1

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 Kirstin Chen, *Soy Sauce for Beginners*. ©2014 by Kirstin Chen. The narrator and her friend Frankie have come from California to work at Lin's Soy Sauce, the narrator's family's business in Singapore.

Line

After I gave her a brief overview of everyone on the office floor—"Avoid the drama vultures in marketing; be nice to Fiona, she has more power than you'd expect"—Frankie and I hunkered down to evaluate the work my cousin Cal had already done on the US Expansion Project. Given my cousin's love of shortcuts, his tendency to keep crucial information to himself, and his questionable vision of a more modern Lin's, we were skeptical about whether his recommendations could be trusted.

From the start, I told Frankie she was in charge, and the arrangement seemed to please her. She got to work at once, methodically making her way through Cal's files, hunting down marketing and sales people—and even my father—when I was of no help. If she noticed the way her new colleagues whispered about her American assertiveness, she didn't let it bother her.

In contrast, I treated the work like a college class: doing the minimum it took to get by. I tried to coerce Frankie into taking breaks by showing her hilarious pictures I'd found on the Internet and bombarding her computer with inane instant messages. She'd indulge me for a minute or two before returning to work, but after I emailed her a third cat picture, she spun around to face me and said, "Look, I realize your uncle hired me mostly as a favor to you, but I really think I can make a difference around here."

Duly chastised, I began to read the files she deemed most relevant, and the more I learned, the more I had to admit that some of this stuff was actually interesting. Who knew that specialty food producers from bastions of Americana as Gainesville, Florida, and Louisville, Kentucky, had begun to experiment with artisanal soy sauce? According to a prominent food magazine, the Kentucky producer even aged its sauce in old bourbon barrels for an added whiff of smoke and local color. Top chefs all over America were raving about the depth of flavor the smoky sauce brought to dry-aged filet mignon and buttery black cod. An avant-garde chef in Chicago had infused the soy sauce into butter. The resulting concoction was spread on bite-sized brioche, topped with tobiko caviar, and served as the *amuse bouche* to his seventeen-course tasting menu.

One didn't need to pore over these files to discern the burgeoning excitement for all things natural and handmade—after all, Frankie and I both hailed from San Francisco, the epicenter of the artisanal food movement. And yet Lin's was edging away from its traditional brewing methods.

I filled Frankie in: several months earlier, Uncle Robert's first move as president had been to purchase the factory's first industrial fiberglass tanks, a decision my father had opposed. To avoid further angering my father, the tanks had been housed in a shed, out of sight. The new additions were large

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gray-green vats, as different from one of our jars as a Yamaha violin from a Stradivarius. But Uncle Robert argued that each fiberglass tank had five times the capacity of a single jar. Furthermore, the workers would no longer have to hand-stir the fermenting soybeans since a simple twist of a valve would agitate the contents of each tank. As a result, fermentation would be reduced from six months to four, shortening production time and lowering costs.

Frankie tapped her pen on the table. "Makes perfect sense. Especially if it all basically tastes the same, right?"

I didn't hide my incredulousness. "We can't go any further until you try some sauce." I reached over, closed Frankie's laptop and ordered her to move her papers aside.

And so I staged a spontaneous soy sauce tasting right in my office, exactly like the ones I'd seen my father lead dozens of times. Despite curious looks from co-workers passing by, I made Frankie take one sip after another of our premium sauces, until I was sure she understood the value of our clay jars—jars that were rinsed every six months in tepid water and left to dry in direct sunlight. This special treatment protected fifty years' worth of golden residue that coated the jars' insides and gave our sauce its signature earthiness.

"Incredible," Frankie said, smacking her lips. "I've had plenty of soy sauce in my lifetime, but this sauce isn't even remotely the same species."

1

Which choice best supports the idea that Frankie recognizes the value of Cal's files more quickly than the narrator does?

A) Lines 6-11 ("Given . . . trusted")
B) Lines 12-13 ("From . . . her")
C) Lines 17-19 ("If she . . . her")
D) Lines 30-33 ("Duly . . . interesting")

2

As used in line 9, "vision" most nearly means

A) illusion.
B) observation.
C) sight.
D) notion.

