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# The SAT<sup>®</sup>

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# Question- and-Answer Service

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# Reading Test

65 MINUTES, 52 QUESTIONS

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

## DIRECTIONS

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

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

This passage is adapted from Willa Cather, *O Pioneers!* Originally published in 1913. John Bergson is a farmer on his deathbed. Alexandra Bergson is his teenage daughter.

In eleven long years John Bergson had made but little impression upon the wild land he had come to tame. It was still a wild thing that had its ugly moods; and no one knew when they were likely to come, or  
5 why. Mischance hung over it. Its Genius was unfriendly to man. The sick man was feeling this as he lay looking out of the window, after the doctor had left him, on the day following Alexandra's trip to town. There it lay outside his door, the same land, the  
10 same lead-colored miles. He knew every ridge and draw and gully between him and the horizon. To the south, his plowed fields; to the east, the sod stables, the cattle corral, the pond,—and then the grass.

John Bergson had the Old-World belief that land,  
15 in itself, is desirable. But this land was an enigma. It was like a horse that no one knows how to break to harness, that runs wild and kicks things to pieces. He had an idea that no one understood how to farm it properly, and this he often discussed with Alexandra.  
20 Their neighbors, certainly, knew even less about farming than he did. Many of them had never worked on a farm until they took up their homesteads. They had been *handworkers* at home; tailors, locksmiths, joiners, cigar-makers, etc. Bergson himself had  
25 worked in a shipyard.

For weeks, John Bergson had been thinking about these things. His bed stood in the sitting-room, next

to the kitchen. Through the day, while the baking and washing and ironing were going on, the father lay  
30 and looked up at the roof beams that he himself had hewn, or out at the cattle in the corral. He counted the cattle over and over. It diverted him to speculate as to how much weight each of the steers would probably put on by spring. He often called his  
35 daughter in to talk to her about this. Before Alexandra was twelve years old she had begun to be a help to him, and as she grew older he had come to depend more and more upon her resourcefulness and good judgment. His boys were willing enough to  
40 work, but when he talked with them they usually irritated him. It was Alexandra who read the papers and followed the markets, and who learned by the mistakes of their neighbors. It was Alexandra who could always tell about what it had cost to fatten each  
45 steer, and who could guess the weight of a hog before it went on the scales closer than John Bergson himself. Lou and Oscar were industrious, but he could never teach them to use their heads about their work. Alexandra, her father often said to himself, was  
50 like her grandfather; which was his way of saying that she was intelligent. John Bergson's father had been a shipbuilder, a man of considerable force and of some fortune. Late in life he married a second time, a  
55 Stockholm woman of questionable character, much younger than he, who goaded him into every sort of extravagance. On the shipbuilder's part, this marriage was an infatuation, the despairing folly of a powerful man who cannot bear to grow old. In a few years his unprincipled wife warped the probity of a lifetime.

60 He speculated, lost his own fortune and funds entrusted to him by poor seafaring men, and died disgraced, leaving his children nothing. But when all was said, he had come up from the sea himself, had built up a proud little business with no capital but his own skill and foresight, and had proved himself a man. In his daughter, John Bergson recognized the strength of will, and the simple direct way of thinking things out, that had characterized his father in his better days. He would much rather, of course, have seen this likeness in one of his sons, but it was not a question of choice. As he lay there day after day he had to accept the situation as it was, and to be thankful that there was one among his children to whom he could entrust the future of his family and the possibilities of his hard-won land.

1

A central theme developed in the passage is that of the

- A) danger of exploiting the environment for material gain.
- B) dependability of family despite past conflict among members.
- C) foolishness of denying the inevitability of old age.
- D) futility of seeking to gain full mastery over the natural world.

2

Over the course of the passage, the main focus of John Bergson's thoughts shifts from the

- A) weaknesses that he deplores in his sons to the strengths that he prizes in his daughter.
- B) initial difficulty that he faced as a novice farmer to his eventual achievement as an experienced farmer.
- C) challenges of being a successful farmer to those of being a successful shipbuilder.
- D) physical qualities of his land to the personal qualities that he values most in a potential successor.

3

The simile in lines 14-17 ("It was . . . pieces") primarily serves which function?

- A) It expands on the characterization provided in lines 3-5 ("It was . . . why").
- B) It contrasts with the images evoked in lines 5-6 ("Mischance . . . to man").
- C) It highlights the belief conveyed in lines 14-15 ("John . . . desirable").
- D) It reinforces the details presented in lines 22-25 ("They . . . shipyard").

4

In the passage, the main contrast that John Bergson draws between himself and his neighbors is that his neighbors

- A) had previously worked in urban areas while he had always worked in rural ones.
- B) are less skilled than he is at the occupation that they all have in common.
- C) resisted becoming homestead farmers, whereas he was eager to be one.
- D) had better luck with their particular parcels of land than he did with his.

5

As used in line 42, "followed" most nearly means

- A) came after.
- B) imitated closely.
- C) kept under guard.
- D) stayed informed about.

6

The narrator most clearly indicates that John Bergson regards his sons as

- A) hardworking but not smart enough to manage the farm.
- B) loyal but insufficiently appreciative of the farm's value.
- C) well intentioned but too reckless to handle the family's business.
- D) capable but unwilling to involve their sister in overseeing the farm.

7

The passage best supports which characterization of Alexandra Bergson in her attention to the details of the family farm?

- A) She values others' opinions and ideas.
- B) She possesses great instinct and insight.
- C) She reluctantly defers to her brothers' decisions.
- D) She is a better farmer than was her father as a young man.

8

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

- A) Lines 31-35 ("He counted . . . this")
- B) Lines 39-41 ("His boys . . . him")
- C) Lines 41-47 ("It was . . . himself")
- D) Lines 49-51 ("Alexandra . . . intelligent")

9

Which choice most clearly supports the idea that John Bergson's father was afraid of aging?

- A) Lines 51-53 ("John . . . fortune")
- B) Lines 53-56 ("Late . . . extravagance")
- C) Lines 56-58 ("On the . . . old")
- D) Lines 58-59 ("In a few . . . lifetime")

10

Which situation is most similar to that described in lines 66-75 ("In his . . . land")?

- A) A teacher sees her female students outperforming her male students, and she chastises the males for not working harder.
- B) A small business owner is faced with daunting new challenges, but her employees collaborate successfully to solve the problems.
- C) A coach needs one of her players to step forward and lead the team, but the player who does so is not the one the coach expected.
- D) A shopkeeper works hard to ensure that her daughter will have better opportunities than she had, and the daughter eventually runs a large corporation.

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

Passage 1 is adapted from Milton Friedman and Rose Friedman, *Free to Choose*. ©1980 by Milton Friedman and Rose Friedman. Passage 2 is adapted from Douglas J. Amy, *Government Is Good*. ©2011 by Douglas J. Amy.

**Passage 1**

An essential part of economic freedom is freedom to choose how to use our income: how much to spend on ourselves and on what items; how much to save and in what form; how much to give away and to whom. Currently, more than 40 percent of our income is disposed of on our behalf by government at federal, state, and local levels combined. One of us once suggested a new national holiday, ‘Personal Independence Day—that day in the year when we stop working to pay the expenses of government . . . and start working to pay for the items we severally and individually choose in light of our own needs and desires.’ In 1929, that holiday would have come on Abraham Lincoln’s birthday, February 12; today it would come about May 30; if present trends were to continue, it would coincide with the other Independence Day, July 4, around 1988.

Of course, we have something to say about how much of our income is spent on our behalf by government. We participate in the political process that has resulted in government’s spending an amount equal to more than 40 percent of our income. Majority rule is a necessary and desirable expedient. It is, however, very different from the kind of freedom you have when you shop at a supermarket. When you enter the voting booth once a year, you almost always vote for a package rather than for specific items. If you are in the majority, you will at best get both the items you favored and the ones you opposed but regarded as on balance less important. Generally, you end up with something different from what you thought you voted for. If you are in the minority, you must conform to the majority vote and wait for your turn to come. When you vote daily in the supermarket, you get precisely what you voted for, and so does everyone else. The ballot box produces conformity without unanimity; the marketplace, unanimity without conformity. That is why it is desirable to use the ballot box, so far as possible, only for those decisions where conformity is essential.

**Passage 2**

So why are most people in denial about the beneficial roles that government plays in their lives? There are several answers. First, most Americans have become so used to the benefits of government that they simply take them for granted. Benefits that are provided reliably for long periods of time—such as clean water and a stable currency system—tend to fade into the background and to not be considered benefits at all. They disappear from our consciousness. Our failure to notice or appreciate what government does for us also has to do with the unique and peculiar nature of many government benefits. The benefits we get from paying our taxes are usually not immediate, and they are often not particularly tangible either. They can be remote and elusive. This is easy to see if we contrast government benefits with the benefits we receive from exchanges in the marketplace. When we go to the store, we hand over our money and immediately get something very concrete in return—a candy bar, a blouse, some groceries. This kind of exchange is very satisfying; we see what we get for our money right away.

Not so with many of the exchanges we have with our governments. We shell out money for our taxes, but what we gain in return is frequently delayed or remote. For instance, we pay our local government to treat our sewage, but the environmental payoffs may not be immediately obvious to us. When we later go fishing or swimming in our local lake or river—waters whose purity depends upon adequate sewage treatment—we probably do not see this enjoyable experience as a result of our sewer tax. When benefits are remote like this, it is hard to make the connections between them and the taxes we pay.

Government benefits are also different because they are often less tangible than the goods we get from a store. These benefits frequently take the form not of the presence of something, but of the absence of something. Think of it this way: much of the job of government in our lives is to ensure that bad things don’t happen to us. We pay taxes so that our homes don’t get burgled, and our food doesn’t make us sick, our banks don’t fail, and our bridges don’t collapse. In other words, often when people in government are doing their job right—nothing happens. No wonder no one notices. So while we really do get a lot for our taxes, we often get it in a form that is largely invisible to us. This is one of the reasons why we too easily fall for the illusion that government is doing nothing for us.

11

In Passage 1, the authors repeat “40 percent” (line 5 and line 22) to

- A) emphasize a number they believe is too large.
- B) support a claim they believe many people will doubt.
- C) ensure the reader understands how they arrived at their calculations.
- D) correct a perception they believe is incorrect.

12

According to Passage 1, over time, Personal Independence Day would occur later in the year because

- A) people are unaware of how much of their income goes to taxes each year.
- B) people’s incomes are not growing as rapidly as they were in the past.
- C) people are spending a greater percentage of their income each year on taxes.
- D) people misunderstand the underlying desires that motivate their spending.

