QUESTION 23

**Choice C is correct.** Since the angles are acute and  $\sin(a^\circ) = \cos(b^\circ)$ , it follows from the complementary angle property of sines and cosines that  $a + b = 90$ . Substituting  $4k - 22$  for  $a$  and  $6k - 13$  for  $b$  gives  $(4k - 22) + (6k - 13) = 90$ , which simplifies to  $10k - 35 = 90$ . Therefore,  $10k = 125$ , and  $k = 12.5$ .

Choice A is incorrect and may be the result of mistakenly assuming that  $a = b$  and making a sign error. Choices B and D are incorrect because they result in values for  $a$  and  $b$  such that  $\sin(a^\circ) \neq \cos(b^\circ)$ .

## QUESTION 24

**Choice D is correct.** Let  $c$  be the number of students in Mr. Kohl's class. The conditions described in the question can be represented by the equations  $n = 3c + 5$  and  $n + 21 = 4c$ . Substituting  $3c + 5$  for  $n$  in the second equation gives  $3c + 5 + 21 = 4c$ , which can be solved to find  $c = 26$ .

Choices A, B, and C are incorrect because the values given for the number of students in the class cannot fulfill both conditions given in the question. For example, if there were 16 students in the class, then the first condition would imply that there are  $3(16) + 5 = 53$  milliliters

of solution in the beaker, but the second condition would imply that there are  $4(16) - 21 = 43$  milliliters of solution in the beaker. This contradiction shows that there cannot be 16 students in the class.

### QUESTION 25

**Choice D is correct.** The volume of the grain silo can be found by adding the volumes of all the solids of which it is composed. The silo is made up of a cylinder with height 10 feet (ft) and base radius 5 ft and two cones, each having height 5 ft and base radius 5 ft. The formulas  $V_{\text{cylinder}} = \pi r^2 h$  and  $V_{\text{cone}} = \frac{1}{3} \pi r^2 h$  can be used to determine the total volume of the silo. Since the two cones have identical dimensions, the total volume, in cubic feet, of the silo is given by  $V_{\text{silo}} = \pi(5)^2(10) + (2)\left(\frac{1}{3}\right)\pi(5)^2(5) = \left(\frac{4}{3}\right)(250)\pi$ , which is approximately equal to 1,047.2 cubic feet.

Choice A is incorrect because this is the volume of only the two cones. Choice B is incorrect because this is the volume of only the cylinder. Choice C is incorrect because this is the volume of only one of the cones plus the cylinder.

### QUESTION 26

**Choice C is correct.** The line passes through the origin,  $(2, k)$ , and  $(k, 32)$ . Any two of these points can be used to find the slope of the line. Since the line passes through  $(0, 0)$  and  $(2, k)$ , the slope of the line is equal to  $\frac{k-0}{2-0} = \frac{k}{2}$ . Similarly, since the line passes through  $(0, 0)$  and  $(k, 32)$ , the slope of the line is equal to  $\frac{32-0}{k-0} = \frac{32}{k}$ . Since each expression gives the slope of the same line, it must be true that  $\frac{k}{2} = \frac{32}{k}$ . Multiplying each side of  $\frac{k}{2} = \frac{32}{k}$  by  $2k$  gives  $k^2 = 64$ , from which it follows that  $k = 8$  or  $k = -8$ . Therefore, of the given choices, only 8 could be the value of  $k$ .

Choices A, B, and D are incorrect and may be the result of computational errors.

### QUESTION 27

**Choice C is correct.** Let  $\ell$  and  $w$  be the length and width, respectively, of the original rectangle. The area of the original rectangle is  $A = \ell w$ . The rectangle is altered by increasing its length by 10 percent and decreasing its width by  $p$  percent; thus, the length of the altered rectangle is  $1.1\ell$ , and the width of the altered rectangle is  $\left(1 - \frac{p}{100}\right)w$ . The alterations decrease the area by 12 percent, so the area of the altered rectangle is  $(1 - 0.12)A = 0.88A$ . The area of the altered rectangle is the product of its length and width, so  $0.88A = (1.1\ell)\left(1 - \frac{p}{100}\right)w$ . Since  $A = \ell w$ , this last equation can

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be rewritten as  $0.88A = (1.1)\left(1 - \frac{p}{100}\right)\ell w = (1.1)\left(1 - \frac{p}{100}\right)A$ , from which it follows that  $0.88 = (1.1)\left(1 - \frac{p}{100}\right)$ , or  $0.8 = \left(1 - \frac{p}{100}\right)$ . Therefore,  $\frac{p}{100} = 0.2$ , and so the value of  $p$  is 20.