3

Over the course of the passage, the narrator's attitude toward her job gradually changes from one of

A) moderate anxiety to calm contentment.
B) casual unconcern to eager engagement.
C) obstinate apathy to reluctant cooperation.
D) pronounced pessimism to unreserved optimism.

4

The passage indicates that Frankie is the type of office worker who

A) strives to make a positive impression on her colleagues.
B) hopes to be promoted quickly.
C) handles tasks systematically and capably.
D) makes business decisions quickly and independently.

5

The information in lines 33-46 ("Who . . . menu") mainly serves to

A) emphasize the narrator's admiration for experimental cooking techniques.
B) demonstrate the narrator's extensive knowledge of US culinary trends.
C) hint at the narrator's desire to return to the United States.
D) convey the narrator's growing fascination with aspects of Cal's research.

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6

It can most reasonably be inferred from the passage that the changes Uncle Robert has initiated at Lin's Soy Sauce may prove to be

A) ineffective, since the expense of purchasing the new tanks exceeds the profit they could potentially generate.

B) misguided, since the kinds of production techniques prized by the narrator's father are actually in demand in the United States.

C) unpopular, since workers would likely resist the adoption of technologies that would make some of their tasks obsolete.

D) temporary, since the narrator's father would likely demand the removal of the tanks after discovering them.

7

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

A) Lines 47-52 ("One . . . methods")

B) Lines 53-56 ("I filled . . . opposed")

C) Lines 56-58 ("To avoid . . . sight")

D) Lines 62-67 ("Furthermore . . . costs")

8

As used in line 65, "agitate" most nearly means

A) churn.

B) upset.

C) compress.

D) confront.

9

Based on the passage, the narrator assumes that in order for the US Expansion Project to succeed, employees planning it must be able to

A) urge senior management to transform the company's products.

B) invent unconventional uses for the company's products.

C) understand the distinctive nature of the company's products.

D) accept changing social attitudes toward the company's products.

10

It can most reasonably be inferred from the passage that Frankie's experience of tasting the soy sauces will most likely lead her to

A) decide that the narrator should be in charge of the US Expansion Project.

B) become skeptical about the company's use of industrial tanks.

C) place less importance on Cal's research files.

D) embrace a more relaxed attitude toward her job.

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

This passage and accompanying figure are adapted from Ian Morris, *Foragers, Farmers, and Fossil Fuels: How Human Values Evolve*. ©2015 by Ian Morris.

In the last two centuries, humans have vastly increased the amount of energy they capture by learning to tap into fossilized sunlight. This comes chiefly in the form of vast deposits of coal, gas, and oil buried under the earth's surface since the Carboniferous Era, roughly 300 to 360 million years ago. Exploiting fossil fuels has set off an energy bonanza, transforming human societies and values.

Fossil-fuel society is the product of two innovations. The first, which some northwest Europeans had already made two thousand years ago, was the discovery that coal could be burned to release heat. Only around AD 1000 (in China) and 1600 (in England), however, did coal begin to rival wood as an energy source. The second breakthrough, initially made in the third century BC by engineers in Egypt, was that heat could be converted to motion by burning wood to boil water and then using the steam to power pistons. Egyptians did little with this idea, however, beyond providing their gods with steam-powered temple doors that appeared to open magically by themselves.

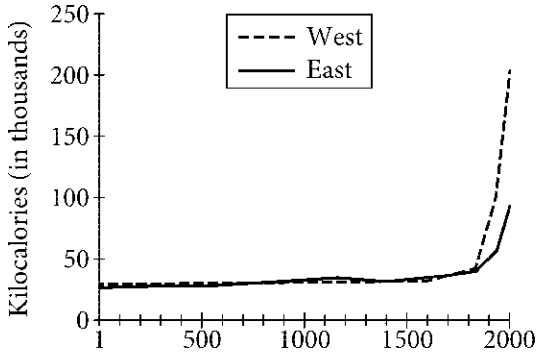
Not until the seventeenth century were fossil fuels and steam power put together in a productive way, by northwest European coalminers who realized that they could burn the coal they dug up to power engines that would pump water out of their mineshafts, allowing them to dig deeper to find more coal. The earliest steam engines burned so much coal that they were economical only if used right next to the mines that fed them, but in 1776, James Watt and Matthew Boulton managed to build an engine with separate heating and condensing chambers, dramatically cutting its coal consumption. Industrialists quickly figured out how to augment human and animal muscles with steam power in all walks of life. Productivity soared and prices collapsed, but despite this, sales increased so much that profits rose much higher than ever before. Energy capture per capita in the most industrialized Western economies grew sevenfold, from roughly 38,000 kilocalories per person per day around 1800 to 230,000 by the 1970s. The age of energy abundance had begun.