13

According to Passage 1, one result of the current political process for determining how taxes are spent is that

- A) the government has more funds than it needs to operate efficiently.
- B) the government is unable to secure the public’s confidence.
- C) voters who are in the majority tend to be highly satisfied.
- D) voters rarely get exactly what they want.

14

The authors’ remark in lines 36-38 (“The ballot . . . conformity”) serves to

- A) suggest that conformity is more desirable than unanimity.
- B) caution that unanimity and conformity are incompatible aims.
- C) point out that two activities have similar flaws.
- D) emphasize a sharp contrast between two familiar activities.

15

A central idea of Passage 2 is that

- A) people unfairly compare the worth of purchased goods with the worth of government benefits.
- B) people tend to overlook the connection between paying taxes and receiving some ongoing government benefits.
- C) more people take advantage of government spending today than in the past.
- D) government benefits are more reliable today than they once were.

16

As used in line 51, “appreciate” most nearly means

- A) accumulate.
- B) judge.
- C) value.
- D) safeguard.

17

It can reasonably be inferred that the author of Passage 2 would characterize tax money spent on road maintenance as providing benefits that are

- A) easier to understand than most of the benefits taxes provide.
- B) unlikely to be acknowledged as long as the roads are in good condition.
- C) dedicated to future generations at the expense of current taxpayers.
- D) a result of a compromise in which no voters are satisfied.

18

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

- A) Lines 42-44 (“So why . . . answers”)
- B) Lines 51-54 (“Our . . . benefits”)
- C) Lines 76-78 (“Government . . . store”)
- D) Lines 78-82 (“These . . . to us”)

19

Based on the passages, the authors of Passage 1 and Passage 2 would agree that transactions in the marketplace

- A) are often taken for granted by consumers.
- B) are a source of satisfaction to consumers.
- C) should be generating more tax revenue than they do currently.
- D) are too tightly regulated by the government.

20

It can reasonably be inferred from Passage 2 that Amy would likely respond to the Friedmans’ proposal of a Personal Independence Day by asserting that the Friedmans

- A) ignore how much people receive from the government in return for their tax dollars.
- B) disregard the problem of US citizens spending too much of their income on personal needs and desires.
- C) fail to understand that economic freedom is something that most US citizens view as a right.
- D) underestimate the extent to which economic freedom is threatened by high levels of taxation.

21

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

- A) Lines 46-50 (“Benefits . . . all”)
- B) Lines 57-59 (“This is . . . marketplace”)
- C) Lines 59-62 (“When . . . groceries”)
- D) Lines 62-63 (“This kind . . . right away”)

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

This passage is adapted from Catherine Clabby, “If Not for Plants, Could Rivers Bend?” ©2010 by Sigma Xi, The Scientific Research Society.

For decades, the Canadian geologist Martin Gibling has been intrigued by the tough-to-prove hypothesis that land plants created the shape of modern rivers hundreds of millions of years ago.

Line 5 Plant roots reinforced the ground, the thinking goes, creating stable banks that funneled what once were wide, shallow water flows into narrower and deeper channels. By extension, that set the stage for lots of significant Earth history events, including the rise of human civilizations in modern river basins so many millennia later.

Now Gibling and postdoctoral scientist Neil Davies, both at Dalhousie University, have strengthened this case. When the pair compared a much-improved plant fossil record with evidence of how rivers changed very long ago, the transitions matched up.

Line 20 “As soon as the plants got a foothold on land and rooted vegetation started, that changed the landscape. Basically plants engineered that landscape as they evolved,” says Davies.

Back in the Cambrian period, which ended some 500 million years ago, the geologic record indicates that rivers were very shallow but wide things, almost floods that allowed rainwater to wash from largely barren solid ground to sea. Deposits left behind were preserved as sheets of coarse grains, some of which suggest these rivers were 1,000 or more times as wide as they were deep.

Line 30 “There is probably nowhere on Earth where rivers form the way they did before vegetation,” Gibling says.

But at the time separating the Silurian and Devonian periods, some 420 million years ago, the picture found in preserved sedimentary rock changes. The blankets of unconsolidated sediment found in earlier river deposits appear less frequently. It happens just as evidence of land vegetation with root systems also expands in the rock record.

Line 40 In addition, more complex and diverse river remains emerge, including more traces of mud, probably due to the enhanced chemical weathering that plants assist; smaller-sized sand grains; and samples of organic remains. Significantly, shapes shift too.

Organized deposits become visible in the remains

of highly sinuous, single-thread channels. Evidence of lateral accretion—the digging away of material at the outer bends of a river and the simultaneous deposition of material at the inner bends—is more abundant.

Line 55 There is also variation that appears to be related to the local climate during the times that the rivers flowed. “Before plants evolved, it didn’t matter if a river was in a polar region, a temperate region or an arid region, the rivers looked the same. Later you find differences,” says Davies, who devoted two and a half years to this project.

Using funding from the Canadian government, Davies and Gibling reviewed 144 published reports describing river sediment preserved in the rock record, dating from the Cambrian to the Devonian, to build their case. They visited 34 spots themselves in North America and Europe. And they scrutinized experimental results.

Line 65 One laboratory finding that impressed Gibling was achieved at St. Anthony Falls Laboratory at the University of Minnesota. Working in a tank, researchers there described how vegetation—in this case alfalfa sprouts that were allowed to germinate on banks—transformed a channel that flowed between multiple sandbars into one that self-organized into a single-thread channel.

Line 75 “The strength of the roots of alfalfa was enough to completely change the whole pattern. That generated a meandering river with banks that migrate and are erosion resistant,” Gibling says.

Line 80 Dov Corenblit, an associate professor at the University of Paris who describes himself as a biogeomorphologist, says Davies and Gibling have delivered more than just insight into the history of rivers. They have expanded evidence that the biotic and abiotic features of this planet influence one another.

Line 85 Their findings “may be considered significant progress in the comprehension of one of the most critical phases in the coupling between physical and biological processes on Earth,” Corenblit says.

The Dalhousie University geologists aren’t done. Line 90 They want to explore whether any of the periodic mass extinctions experienced on Earth might have affected the shapes of rivers as well. They are scouring the literature for changes preserved from the end of the Permian, when a lot of plant life was wiped out.

Line 95 “We’ll look to see if rivers reverted to the older form,” Davies says.



22

The primary purpose of the passage is to

- A) evaluate the outcomes of a study that appears to synthesize two competing explanations of how rivers form.
- B) describe recent findings that support a long-standing hypothesis about the impact of plants on river formation.
- C) identify the effect of groundbreaking research on the development of a new theory about the origin of rivers.
- D) explain field results that appear to conflict with laboratory results of experiments exploring the ways in which plants change the landscape.

23

Which statement best describes the reasoning that Davies and Gibling used to reach their main conclusion?

- A) The reshaping of rivers preceded the appearance of rooted vegetation, so it is likely that the reshaping of rivers resulted in rooted vegetation.
- B) Rivers change shape regularly in the present with no evidence that they did not do so in the past, so rivers likely did change shape in the past.
- C) The appearance of rooted vegetation and the reshaping of rivers occurred around the same time in the past, and rooted vegetation can be shown to cause changes to river shapes, so it likely did reshape the rivers.
- D) While there is no direct evidence that rooted vegetation existed in the past, there is evidence of an effect of this type of vegetation, so it likely did exist.

24

Which choice provides the best evidence for the idea that plants can affect the lateral pattern of flowing water?

- A) Lines 14-17 (“When . . . matched up”)
- B) Lines 30-32 (“There . . . says”)
- C) Lines 54-56 (“Before . . . same”)
- D) Lines 68-73 (“Working . . . channel”)

25

The passage most strongly suggests that there is a relationship between the presence of plants rooted near rivers and which characteristic of those rivers?

- A) The size and composition of particles from vegetation and rocks
- B) The color of preserved sedimentary rocks they contain
- C) The temperature of their main currents
- D) The distance they cover from source to sea

26

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

- A) Lines 18-19 (“As soon . . . landscape”)
- B) Lines 33-35 (“But at . . . changes”)
- C) Lines 37-39 (“It happens . . . record”)
- D) Lines 40-44 (“In addition . . . remains”)

27

As used in line 41, “emerge” most nearly means

- A) rise.
- B) proceed.
- C) appear.
- D) flow.

28

The main function of the eleventh paragraph (lines 59-65) is to

- A) describe how Davies and Gibling gathered their data.
- B) restate Davies and Gibling’s central claim.
- C) illustrate how Davies and Gibling’s findings were received.
- D) highlight difficulties that Davies and Gibling encountered in their study.

29

The author most likely discusses the research conducted at the University of Minnesota to

- A) show that Davies and Gibling were able to replicate their field observations in a controlled setting.
- B) summarize the laboratory finding that led Davies and Gibling to propose their theory.
- C) describe how other researchers have tested and confirmed Davies and Gibling’s hypothesis.
- D) highlight the results of an experiment that supports the claim made by Davies and Gibling.

30

As used in line 87, “critical” most nearly means

- A) important.
- B) analytical.
- C) negative.
- D) urgent.

31

Which finding about rivers from the end of the Permian period, if true, would best support Davies and Gibling’s argument?

- A) They often flowed through areas containing very little rooted vegetation.
- B) They were generally shallow, wide, and contained relatively little mud.
- C) They tended to be single-channel, meandering rivers.
- D) They characteristically displayed extensive lateral accretion.

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

This passage is adapted from Philip E. Tetlock and Dan Gardner, *Superforecasting: The Art and Science of Prediction*. ©2015 by Philip Tetlock Consulting, Inc., and Connaught Street, Inc.

Human beings have coped with uncertainty for as long as we have been recognizably human. And for almost all that time we didn't have access to statistical models of uncertainty because they didn't exist. It was remarkably late in history—arguably as late as the 1713 publication of Jakob Bernoulli's *Ars Conjectandi*—before the best minds started to think seriously about probability.