Choice A is incorrect and may be the result of confusing the 12 percent decrease in area with the percent decrease in width. Choice B is incorrect because decreasing the width by 15 percent results in a 6.5 percent decrease in area, not a 12 percent decrease. Choice D is incorrect and may be the result of adding the percents given in the question (10 + 12).

## QUESTION 28

**Choice D is correct.** For the present population to decrease by 10 percent, it must be multiplied by the factor 0.9. Since the engineer estimates that the population will decrease by 10 percent every 20 years, the present population, 50,000, must be multiplied by  $(0.9)^n$ , where  $n$  is the number of 20-year periods that will have elapsed  $t$  years from now. After  $t$  years, the number of 20-year periods that have elapsed is  $\frac{t}{20}$ . Therefore,  $50,000(0.9)^{\frac{t}{20}}$  represents the engineer's estimate of the population of the city  $t$  years from now.

Choices A, B, and C are incorrect because each of these choices either confuses the percent decrease with the multiplicative factor that represents the percent decrease or mistakenly multiplies  $t$  by 20 to find the number of 20-year periods that will have elapsed in  $t$  years.

## QUESTION 29

**Choice A is correct.** Let  $x$  be the number of left-handed female students and let  $y$  be the number of left-handed male students. Then the number of right-handed female students will be  $5x$  and the number of right-handed male students will be  $9y$ . Since the total number of left-handed students is 18 and the total number of right-handed students is 122, the system of equations below must be satisfied.

$$\begin{cases} x + y = 18 \\ 5x + 9y = 122 \end{cases}$$

Solving this system gives  $x = 10$  and  $y = 8$ . Thus, 50 of the 122 right-handed students are female. Therefore, the probability that a right-handed student selected at random is female is  $\frac{50}{122}$ , which to the nearest thousandth is 0.410.

Choices B, C, and D are incorrect and may be the result of incorrectly calculating the missing values in the table.



**QUESTION 30**

**Choice A is correct.** Subtracting the sides of  $3y + c = 5y - 7$  from the corresponding sides of  $3x + b = 5x - 7$  gives  $(3x - 3y) + (b - c) = (5x - 5y + (-7 - (-7)))$ . Since  $b = c - \frac{1}{2}$ , or  $b - c = -\frac{1}{2}$ , it follows that  $(3x - 3y) + \left(-\frac{1}{2}\right) = (5x - 5y)$ . Solving this equation for  $x$  in terms of  $y$  gives  $x = y - \frac{1}{4}$ . Therefore,  $x$  is  $y$  minus  $\frac{1}{4}$ .

Choices B, C, and D are incorrect and may be the result of making a computational error when solving the equations for  $x$  in terms of  $y$ .

**QUESTION 31**

**The correct answer is either 4 or 5.** Because each student ticket costs \$2 and each adult ticket costs \$3, the total amount, in dollars, that Chris spends on  $x$  student tickets and 1 adult ticket is  $2(x) + 3(1)$ . Because Chris spends at least \$11 but no more than \$14 on the tickets, one can write the compound inequality  $2x + 3 \geq 11$  and  $2x + 3 \leq 14$ . Subtracting 3 from each side of both inequalities and then dividing each side of both inequalities by 2 yields  $x \geq 4$  and  $x \leq 5.5$ . Thus, the value of  $x$  must be an integer that is both greater than or equal to 4 and less than or equal to 5.5. Therefore,  $x = 4$  or  $x = 5$ . Either 4 or 5 may be gridded as the correct answer.

**QUESTION 32**

**The correct answer is 58.6.** The mean of a data set is determined by calculating the sum of the values and dividing by the number of values in the data set. The sum of the ages, in years, in the data set is 703, and the number of values in the data set is 12. Thus, the mean of the ages, in years, of the first 12 United States presidents at the beginning of their terms is  $\frac{703}{12}$ . The question asks for an answer rounded to the nearest tenth, so the decimal equivalent, rounded to the nearest tenth, is the correct answer. This rounded decimal equivalent is 58.6.