People of course still needed to eat, which meant that domesticated plants and animals remained vital sources of energy, but fossil fuels quickly transformed farming too. By the late nineteenth century, trains and steamships had made it much easier and cheaper to move food to people, and in the twentieth, chemical fertilizers, gasoline for tractors, and electricity to pump water to fields directly increased output. By 2000, each acre of American farmland absorbed, on average, eighty times as much energy as it had done in 1900, and yielded four times as much food.

Like foraging and farming, serious fossil-fuel use began in a specific place (Northwest Europe) at a specific time (roughly two hundred years ago). The great difference between the industrial revolution and the two earlier transformations in energy capture, though, was that industrialization changed the world much more abruptly. It made so much energy available so suddenly that Britain, where the initial breakthrough came, was able to project its power across the entire globe in the nineteenth century. Consequently, once Britain began its industrial revolution, there was no time for anyone else to invent fossil-fuel industry independently. By 1914, most of the people on earth were part of a Western-dominated fossil-fuel economy and tied to global markets, and Europeans and their overseas colonists had exploited the advantages of being early adopters to take control of 84 percent of the planet's landmass and 100 percent of its oceans.

The industrial revolution is the biggest discontinuity in human history—so far.

Average Energy Use per Person per Day



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11

As used in line 7, "exploiting" most nearly means

A) influencing.
B) utilizing.
C) reaching.
D) mistreating.

12

Which choice best supports the idea that steam power lowered the cost of industrial production?

A) Lines 15-19 ("The second . . . pistons")
B) Lines 23-29 ("Not . . . coal")
C) Lines 35-37 ("Industrialists . . . life")
D) Lines 37-39 ("Productivity . . . before")

13

Based on the passage, the author is most likely writing from the point of view of

A) an industrialist highlighting the historical importance of steam power.
B) an engineer outlining major setbacks and developments in energy capture.
C) a scientist concerned about the environmental effects of fossil fuel use.
D) a scholar with expertise on the impact of technology on social history.

14

Based on the passage, which choice best describes the effect of fossil fuel use on food production?

A) Fossil fuels have reduced the amount of land needed to produce a given amount of food.
B) Fossil fuels have raised the costs of food production due to farmers purchasing more equipment.
C) Fossil fuels have decreased the amount of food that needs to be produced per acre of land.
D) Fossil fuels have resulted in increased food production by increasing the number of farmers.

15

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

A) Lines 40-43 ("Energy . . . 1970s")
B) Lines 43-44 ("The age . . . begun")
C) Lines 45-48 ("People . . . too")
D) Lines 53-56 ("By 2000 . . . food")

16

In the passage, the author compares the Industrial Revolution with other major developments in energy use to make the point that the Industrial Revolution occurred

A) earlier in history.
B) in a more limited region.
C) with lesser impact.
D) more rapidly.

17

The main effect of the phrase "so far" in line 77 is to

A) imply uncertainty about the accuracy of the data in the passage.
B) emphasize the cautions issued throughout the passage.
C) suggest that a future development may negate the preceding claim.
D) note the topic of the author's future publications.

18

The information in the figure best supports the claim in which lines from the passage?

A) Lines 1-3 ("In the . . . sunlight")
B) Lines 3-7 ("This . . . ago")
C) Lines 9-10 ("Fossil-fuel . . . innovations")
D) Lines 13-15 ("Only . . . source")

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19

Which claim about energy use in the East is best supported by the figure?

A) It established an initial model that the West has followed.

B) It will not surpass the levels recorded in the West.

C) It has been more erratic over time than that in the West.

D) It has largely been consistent with that in the West.

20

During which range of years represented in the graph did energy use in the West increase the most?