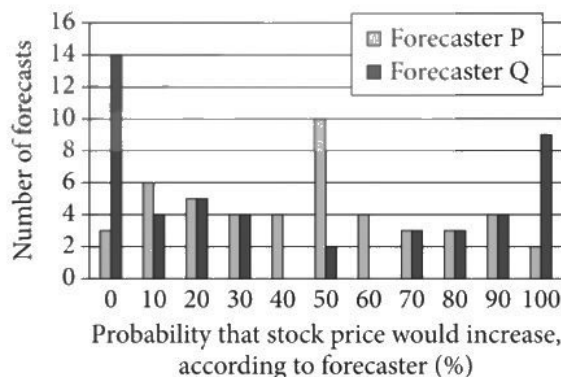
Before that, people had no choice but to rely on the tip-of-your-nose perspective. You see a shadow moving in the long grass. Should you worry about lions? You try to think of an example of a lion attacking from the long grass. If the example comes to mind easily, run! If the response is strong enough, it can produce a binary conclusion: “Yes, it's a lion,” or “No, it's not a lion.” But if it's weaker, it can produce an unsettling middle possibility: “Maybe it's a lion.” What the tip-of-your-nose perspective will not deliver is a judgment so fine grained that it can distinguish between, say, a 60% chance that it is a lion and an 80% chance. That takes slow, conscious, careful thought. Of course, when you were dealing with the pressing existential problems our ancestors faced, it was rarely necessary to make such fine distinctions. It may not even have been desirable. A three-setting dial gives quick, clear directions. Is that a lion? YES = run! MAYBE = stay alert! NO = relax. The ability to distinguish between a 60% probability and an 80% probability would add little. In fact, a more fine-grained analysis could slow you down—and get you killed.

In this light, the preference for two- and three-setting mental dials makes sense. And lots of research underscores the point. Why is a decline from 5% to 0% so much more valuable than a decline from 10% to 5%? Because it delivers more than a 5% reduction in risk. It delivers certainty. Both 0% and 100% weigh far more heavily in our minds than the mathematical models of economists say they should. Again, this is not surprising if you think about the world in which our brain evolved. There was always at least a tiny chance a lion was lurking in the vicinity. Or a snake. Or any of the countless other threats people faced.

But our ancestors couldn't maintain a state of constant alert. The cognitive cost would have been too great. They needed worry-free zones. The solution? Ignore small chances and use the two-setting dial as much as possible. Either it is a lion or it isn't. Only when something undeniably falls between those two settings—only when we are compelled—do we turn the mental dial to maybe.

We want answers. A confident yes or no is satisfying in a way that maybe never is, a fact that helps to explain why the media so often turn to hedgehogs [single-minded people] who are sure they know what is coming no matter how bad their forecasting records may be. Of course it's not always wrong to prefer a confident judgment. All else being equal, our answers to questions like “Does France have more people than Italy?” are likelier to be right when we are confident they are right than when we are not. Confidence and accuracy are positively correlated. But research shows we exaggerate the size of the correlation. For instance, people trust more confident financial advisers over those who are less confident even when their track records are identical. And people equate confidence and competence, which makes the forecaster who says something has a middling probability of happening less worthy of respect. As one study noted, people “took such judgments as indications the forecasters were either generally incompetent, ignorant of the facts in a given case, or lazy, unwilling to expend the effort required to gather information that would justify greater confidence.”

Number of Forecasts of the Probability That a Stock Price Would Increase



Adapted from J. Frank Yates et al., “Good Probabilistic Forecasters: The ‘Consumer’s’ Perspective.” ©1996 by Elsevier Science B. V.

32

The main purpose of the passage is to

- A) criticize the unreasonable expectations held by many human beings.
- B) contrast the behaviors of ancient and modern societies.
- C) offer an alternative explanation for an uncommon phenomenon.
- D) place a human tendency within an evolutionary context.

33

Which choice best supports the idea that the reassurance provided by binary options extends beyond matters of personal safety?

- A) Lines 22-25 (“Of course . . . distinctions”)
- B) Lines 39-41 (“Again . . . evolved”)
- C) Lines 49-51 (“Only . . . maybe”)
- D) Lines 52-57 (“A confident . . . may be”)

34

The passage implies that probabilistic thinking did not become useful until

- A) the problem of daily survival became a less pressing issue than it had been in the past.
- B) sophisticated technology was devised that was able to provide fine measurement distinctions.
- C) people realized it could be used to enhance common defensive maneuvers.
- D) assessing the confidence levels of others became important to daily life.

35

As used in line 36 and line 37, “delivers” most nearly means

- A) surrenders.
- B) releases.
- C) transports.
- D) provides.

36

The phrases “cognitive cost” and “worry-free zones” (lines 45-46) help convey a sense of the

- A) mental toll of continual uneasiness.
- B) physical damage caused by ongoing attacks.
- C) intellectual challenge of solving difficult puzzles.
- D) grave consequences of sudden decisions.

37

According to the passage, which choice best states the relationship between the confidence level of someone providing a judgment and the accuracy of that judgment?

- A) The greater the confidence level of someone providing a judgment, the less accurate that judgment will usually prove to be in the end.
- B) The greater the confidence level of someone providing a judgment, the more likely people are to scrutinize the accuracy of that judgment.
- C) The greater the confidence level of someone providing a judgment, the more accurate that judgment is likely to be up to a certain point.
- D) The greater the confidence level of someone providing a judgment, the more accurate that judgment will nearly always be.

38

The authors' main purpose in citing the study in the last sentence of the passage is to

- A) offer quotations from subjects that appear to contradict some of the ideas discussed in the passage.
- B) note several irrational conclusions subjects have reached that support claims made earlier in the passage.
- C) compare contemporary subjects with the ancient humans described in the passage.
- D) suggest how economic forecasters can use information provided in the passage to improve their reputations.

39

According to the graph, which choice represents the number of forecasts made by Forecaster P that predicted that a stock price had a 50 percent probability of increasing?

- A) 2
- B) 6
- C) 10
- D) 14

40

Based on the graph and the passage, people would be most likely to follow the advice of which forecaster?

- A) Forecaster Q, because his or her predictions proved to be more accurate than the predictions of Forecaster P.
- B) Forecaster Q, because his or her predictions offered greater certainty than did the predictions of Forecaster P.
- C) Forecaster P, because he or she exhibited a greater level of confidence than did Forecaster Q.
- D) Forecaster P, because he or she was generally more cautious than was Forecaster Q.

41

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

- A) Lines 18-21 ("What the . . . chance")
- B) Lines 28-29 ("The ability . . . little")
- C) Lines 63-64 ("But research . . . correlation")
- D) Lines 67-70 ("And people . . . respect")

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

This passage is adapted from Dawn Levy, “ORNL Researchers Invent Tougher Plastic with 50 Percent Renewable Content.” Published in 2016 by Oak Ridge National Laboratory.

A car’s bumper is usually made of a moldable thermoplastic polymer called ABS, shorthand for its acrylonitrile, butadiene and styrene components.

Line Light, strong and tough, it is also the stuff of  
5 ventilation pipes, protective headgear, kitchen appliances, Lego bricks and many other consumer products. Useful as it is, one of its drawbacks is that it is made using chemicals derived from petroleum.

10 Researchers at the Department of Energy’s Oak Ridge National Laboratory (ORNL) have made a better thermoplastic by replacing styrene with lignin, a brittle, rigid polymer that, with cellulose, forms the woody cell walls of plants. In doing so, they have invented a solvent-free production process that  
15 interconnects equal parts of nanoscale lignin dispersed in a synthetic rubber matrix to produce a meltable, moldable, ductile material that’s at least ten times tougher than ABS. The resulting thermoplastic—called ABL for acrylonitrile, butadiene, lignin—is  
20 recyclable, as it can be melted three times and still perform well. The results, published in the journal *Advanced Functional Materials*, may bring cleaner, cheaper raw materials to diverse manufacturers.

The technology could make use of the lignin-rich  
25 biomass byproduct stream from biorefineries and pulp and paper mills. With the prices of natural gas and oil dropping, renewable fuels can’t compete with fossil fuels, so biorefineries are exploring options for developing other economically viable products.

30 Among cellulose, hemicellulose and lignin, the major structural constituents of plants, lignin is the most commercially underutilized. The ORNL study aimed to use it to produce, with an eye toward commercialization, a renewable thermoplastic with  
35 properties rivaling those of current petroleum-derived alternatives.

“Lignin is a very brittle natural polymer, so it needs to be toughened,” explained study author Amit Naskar, leader of ORNL’s Carbon and Composites  
40 group. A major goal of the group is producing industrial polymers that are strong and tough enough to be deformed without fracturing. “We need to chemically combine soft matter with lignin. That soft matrix would be ductile so that it can be malleable or

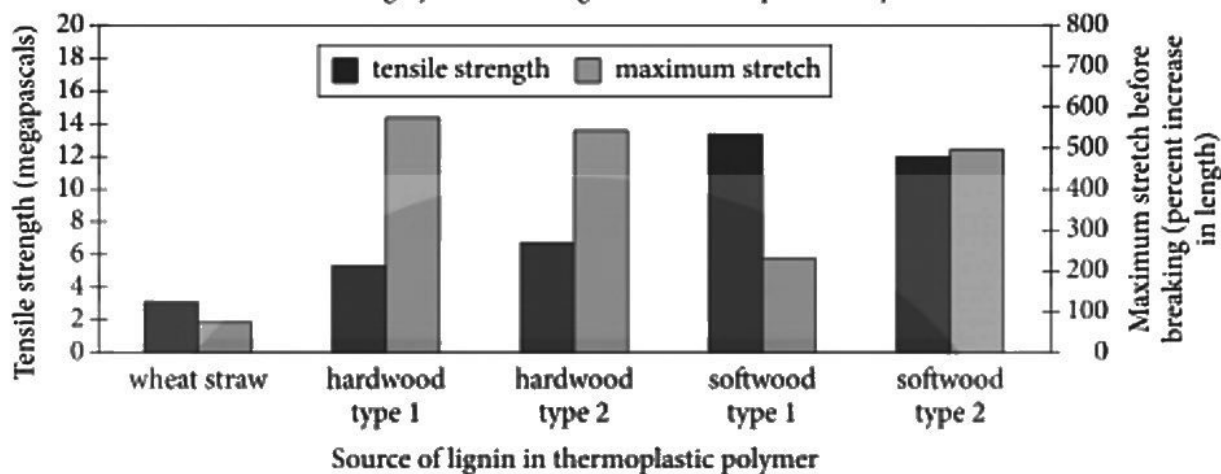
45 stretchable. Very rigid lignin segments would offer resistance to deformation and thus provide stiffness.”

All lignins are not equal in terms of heat stability. To determine what type would make the best thermoplastic feedstock, the scientists evaluated  
50 lignin from wheat straw, softwoods like pine and hardwoods like oak. They found hardwood lignin is the most thermally stable, and some types of softwood lignins are also melt-stable.