**QUESTION 33**

**The correct answer is 9.** To rewrite the difference  $(-3x^2 + 5x - 2) - 2(x^2 - 2x - 1)$  in the form  $ax^2 + bx + c$ , the expression can be simplified by using the distributive property and combining like terms as follows:

$$\begin{aligned} & -3x^2 + 5x - 2 - (2x^2 - 4x - 2) \\ & -3x^2 - 2x^2 + (5x - (-4x) + (-2 - (-2))) \\ & -5x^2 + 9x + 0 \end{aligned}$$

The coefficient of  $x$  is the value of  $b$ , which is 9.

Alternatively, since  $b$  is the coefficient of  $x$  in the difference  $-3x^2 + 5x - 2 - 2(x^2 - 2x - 1)$ , one need only compute the  $x$ -term in the difference. The  $x$ -term is  $5x - 2(-2x) = 5x + 4x = 9x$ , so the value of  $b$  is 9.

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### QUESTION 34

**The correct answer is  $\frac{5}{8}$  or .625.** A complete rotation around a point is  $360^\circ$  or  $2\pi$  radians. Since the central angle  $AOB$  has measure  $\frac{5\pi}{4}$  radians, it represents  $\frac{\frac{5\pi}{4}}{2\pi} = \frac{5}{8}$  of a complete rotation around point  $O$ . Therefore, the sector formed by central angle  $AOB$  has area equal to  $\frac{5}{8}$  the area of the entire circle. Either the fraction  $5/8$  or its decimal equivalent, .625, may be gridded as the correct answer.

### QUESTION 35

**The correct answer is 50.** The mean of a data set is the sum of the values in the data set divided by the number of values in the data set. The mean of 75 is obtained by finding the sum of the first 10 ratings and dividing by 10. Thus, the sum of the first 10 ratings was 750. In order for the mean of the first 20 ratings to be at least 85, the sum of the first 20 ratings must be at least  $(85)(20) = 1700$ . Therefore, the sum of the next 10 ratings must be at least  $1700 - 750 = 950$ . The maximum rating is 100, so the maximum possible value of the sum of the 12th through 20th ratings is  $9 \times 100 = 900$ . Therefore, for the store to be able to have an average of at least 85 for the first 20 ratings, the least possible value for the 11th rating is  $950 - 900 = 50$ .

### QUESTION 36

**The correct answer is 750.** The inequalities  $y \leq -15x + 3000$  and  $y \leq 5x$  can be graphed in the  $xy$ -plane. They are represented by the lower half-planes with the boundary lines  $y = -15x + 3000$  and  $y = 5x$ , respectively. The solution set of the system of inequalities will be the intersection of these half-planes, including the boundary lines, and the solution  $(a, b)$  with the greatest possible value of  $b$  will be the point of intersection of the boundary lines. The intersection of boundary lines of these inequalities can be found by substituting  $5x$  for  $y$  in the equation for the first line:  $5x = -15x + 3000$ , which has solution  $x = 150$ . Thus, the  $x$ -coordinate of the point of intersection is 150. Therefore, the  $y$ -coordinate of the point of intersection of the boundary lines is  $5(150) = -15(150) + 3000 = 750$ . This is the maximum possible value of  $b$  for a point  $(a, b)$  that is in the solution set of the system of inequalities.

### QUESTION 37

**The correct answer is 7.** The average number of shoppers,  $N$ , in the checkout line at any time is  $N = rt$ , where  $r$  is the number of shoppers entering the checkout line per minute and  $T$  is the average number of minutes each shopper spends in the checkout line. Since 84 shoppers per hour make a purchase, 84 shoppers per hour enter the checkout line. This needs to be converted to the number of

shoppers per minute. Since there are 60 minutes in one hour, the rate is  $\frac{84 \text{ shoppers}}{60 \text{ minutes}} = 1.4$  shoppers per minute. Using the given formula with  $r = 1.4$  and  $t = 5$  yields  $N = rt = (1.4)(5) = 7$ . Therefore, the average number of shoppers,  $N$ , in the checkout line at any time during business hours is 7.

### QUESTION 38

**The correct answer is 60.** The estimated average number of shoppers in the original store at any time is 45. In the new store, the manager estimates that an average of 90 shoppers per hour enter the store, which is equivalent to 1.5 shoppers per minute. The manager also estimates that each shopper stays in the store for an average of 12 minutes. Thus, by Little's law, there are, on average,  $N = rt = (1.5)(12) = 18$  shoppers in the new store at any time. This is  $\frac{45 - 18}{45} \times 100 = 60$  percent less than the average number of shoppers in the original store at any time.