A) 1–500

B) 500–1000

C) 1000–1500

D) 1500–2000

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1

Questions 21-31 are based on the following passage and supplementary material.

This passage is adapted from Jessica P. Johnson, "Amoeba Have Long-Distance Preference for Certain Bacteria, Pointing to Other Cell-Sensing Insights." ©2019 by National Academy of Sciences. Gram-negative and Gram-positive bacteria have different types of cell walls and are categorized according to their ability to take on stains during a test called Gram staining.

How does the microscopic amoeba track down prey in the vastness of the forest floor? Ample research on the soil amoeba *Dicytostelium discoideum*, affectionately called "Dicty" by researchers, has provided some clues. But the mechanisms behind long-distance sensing of bacterial signals are still largely a mystery. A recent study takes a simple behavioral biology approach to uncover crucial clues. Further insights could elucidate other cell-sensing mysteries, such as how immune cells pick up signals from invading pathogens.

Previous research suggested that Dicty, a popular model system for studying phagocytosis [ingestion of smaller cells by larger cells], chemotaxis [movement in response to a chemical stimulus], and host-pathogen interactions, can tell the difference between the Gram-negative and Gram-positive bacteria that it eats. It appears to selectively turn on certain cellular machinery depending on the type of prey it ingests. But few studies have investigated whether Dicty can distinguish between different bacteria during the hunt.

Now, a low-tech behavioral study shows that Dicty prefers to hunt Gram-negative bacteria over Gram-positives. "For an organism that's been studied extensively for many decades, including its ability to sense bacteria, the fact that it discriminates or responds differentially to bacteria at a distance hadn't been shown," says paper coauthor Elizabeth Ostrowski, an evolutionary biologist at Massey University in Auckland, New Zealand.

Researchers know that Dicty can phagocytize bacteria, but much is still unknown about the mechanisms underlying bacterial recognition, explains Michelle Snyder, a cell biologist at Towson University in Maryland who was not involved in the research.

Ostrowski and her coauthor set up paired assays in which Dicty had to choose whether to crawl toward one of four Gram-negative bacterial species or one of four Gram-positive species. In 21 of the 24 assays, Dicty chose the Gram-negative bacteria. "This is a classic test in behavioral biology," Ostrowski says. "We used the tools of behavioral biology and learned something new about its behavior that had been overlooked."

Three different Dicty strains collected from different geographical regions of the US all behaved surprisingly similarly in the Gram-negative/Gram-positive paired assays. "To me, this suggests that [the Dicty strains] have a very basic mechanism of sensing bacteria that is not a rapidly evolving trait," Ostrowski says. "It's something that's fairly evolutionarily conserved."

In a follow up experiment, the researchers tested whether Dicty might be homing in on the large amounts of cyclic adenosine monophosphate (cAMP) that Gram-negative bacteria regularly spill from their cells, whereas Gram-positives excrete little to no cAMP. They observed that Dicty preferentially migrated toward a mutant Gram-negative *Escherichia coli* strain that overproduced cAMP versus a wild type *E. coli* and another mutant strain that produced no cAMP.

The experiments suggest that cAMP might play a role in Dicty preference for Gram-negatives. However, cAMP is likely not the only chemotactic molecule at work. In a control experiment, Dicty preferred the cAMP non-producing *E. coli* mutant over no bacteria at all.

"It would be nice to see if you could somehow manipulate cAMP levels so that you had a Gram-negative and a Gram-positive that secreted the same levels of cAMP," Snyder suggests. She also would like to see experiments that take a Dicty cell missing the receptor that allows for chemotaxis toward cAMP and investigate whether it still discriminates between Gram-negatives and Gram-positives.