Next, the researchers needed to couple the lignin  
55 with soft matter. Chemists typically accomplish this by synthesizing polymers in the presence of solvents. Because lignin and a synthetic rubber containing acrylonitrile and butadiene, called nitrile rubber, both have chemical groups in which electrons are  
60 unequally distributed and therefore likely to interact, Naskar and Chau Tran (who performed melt-mixing and characterization experiments) instead tried to couple the two in a melted phase without solvents.

In a heated chamber with two rotors, the  
65 researchers “kneaded” a molten mix of equal parts powdered lignin and nitrile rubber. During mixing, lignin agglomerates broke into interpenetrating layers or sheets of 10 to 200 nanometers that dispersed well in and interacted with the rubber. Without the proper  
70 selection of a soft matrix and mixing conditions, lignin agglomerates are at least 10 times larger than those obtained with the ORNL process. The product that formed had properties of neither lignin nor rubber, but something in between, with a  
75 combination of lignin’s stiffness and nitrile rubber’s elasticity.

Tensile Strength (Maximum Stress at Breaking) and Maximum Stretch Before Breaking by Source of Lignin in Thermoplastic Polymer



Adapted from Chau D. Tran et al., "A New Class of Renewable Thermoplastics with Extraordinary Performance from Nanostructured Lignin-Elastomers." ©2016 by WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim.

42

The author most likely mentions several commonplace objects in the first paragraph in order to

- A) give a sense of the range of uses to which ABS can be put.
- B) indicate that the plentiful supply of ABS has led to its devaluation.
- C) provide examples of potential alternatives to ABS.
- D) suggest that environmental concerns will curtail reliance on ABS in manufacturing.

43

As used in line 12, "forms" most nearly means

- A) organizes.
- B) composes.
- C) conceives.
- D) acquires.

44

One function of the third paragraph (lines 24-36) is to

- A) describe the methods used by Naskar's team in its research.
- B) suggest a rationale for the research conducted by Naskar's team.
- C) describe the scientific phenomenon that Naskar's team attempted to explain.
- D) discuss the practical benefits that have resulted from the work of Naskar's team.

45

The author suggests that a decrease in the cost of fossil fuels has led to

- A) the near exhaustion of some fossil fuel reserves.
- B) unsustainable energy consumption patterns.
- C) a repudiation of renewable energy initiatives.
- D) a drop in demand for alternative fuel sources.

46

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

- A) Lines 24-26 (“The technology . . . mills”)
- B) Lines 26-29 (“With . . . products”)
- C) Lines 30-32 (“Among . . . underutilized”)
- D) Lines 32-36 (“The ORNL . . . alternatives”)

47

Information in the passage best supports which statement about lignin?

- A) It is too expensive to use as an industrial polymer without being diluted with more common polymers.
- B) It is one of the few polymers that can be processed without the use of high heat.
- C) When combined with soft matter, it yields a polymer more stretchable than the original soft matter.
- D) In its unaltered state, it breaks too easily to be used in high-performance thermoplastics.

48

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

- A) Lines 37-40 (“Lignin . . . group”)
- B) Lines 42-43 (“We need . . . lignin”)
- C) Lines 45-46 (“Very . . . stiffness”)
- D) Line 47 (“All . . . stability”)

49

According to the passage, Naskar’s team used nitrile rubber in its study because

- A) nitrile rubber is stiffer and more thermally stable than are many other types of soft matter.
- B) the chemical composition of nitrile rubber suggested it would combine with lignin without the use of solvents.
- C) sheets of nitrile rubber are only 10 to 200 nanometers thick and thus interpenetrate well with lignin in a melted phase.
- D) molecules of nitrile rubber and lignin have different numbers of electrons.

50

As used in line 73, “properties” most nearly means

- A) possessions.
- B) compositions.
- C) qualities.
- D) objects.



51

According to the graph, which source of lignin resulted in thermoplastic polymer with the greatest tensile strength?

- A) Hardwood type 1
- B) Hardwood type 2
- C) Softwood type 1
- D) Softwood type 2

52

According to the graph, the maximum stretch before breaking of thermoplastic polymer produced from softwood type 2 is closest to a

- A) 300 percent increase.
- B) 400 percent increase.
- C) 500 percent increase.
- D) 600 percent increase.

**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.

### Battle of the Brushstrokes

John Constable and J. M. W. Turner, two prominent nineteenth-century English Romanticist landscape painters, **1** was an ardent rival. Turner believed that Constable’s straightforward depictions of scenery lacked energy; Constable, meanwhile, felt that Turner’s paintings, which represented nature in a more abstract way, were “just steam and light.” **2** They had stylistic differences. These stylistic differences grew into personal animosity in 1831. Appointed to oversee the arrangement of paintings for the annual Royal Academy Exhibition—a prestigious London art show—Constable moved one of

1

- A) NO CHANGE
- B) were ardent rivals.
- C) were an ardent rival.
- D) was ardent rivals.

2

Which choice best combines the underlined sentences?

- A) Growing into personal animosity, their differences were only stylistic until 1831.
- B) Their differences, stylistic until 1831, also grew into personal animosity.
- C) Despite stylistic differences, their personal animosity grew in 1831.
- D) In 1831, their stylistic differences grew into personal animosity.

his rival's paintings from **3** its' central position and replaced it with one of his own. Turner was furious.

The conflict came to a head the following year, as **4** the two artists prepared to display new works side by side at the 1832 Royal Academy Exhibition. Constable's *The Opening of Waterloo Bridge* depicted a grand public occasion with bright colors and detailed illustrations of officers and ships; Turner's *Helvoetsluys*, **5** by contrast, was a relatively sparse painting of windswept ships rendered in grays and whites. A few days before the exhibition's opening, as more than a dozen artists put final touches on their works, Turner eyed Constable's **6** painting, Constable was adorning it with flecks of red paint. Grabbing his palette, Turner faced his own painting

3

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

4

Which choice provides the most relevant information to introduce the paragraph?

- A) NO CHANGE
- B) more than a hundred works were being shown at the 1832 Royal Academy Exhibition.
- C) artists presenting at the 1832 Royal Academy Exhibition were limited to eight works each.
- D) no work shown at the 1832 Royal Academy Exhibition could have been previously shown in public.

5

- A) NO CHANGE
- B) furthermore,
- C) in fact,
- D) ultimately,

6

- A) NO CHANGE
- B) painting, which Constable was adorning it
- C) painting, which Constable was adorning
- D) painting that it was being adorned by Constable

and put a glob of bright red paint about the size of a quarter in the center of the canvas, shaping it into a buoy with a few brief brushstrokes; **7** then, without a word, he left the gallery. “He has been here and fired a gun,” Constable remarked, aghast, upon seeing Turner’s last-minute addition.

Constable’s metaphor rang true: with just a single bright red daub, Turner not only dramatically altered his painting but also dealt a blow to his adversary. Fellow painter C. R. Leslie observed that the prominent spot of red against the otherwise muted seascape ultimately perfected **8** *Helvoetsluys*, at the same time, Turner’s sparing use of color seemed to mock Constable’s adjacent painting, which appeared cluttered and overworked by comparison. “What a piece of plaster it is!” one art critic, capturing the public sentiment, remarked of *The Opening of Waterloo Bridge*.

7

The writer is considering deleting the underlined portion, adjusting the punctuation as needed. Should the underlined portion be kept or deleted?

- A) Kept, because it provides a supporting detail that reinforces the abrupt nature of Turner’s action.
- B) Kept, because it establishes that Turner avoided interacting with other artists.
- C) Deleted, because it distracts from the paragraph’s focus on the paintings with an irrelevant detail concerning Turner’s whereabouts.
- D) Deleted, because it merely repeats information about Turner’s behavior that is provided elsewhere in the passage.

8

- A) NO CHANGE
- B) *Helvoetsluys*
- C) *Helvoetsluys:*
- D) *Helvoetsluys;*

Though Constable's reputation survived the incident, Turner's headline-making stunt stole the show, attracting **9** crowds of an enormous nature eager to judge the **10** paintings merits for themselves. As the public debated whether Turner or Constable better captured the spirit of natural scenery, the older neoclassical style (which favored historical themes) soon fell out of fashion. Thus, **11** landscape painting quickly displaced neoclassical painting as the most popular form of visual art.

9

- A) NO CHANGE
- B) large crowds
- C) tons of people
- D) so many people

10

- A) NO CHANGE
- B) painting's merit's
- C) paintings' merits
- D) paintings merit's

11

The writer wants a conclusion that reflects the main idea of the passage and emphasizes the effects of the painters' rivalry. Which choice best accomplishes this goal?

- A) NO CHANGE
- B) despite their differences—or perhaps because of them—these two rivals jointly influenced the popular taste for landscape painting.
- C) art exhibits became a popular destination for both locals and tourists in nineteenth-century England.
- D) art critics today continue to debate whether Constable or Turner was the more accomplished artist.

Questions 12-22 are based on the following passage and supplementary material.

### No Good Night with Blue Light

Recent research has illuminating news about the effects of electronic-device use on sleep. Artificial light is now known to cause sleep **12** problems. It does this by impacting circadian rhythm, the body’s internal 24-hour clock. The circadian rhythm adjusts biological functions to the changes in levels of light in the environment, which is why people are drowsy at night and alert during the day. Artificial light at night confuses the body and changes its **13** functions—increasing its temperature, for example.

Visible light is the portion of the electromagnetic spectrum that our eyes can see. The human eye reacts to wavelengths from about 390 to 700 nanometers, which roughly correspond to the color range of the rainbow, from the shorter wavelengths of violet at one **14** end, and the longer wavelengths of red at the other. Light in the blue **15** range emitted, by the Sun, during the day causes the eye to send chemical messages to the suprachiasmatic nucleus (SCN) in the brain. The SCN controls the physiological responses of wakefulness, such as increased alertness, elevated body temperature, and

12

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

- A) problems because of its impact on
- B) problems; its impact is on
- C) problems, with impacting
- D) problems to the impact o

13

The writer wants to conclude this paragraph with a detail that will set up the main topic of the rest of the passage. Which choice best accomplishes this goal?

- A) NO CHANGE
- B) functions, in part by disrupting its secretion of melatonin.
- C) functions, with teenagers suffering the most severe effects.
- D) functions—but not all light has the same effect.

14

- A) NO CHANGE
- B) end, as are
- C) end with
- D) end to

15

- A) NO CHANGE
- B) range: emitted by the Sun during the day
- C) range, emitted by the Sun during the day;
- D) range emitted by the Sun during the day

higher heart rate. These blue-light wavelengths are the same as those emitted by artificial sources of **16** light; particularly: computer screens, **17** to watch television, and cell phones. **18** Nevertheless, these devices affect our brains and bodies much **19** like daylight's effect. According to the National Sleep Foundation, 95 percent of Americans use mobile devices in the hour before bedtime and thus are exposed to blue light just before going to sleep. Not surprisingly, 43 percent of Americans report chronic sleep problems.

16

- A) NO CHANGE
- B) light. Particularly
- C) light, particularly
- D) light, particularly;

17

- A) NO CHANGE
- B) televisions,
- C) television viewing,
- D) television light,

18

- A) NO CHANGE
- B) However,
- C) Therefore,
- D) Further,

19

- A) NO CHANGE
- B) as daylight.
- C) like those of daylight.
- D) the way daylight does.

In 2009, researchers at the University of Montreal found that blue light, compared with light at other wavelengths, is particularly effective at elevating body temperature and heart rate. A 2003 study at Harvard Medical School found that blue light **20** suppresses the secretion of melatonin, a hormone released at night that helps the body feel tired. **21** Melatonin plays an important role in the human sleep cycle.

Sleep scientists propose a number of solutions to limit exposure to blue light in the evenings. There is software for mobile devices that adjusts the light of the screen to a reddish color in the evenings. Studies show that when orange-red light is equally as bright as blue light, the orange-red light does not have the same physiological impact on sleep as blue light. People can also wear amber-colored glasses that block blue light. Ultimately, the best way to limit blue-light exposure and get a good night's rest is to banish technology from the bedroom and **22** avoid time in front of screens at the end of the day.

20

- A) NO CHANGE
- B) subdues
- C) destroys
- D) dominates

21

Which choice best summarizes the main idea of this paragraph?

- A) NO CHANGE
- B) Since wavelengths outside the blue range of the spectrum do not inhibit the release of melatonin to the same extent, people do not have to give up electronic devices in the evening altogether.
- C) Testing body temperature, heart rate, and melatonin level are among the best means scientists have to study sleep.
- D) All of these data indicate that exposure to blue light at the end of the day disrupts sleep.

22

Which choice provides a second example that is most similar to the example already in the sentence?

- A) NO CHANGE
- B) send different chemical messages to the SCN.
- C) go to bed when the sun goes down.
- D) consult a medical doctor if sleeplessness continues.



Questions 23-33 are based on the following passage.

### Taking the Long View: Careers in Remote Sensing

**23** Careers in remote sensing, the study of information gathered by satellites, have always been affected by developments in the aerospace industry. Remote sensing specialists use satellite information to create maps, 3-D models, and other visualizations of data that have applications in numerous industries and disciplines.

Uses for remote sensing **24** has become more plentiful as technology has progressed, as NASA scientist Helen Stewart can attest. Stewart is the manager of mission operations and ground data systems for NASA's Interface Region Imaging Spectrograph (IRIS). Launched in 2013 to gather information about the lowest level of the Sun's outer atmosphere, or chromosphere (the primary source of Earth's ultraviolet radiation), the IRIS satellite contains a spectrograph, a camera that captures the physical signatures of light in the form of spectra. These spectra are then modeled and analyzed on NASA's **25** supercomputers. To provide insight into the processes that shape and heat the chromosphere. Stewart and her team will use the simulations of IRIS data to gain a better understanding of the chromosphere and its effect on Earth's atmosphere.

23

Which choice introduces the passage most effectively?

- A) NO CHANGE
- B) The development of artificial satellites in the second half of the twentieth century was crucial to the global expansion of remote sensing technology.
- C) Remote sensing—interpreting information captured by satellites that comes from Earth or from space—is a career field that offers a variety of options and opportunities.
- D) At most universities around the world, the discipline of remote sensing has traditionally been taught within geography departments.

24

- A) NO CHANGE
- B) becomes
- C) have become
- D) will have become

25

- A) NO CHANGE
- B) supercomputers to
- C) supercomputers, and to
- D) supercomputers; to

Remote sensing also serves important functions back on Earth, as illustrated by the work of remote sensing specialist Karen Schuckman, who was involved in the North Carolina Floodplain Mapping Program. The program employed light detection and ranging (LIDAR) **26** technology, and which uses lasers from satellites to measure distances to Earth and **27** induce highly accurate topographical maps, to assess floodplain boundaries. Schuckman combined **28** them with field data to create forecast maps that predict which areas **29** among those that Schuckman surveyed are likely to flood hours or even days before the flooding occurs. **30** Schuckman teaches remote sensing at Pennsylvania State University.

26

- A) NO CHANGE
- B) technology: that
- C) technology, it
- D) technology, which

27

- A) NO CHANGE
- B) accomplish
- C) generate
- D) cause

28

- A) NO CHANGE
- B) these maps of the floodplains
- C) the floodplains
- D) those

29

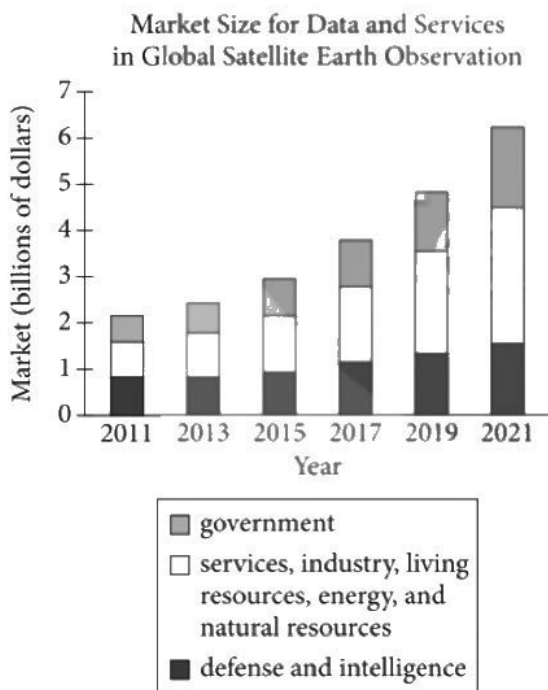
- A) NO CHANGE
- B) have a good chance of experiencing flooding, and probably will,
- C) and zones are likely to see flooding happen
- D) are likely to flood

30

Which choice best concludes the paragraph?

- A) NO CHANGE
- B) Such data help state officials anticipate the extent of flooding and make decisions about any necessary, potentially lifesaving, preparations.
- C) Many companies use satellite-based technology in their own research and for projects they facilitate for state and federal governments.
- D) Therefore, LIDAR technology also has multiple applications in other fields, such as forestry and oceanography.

Research on remote sensing suggests **31** the field will continue to expand rapidly. A 2012 report by Northern Sky Research about satellite data and other remote sensing services, for example, projected that overall growth would be relatively slow between 2011 and 2015, with the size of the market increasing from about \$2 billion to \$3 billion, but that the field would grow much more quickly after 2015, **32** with the exception of 2019. Although spending on defense and intelligence applications is expected to grow overall, its contribution to the market is forecast to be outpaced by that of spending on nondefense and nongovernment services. With so many potential applications, and more on the horizon, remote sensing **33** promises, a wide range of career opportunities.



Adapted from Northern Sky Research, *Global Satellite-Based Earth Observation, 4th Edition*. ©2012 by NSR, LLC.

31

Which choice is best supported by the information in the graph?

- A) NO CHANGE
- B) a dramatic increase in the salaries remote sensing specialists will earn.
- C) the field will incorporate new sources of information that supplement satellite data.
- D) budget constraints will have a powerful influence on the field.

32

Which choice best supports the writer's claim from earlier in the sentence with an accurate interpretation of the data in the graph?

- A) NO CHANGE
- B) becoming a market of over \$6 billion by 2021
- C) despite some predicted fluctuation.
- D) increasing by another \$2 billion over the next six years.

33

- A) NO CHANGE
- B) promises: a wide range
- C) promises a wide range
- D) promises a wide range—

Questions 34–44 are based on the following passage.

### Public Funding Should Mean Public Access

[1] Every year, research studies are conducted with the fiscal support of government entities. [2] Yet these studies—funded with taxpayer money precisely because of their importance to the public interest—are largely published in academic journals whose steep subscription fees place **34** it out of reach of the average person. [3] To rectify this situation, the results of government-funded research should be published in a form that is freely accessible to the public. [4] This arrangement gives private organizations control over information that should be available for the benefit of people around the globe. **35**

34

- A) NO CHANGE
- B) that
- C) them
- D) this

35

To make this paragraph most logical, sentence 3 should be placed

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

One platform that is becoming increasingly popular for free access to research is the open-access database. These databases include academic papers that can be read by anyone at no charge, and they are already being championed by some national agencies and governments. The National Institutes of Health (NIH) in the United States, for example, has had an open-access policy in place since 2008. Recognizing the importance of access to biomedical research for **36** patients, doctors, and others, **37** the NIH's requirement is that any papers resulting from NIH funding be deposited in the open-access database PubMed Central. The government of the United Kingdom has applied this principle more broadly: a 2012 policy mandated that all government-funded research in the United Kingdom be made available to the public free of charge. In a report submitted to the UK government that helped provide the basis for the 2012 mandate, a group led by sociologist Janet Finch asserted that "many benefits could result if we were to move worldwide to an open-access regime," including **38** increased public support for government funding of research.

36

- A) NO CHANGE
- B) patients and for
- C) patients; also
- D) patients, access for

37

- A) NO CHANGE
- B) the NIH requires that any papers resulting from NIH funding
- C) it is a requirement of the NIH that any papers resulting from NIH funding
- D) any papers resulting from NIH funding are required by the NIH to

38

Which choice best sets up the example in the next paragraph?

- A) NO CHANGE
- B) improved quality of articles published in academic journals.
- C) reduced time spent by professionals locating current information.
- D) innovations stemming from public engagement with research.

Consider the case of Jack Andraka, a Maryland high school student who announced in 2012 that he had achieved a medical breakthrough: a diagnostic test for pancreatic cancer that costs only three cents per use and is over four hundred times more sensitive than other tests. Crucial to Andraka's work was **39** published research he had found for free online. That research that he found for free included what he found in PubMed Central. Without open access, he could not have retrieved research essential to the development of his test.

Some are concerned that open-access publications will be too expensive to maintain in the absence of subscription fees. However, online publishing is **40** cheaper compared with traditional publishing, as it **41** eludes the costs of physical production and

39

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

- A) research that had been published and that he had found for free online—including in PubMed Central.
- B) published research he had found for free online—including in PubMed Central.
- C) published research online, including in PubMed Central, as well as the fact that he had found it for free.
- D) research, including what he had found published online in PubMed Central, that was free.

40

- A) NO CHANGE
- B) cheaper when comparing it with
- C) cheaper, more so than
- D) cheaper than

41

- A) NO CHANGE
- B) eliminates
- C) isolates
- D) bans

distribution. One online **42** publisher—the database arXiv, spends only ten dollars per paper accepted, **43** an expense covered by donations. Open access, then, is a viable option. **44**

42

- A) NO CHANGE
- B) publisher:
- C) publisher,
- D) publisher;

43

Which choice best supports the overall point of the paragraph?

- A) NO CHANGE
- B) each of which is revised by experts to ensure topicality and adherence to scholarly standards.
- C) though submissions are limited to math and science topics.
- D) and users can even sign up to be notified when new papers are posted.

44

At this point, the writer wants a conclusion that summarizes the main argument of the passage. Which choice best accomplishes this goal?

- A) Proponents hope that it will provide the basis for more medical innovation around the world.
- B) The effect it has on publishing models proves that online-only publications are the way of the future.
- C) Through it, research is obtainable by anyone with an Internet connection, not just a privileged few.
- D) Its global success shows that governments should be investing more money in scientific research.

## 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.

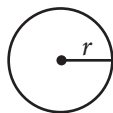
## DIRECTIONS

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

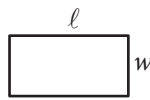
- The use of a calculator **is not permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated,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

## REFERENCE

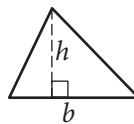


$$A = \pi r^2$$

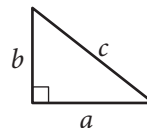
$$C = 2\pi r$$



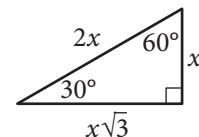
$$A = \ell w$$



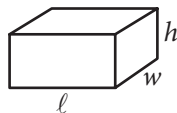
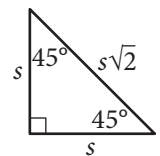
$$A = \frac{1}{2}bh$$



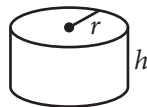
$$c^2 = a^2 + b^2$$



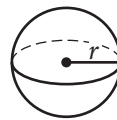
Special Right Triangles



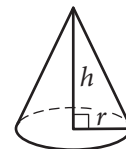
$$V = \ell wh$$



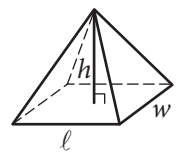
$$V = \pi r^2 h$$



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



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



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

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

What is the solution to the equation  $2x + 3 = 7$  ?

- A) 1
- B) 1.5
- C) 2
- D) 4

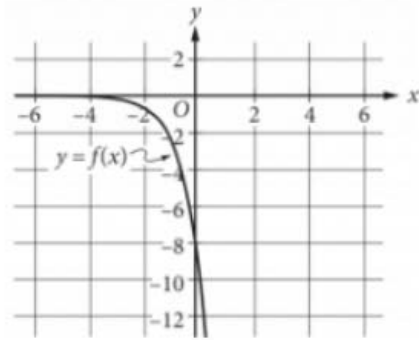
2

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

Which of the following is equivalent to the expression above?

- A)  $x^3 + 5x$
- B)  $3x^3 + x$
- C)  $2x^6 - x^4 - 6x^2$
- D)  $3x^6 - x^4 - 6x^2$

3



The graph of  $y = f(x)$  is shown in the  $xy$ -plane. What is the value of  $f(0)$  ?

- A)  $-8$
- B)  $-4$
- C)  $-1$
- D)  $0$

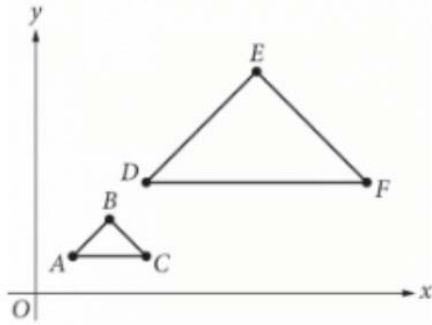
4

The City Transit bus line charges \$2 for an adult and \$1 for a child to ride one way. During a certain 4-hour shift, a bus driver collected \$1,171 from 617 riders. Which of the following systems of equations could be used to determine the number of adult riders,  $A$ , and the number of child riders,  $C$ , during this 4-hour shift?

- A)  $2A + C = 4(1,171)$   
 $A + C = 4(617)$
- B)  $4(2A) + 4C = 1,171$   
 $4(A + C) = 617$
- C)  $2A + C = 617$   
 $A + C = 1,171$
- D)  $2A + C = 1,171$   
 $A + C = 617$



5



In the  $xy$ -plane above, a dilation with center  $O$  and scale factor 3 transforms triangle  $ABC$  to triangle  $DEF$ . Which of the following statements is NOT true?

- A) The perimeter of triangle  $DEF$  is 3 times the perimeter of triangle  $ABC$ .
- B) The measure of angle  $E$  is 3 times the measure of angle  $B$ .
- C) The length of  $\overline{AB}$  is  $\frac{1}{3}$  the length of  $\overline{DE}$ .
- D) Angle  $A$  is congruent to angle  $D$ .

6

In the  $xy$ -plane, the  $y$ -coordinate of the  $y$ -intercept of the graph of the function  $f$  is  $c$ . Which of the following must be equal to  $c$ ?

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

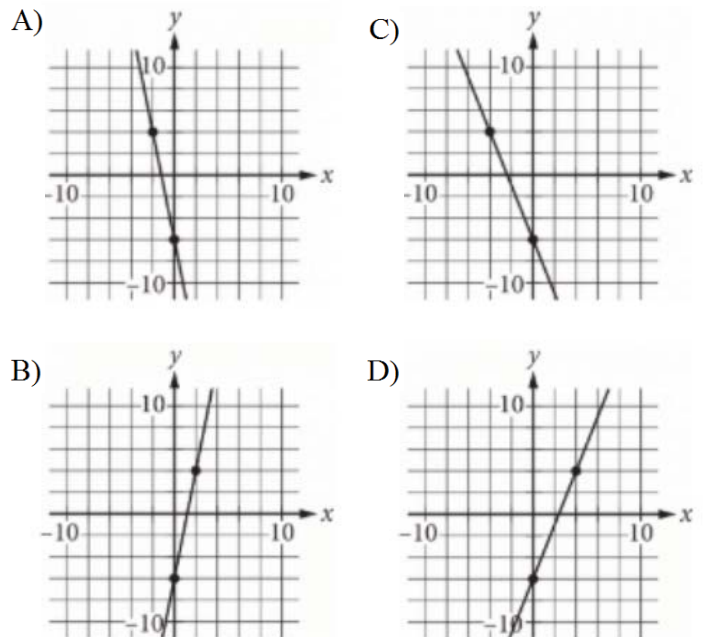
7

The length of a rectangular tile is 4 times the width of the tile. If the area of the tile is 144 square inches, what is the width of the tile, in inches?

- A) 6
- B) 12
- C) 24
- D) 36

8

Which of the following is the graph of  $y - 5x = -6$  in the  $xy$ -plane?





9

$x$	$f(x)$
-1	-2
2	4

The table shown gives some values of  $x$  and the corresponding values of  $f(x)$ , where  $f$  is a linear function. If  $y = f(x)$  is graphed in the  $xy$ -plane, what is the  $y$ -coordinate of the  $y$ -intercept of the graph?

- A) 1
- B) 0.5
- C) 0
- D) -1

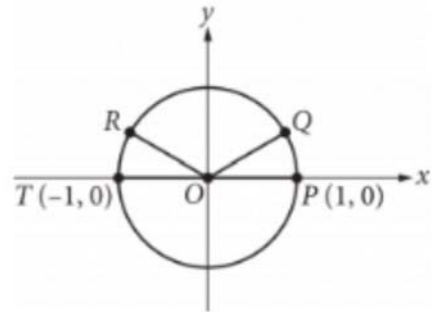
10

$$A = 1,321 + 0.3433m$$

The equation above can be used to estimate the body surface area  $A$ , in square centimeters, of a child with mass  $m$ , in grams, where  $3,000 \leq m \leq 30,000$ . Which of the following statements is consistent with the equation?

- A) For each increase of 1 gram in mass,  $A$  increases by approximately 0.3433 square centimeter.
- B) For each increase of 0.3433 gram in mass,  $A$  increases by approximately 1 square centimeter.
- C) For each increase of 1 gram in mass,  $A$  increases by approximately 1,321 square centimeters.
- D) For each increase of 1,321 grams in mass,  $A$  increases by approximately 1 square centimeter.

11



In the  $xy$ -plane above, points  $P$ ,  $Q$ ,  $R$ , and  $T$  lie on the circle with center  $O$ . The degree measures of angles  $POQ$  and  $ROT$  are each  $30^\circ$ . What is the radian measure of angle  $QOR$ ?

- A)  $\frac{5}{6}\pi$
- B)  $\frac{3}{4}\pi$
- C)  $\frac{2}{3}\pi$
- D)  $\frac{1}{3}\pi$

12

$$\frac{4x^2}{x^2 - 9} - \frac{2x}{x + 3} = \frac{1}{x - 3}$$

What value of  $x$  satisfies the equation above?

- A) -3
- B)  $-\frac{1}{2}$
- C)  $\frac{1}{2}$
- D) 3



13

A right circular cone has a volume of  $\frac{1}{3}\pi$  cubic feet and a height of 9 feet. What is the radius, in feet, of the base of the cone?

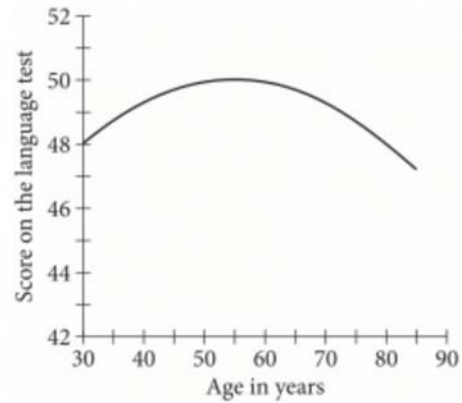
- A)  $\frac{1}{3}$
- B)  $\frac{1}{\sqrt{3}}$
- C)  $\sqrt{3}$
- D) 3

14

Which of the following is equivalent to  $r^{\frac{2}{5}} \cdot \sqrt{r}$ , where  $r > 0$ ?

- A)  $r^{\frac{1}{5}}$
- B)  $r^{\frac{3}{10}}$
- C)  $r^{\frac{3}{7}}$
- D)  $r^{\frac{9}{10}}$

15



A scientist tested a group of adults aged 30 to 85. The graph shows the quadratic function  $S$ , which models their scores on a language test as a function of their age  $x$ , in years. Which of the following could define  $S$ ?

- A)  $S(x) = -\frac{1}{320}(x - 50)^2 + 55$
- B)  $S(x) = -\frac{1}{320}(x - 55)^2 + 50$
- C)  $S(x) = \frac{1}{320}(x - 50)^2 + 55$
- D)  $S(x) = \frac{1}{320}(x - 55)^2 + 50$

**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.

← Fraction line

← Decimal point

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

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

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

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

	2	/	3
•	•	•	•
	0	0	0
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
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	•	•	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

On a 210-mile trip, Cameron drove at an average speed of 60 miles per hour for the first  $x$  hours. He then completed the trip, driving at an average speed of 50 miles per hour for the remaining  $y$  hours. If  $x = 1$ , what is the value of  $y$ ?

17

$$2zw^2 - 3w - 10 = 2z$$

In the equation above, what is the value of  $z$  when  $w = 2$ ?

18

$$x - 2\sqrt{x} - 3 = 0$$

What value of  $x$  satisfies the equation above?

19

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

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

20

$$2k(x - 2) = x - 2$$

In the equation above,  $k$  is a constant. If the equation has infinitely many solutions, what is the value of  $k$ ?

**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.

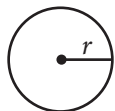
## DIRECTIONS

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

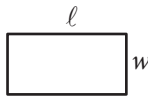
- The use of a calculator **is permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated, the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

## REFERENCE

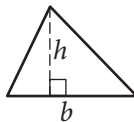


$$A = \pi r^2$$

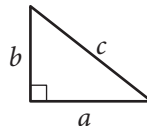
$$C = 2\pi r$$



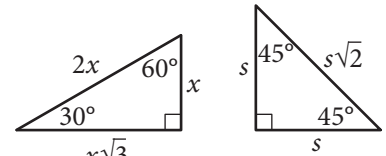
$$A = \ell w$$



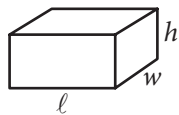
$$A = \frac{1}{2}bh$$



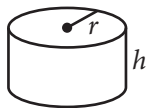
$$c^2 = a^2 + b^2$$



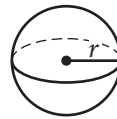
Special Right Triangles



$$V = \ell wh$$



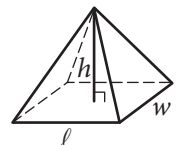
$$V = \pi r^2 h$$



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



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



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

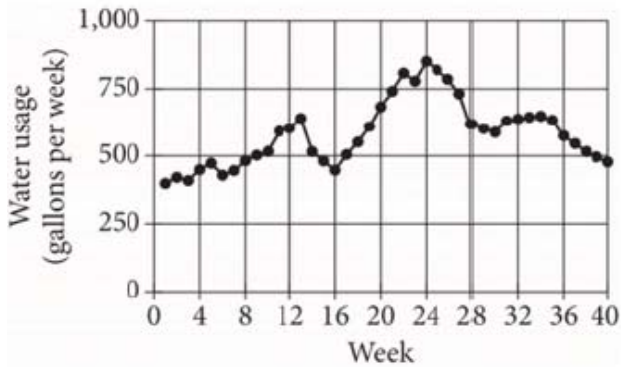
The number of degrees of arc in a circle is 360.

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 the Chen family's water usage over 40 weeks. During which of the following periods was the family's water usage above 750 gallons per week?

- A) From week 5 through week 8
- B) From week 13 through week 17
- C) From week 22 through week 26
- D) From week 33 through week 36

2

The distance between two locations on a map is 6 centimeters (cm). If 1 cm on the map corresponds to an actual distance of 15 miles, what is the actual distance, in miles, between the two locations?

- A) 0.4
- B) 2.5
- C) 90
- D) 150

3

A store received a shipment of 1,000 MP3 players, 4 of which were defective. If an MP3 player is randomly selected from this shipment, what is the probability that it is defective?

- A) 0.004
- B) 0.04
- C) 0.4
- D) 4

4

$$f(x) = (x + 0.25x)(50 - x)$$

The function  $f$  is defined above. What is the value of  $f(20)$ ?

- A) 250
- B) 500
- C) 750
- D) 2,000





5

Which of the following expressions is equivalent to  $2(ab - 3) + 2$ ?

- A)  $2ab - 1$
- B)  $2ab - 4$
- C)  $2ab - 5$
- D)  $2ab - 8$

6

What number is 20% greater than 60?

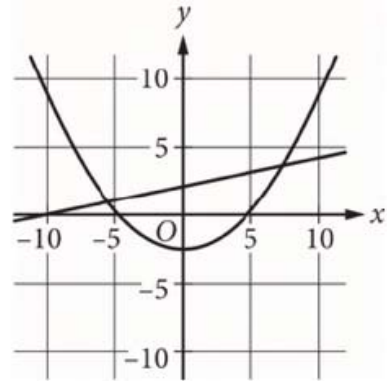
- A) 50
- B) 72
- C) 75
- D) 132

7

The graph of  $y = 3x - 5$  in the  $xy$ -plane is a line. What is the slope of the line?

- A)  $-5$
- B)  $\frac{1}{3}$
- C) 3
- D) 5

8



A system of equations consists of a quadratic equation and a linear equation. The equations in this system are graphed in the  $xy$ -plane above. How many solutions does the system have?

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



9

$$2n + 6 = 14$$

A tree had a height of 6 feet when it was planted. The equation above can be used to find how many years  $n$  it took the tree to reach a height of 14 feet. Which of the following is the best interpretation of the number 2 in this context?

- A) The number of years it took the tree to double its height
- B) The average number of feet that the tree grew per year
- C) The height, in feet, of the tree when the tree was 1 year old
- D) The average number of years it take similar trees to grow 14 feet

10

Residents of a town were surveyed to determine whether they are satisfied with the concession stand at the local park. A random sample of 200 residents was selected. All 200 responded, and 87% said they are satisfied. Based on this information, which of the following statements must be true?

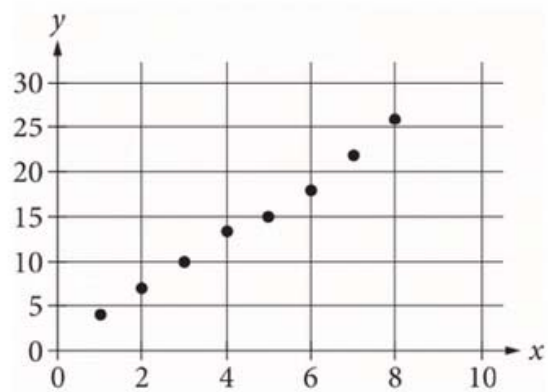
- I. Of all the town residents, 87% would say they are satisfied with the concession stand at the local park.
  - II. If another random sample of 200 residents were surveyed, 87% would say they are satisfied.
- A) Neither
  - B) I only
  - C) II only
  - D) I and II

11

In the  $xy$ -plane, the graph of  $y = x + 3$  intersects the graph of  $y = 2x - 6$  at the point  $(a, b)$ . What is the value of  $a$ ?

- A) 3
- B) 6
- C) 9
- D) 12

12



Which of the following could be the equation for a line of best fit for the data shown in the scatterplot above?

- A)  $y = 3x + 0.8$
- B)  $y = 0.8x + 3$
- C)  $y = -0.8x + 3$
- D)  $y = -3x + 0.8$



13

$$(8 - \sqrt{x})^2 = (4 + \sqrt{x})^2$$

What is the solution to the equation above?

- A)  $x = 2$
- B)  $x = 4$
- C)  $x = 8$
- D)  $x = 16$

14

A fish hatchery has three tanks for holding fish before they are introduced into the wild. Ten fish weighing less than 5 ounces are placed in tank A. Eleven fish weighing at least 5 ounces but no more than 13 ounces are placed in tank B. Twelve fish weighing more than 13 ounces are placed in tank C. Which of the following could be the median of the weights, in ounces, of these 33 fish?

- A) 4.5
- B) 8
- C) 13.5
- D) 15

15

In triangle  $ABC$ , the measure of angle  $A$  is  $50^\circ$ . If triangle  $ABC$  is isosceles, which of the following is NOT a possible measure of angle  $B$ ?

- A)  $50^\circ$
- B)  $65^\circ$
- C)  $80^\circ$
- D)  $100^\circ$

16

In the  $xy$ -plane, a circle with radius 5 has center  $(-8, 6)$ . Which of the following is an equation of the circle?

- A)  $(x - 8)^2 + (y + 6)^2 = 25$
- B)  $(x + 8)^2 + (y - 6)^2 = 25$
- C)  $(x - 8)^2 + (y + 6)^2 = 5$
- D)  $(x + 8)^2 + (y - 6)^2 = 5$



Questions 17 and 18 refer to the following information.

According to the 2010 Census, the adult population aged 18 or greater of the United States in 2010 was 234,564,071. In 2010, a survey was conducted among a randomly chosen sample of adults aged 18 or greater in the United States about their preference to live in a warm climate or a cool climate. The table below displays a summary of the survey results.

	Warm	Cool	No preference	Total
18-35 years old	295	168	45	508
36-50 years old	246	123	41	410
51-65 years old	238	117	48	403
Greater than 65 years old	137	78	64	279
Total	916	486	198	1,600

17

Based on the data, which of the following is closest to the probability that a randomly selected adult who is 18-35 years old prefers to live in a cool climate?

- A) 0.11
- B) 0.30
- C) 0.33
- D) 0.49

18

Which of the following is closest to the difference between the percentage of adults aged 18-50 years who responded “warm” and the percentage of adults aged 51 years or greater who responded “warm”?

- A) 4%
- B) 5%
- C) 10%
- D) 18%

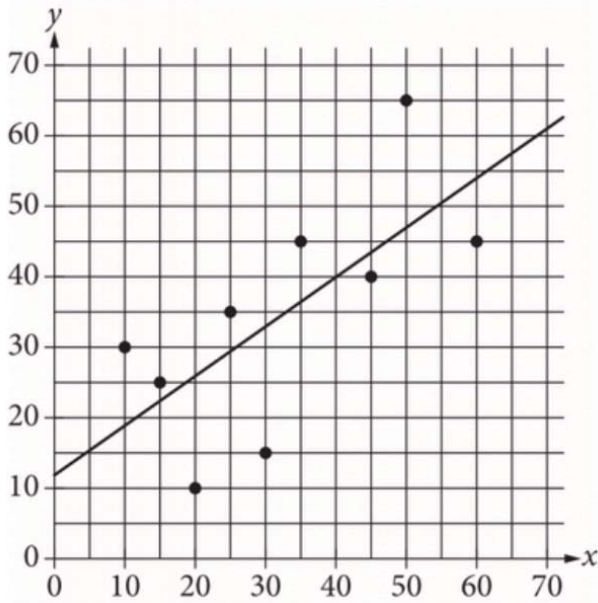
19

Which of the following speeds is equivalent to 90 kilometers per hour? (1 kilometer = 1,000 meters)

- A) 25 meters per second
- B) 32 meters per second
- C) 250 meters per second
- D) 324 meters per second



20



The scatterplot in the  $xy$ -plane above shows nine points  $(x, y)$  and a line of best fit. Of the following, which best estimates the amount by which the line underestimates the value of  $y$  when  $x = 50$ ?

- A) 8
- B) 10
- C) 13
- D) 18

21

A certain elephant weighs 200 pounds at birth and gains more than 2 but less than 3 pounds per day during its first year. Which of the following inequalities represents all possible weights  $w$ , in pounds, for the elephant 365 days after its birth?

- A)  $400 < w < 600$
- B)  $565 < w < 930$
- C)  $730 < w < 1,095$
- D)  $930 < w < 1,295$

22

If  $3(m + 2) - 5 = m + 2$ , what is the value of  $m + 2$ ?

- A) 0
- B) 2.5
- C) 4.5
- D) The given equation has no solution.



23

The dwarf planet Makemake completes one orbit around the Sun every 310 years. Which of the following functions  $r$  models the number of orbits of Makemake in  $t$  years?

- A)  $r(t) = 310 + t$
- B)  $r(t) = 310t$
- C)  $r(t) = \frac{t}{310}$
- D)  $r(t) = \frac{310}{t}$

24

$$7x - 5y = 4$$

$$4x - 8y = 9$$

If  $(x, y)$  is the solution to the system of equations above, what is the value of  $3x + 3y$ ?

- A) -13
- B) -5
- C) 5
- D) 13

25

A data set of 27 different numbers has a mean of 33 and a median of 33. A new data set is created by adding 7 to each number in the original data set that is greater than the median and subtracting 7 from each number in the original data set that is less than the median. Which of the following measures does NOT have the same value in both the original and the new data sets?

- A) Median
- B) Mean
- C) Sum of the numbers
- D) Standard deviation

26

The function  $f$  is linear,  $f(2) = 17$ , and  $f(8) = 19$ . If  $f(x) = mx + b$ , where  $m$  and  $b$  are constants, what is the value of  $b$ ?

- A) 11
- B) 13
- C)  $\frac{49}{3}$
- D)  $\frac{55}{3}$



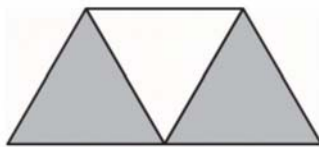
27

Sample	Percent in favor	Margin of error
A	52%	4.2%
B	48%	1.6%

The results of two random samples of votes for a proposition are shown above. The samples were selected from the same population, and the margins of error were calculated using the same method. Which of the following is the most appropriate reason that the margin of error for sample A is greater than the margin of error for sample B?

- A) Sample A had a smaller number of votes that could not be recorded.
- B) Sample A had a higher percent of favorable responses.
- C) Sample A had a larger sample size.
- D) Sample A had a smaller sample size.

28



A graphic designer is creating a logo for a company. The logo is shown in the figure above. The logo is in the shape of a trapezoid and consists of three congruent equilateral triangles. If the perimeter of the logo is 20 centimeters, what is the combined area of the shaded regions, in square centimeters, of the logo?

- A)  $2\sqrt{3}$
- B)  $4\sqrt{3}$
- C)  $8\sqrt{3}$
- D) 16

29

Kao measured the temperature of a cup of hot chocolate placed in a room with a constant temperature of 70 degrees Fahrenheit ( $^{\circ}\text{F}$ ). The temperature of the hot chocolate was 185 $^{\circ}\text{F}$  at 6:00 p.m. when it started cooling. The temperature of the hot chocolate was 156 $^{\circ}\text{F}$  at 6:05 p.m. and 135 $^{\circ}\text{F}$  at 6:10 p.m. The temperature of the hot chocolate continued to decrease. Of the following functions, which best models the temperature  $T(m)$ , in degrees Fahrenheit, of Kao's hot chocolate  $m$  minutes after it started cooling?

- A)  $T(m) = 185(1.25)^m$
- B)  $T(m) = 185(0.85)^m$
- C)  $T(m) = (185 - 70)(0.75)^{\frac{m}{5}}$
- D)  $T(m) = 70 + 115(0.75)^{\frac{m}{5}}$

30

The equation  $9x + 5 = a(x + b)$ , where  $a$  and  $b$  are constants, has no solutions. Which of the following must be true?

- I.  $a = 9$
  - II.  $b = 5$
  - III.  $b \neq \frac{5}{9}$
- A) None
  - B) I only
  - C) I and II only
  - D) I and III only



**DIRECTIONS**

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

1. 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.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
4. Some problems may have more than one correct answer. In such cases, grid only one answer.
5. **Mixed numbers** such as  $3\frac{1}{2}$  must be gridded as 3.5 or  $7/2$ . (If  $\begin{array}{|c|c|c|c|} \hline 3 & 1 & / & 2 \\ \hline \bullet & \circ & \bullet & \bullet \\ \hline \end{array}$  is entered into the grid, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)
6. **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.

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

Write answer → in boxes.

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

Grid in result.

Answer: 2.5

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

← Fraction line

← Decimal point

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

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

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

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

Answer: 201 – either position is correct

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

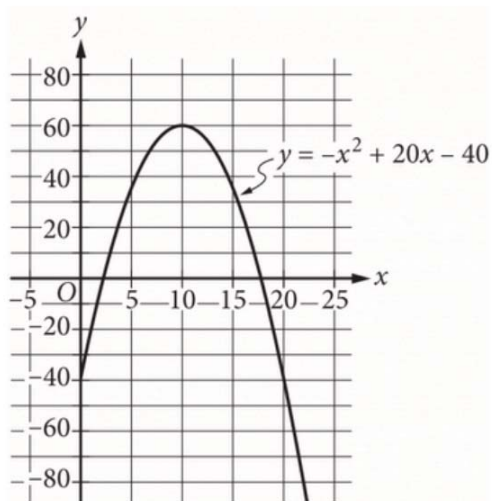
2	0	1	
◦	◦	◦	◦
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3

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





31



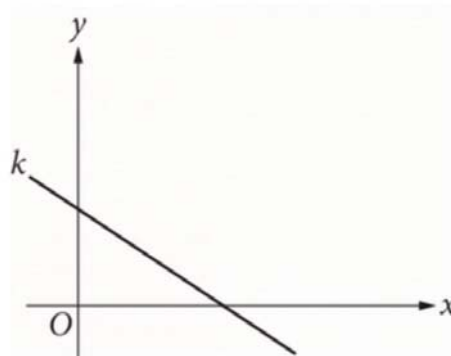
The graph above models the daily profit  $y$ , in dollars, that a school club expects to make from selling shirts for a price of  $x$  dollars. Based on the model, what is the maximum daily profit, in dollars? (Disregard the \$ sign when gridding your answer.)

32

$$P = 686q$$

The formula above gives the theoretical power  $P$ , in kilowatts (kW), available from water falling from a certain height in terms of its flow rate,  $q$ , in cubic meters per second. What is the flow rate, in cubic meters per second, of water falling from the same height with a theoretical power of 1,029,000 kW?

33



In the  $xy$ -plane above, line  $k$  passes through the points  $(0, 2)$  and  $(3, 0)$ . If the line  $k$  is defined by the equation  $y = mx + b$ , where  $m$  and  $b$  are constants, what is the value of  $b$ ?

34

Trevor works as a sales associate at a retail store. He is normally paid 20% of the total retail value of the merchandise he sells, but he may also earn a bonus. When he earns a bonus, he is paid an additional 15% of his normal pay. During one pay period, Trevor sold \$3500 in merchandise and earned a bonus. How much was he paid, in dollars, for this pay period? (Disregard the \$ sign when gridding your answer.)



35

$$c(x) = mx + 500$$

A company's total cost  $c(x)$ , in dollars, to produce  $x$  shirts is given by the function above, where  $m$  is a constant and  $x > 0$ . The total cost to produce 100 shirts is \$800. What is the total cost, in dollars, to produce 1000 shirts? (Disregard the \$ sign when gridding your answer.)

36

The total distance  $d$ , in meters, traveled by an object moving in a straight line can be modeled by a quadratic function that is defined in terms of  $t$ , where  $t$  is the time in seconds. At a time of 10.0 seconds, the total distance traveled by the object is 50.0 meters, and at a time of 20.0 seconds, the total distance traveled by the object is 200.0 meters. If the object was at a distance of 0 meters when  $t = 0$ , then what is the total distance traveled, in meters, by the object after 30.0 seconds?



Questions 37 and 38 refer to the following information.

For a certain computer game, individuals receive an integer score that ranges from 2 through 10. The table below shows the frequency distribution of the scores of the 9 players in group A and the 11 players in group B.

	Score	2	3	4	5	6	7	8	9	10	Total
Score frequencies	Group A	1	1	2	1	3	0	0	1	0	9
	Group B	0	0	0	4	2	0	2	1	2	11

37

The median of the scores for group B is how much greater than the median of the scores for group A?

38

The mean of the scores for group A is 5, and the mean of the scores for group B is 7. What is the mean of the scores for the 20 players in groups A and B combined?

# STOP

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