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Figure 1

Response of *Dictyostelium Discoideum* Strains from Three Geographic Regions to Gram-negative and Gram-positive Bacterial Pairs

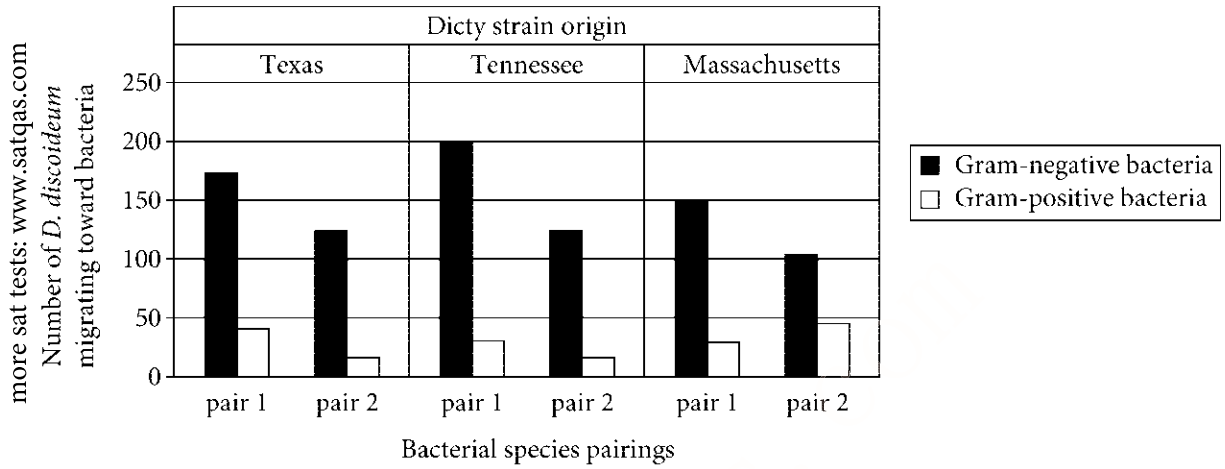
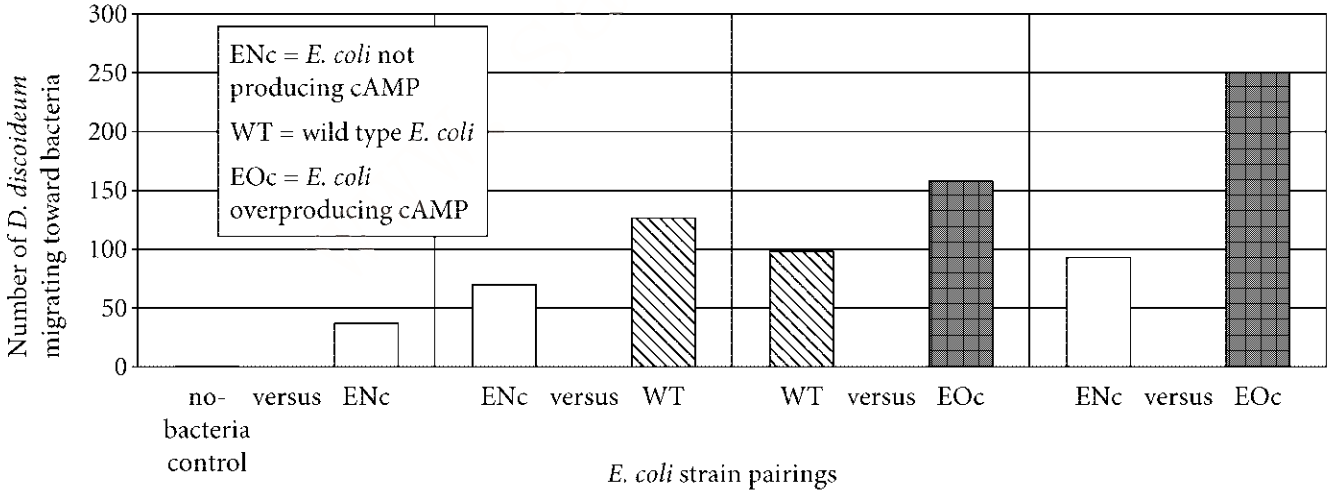


Figure 2

Response of Tennessee *Dictyostelium discoideum* Strain to *E. coli* Strains with and without cAMP Mutations



Figures adapted from Ghazai Rashidi and Elizabeth A. Ostrowski, "Phagocyte Chase Behaviours: Discrimination between Gram-Negative and Gram-Positive Bacteria by Amoebae." ©2019 by Ghazai Rashidi and Elizabeth A. Ostrowski.

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21

The main purpose of the passage is to

A) discuss research that explores factors that influence the prey selection of a soil amoeba.

B) examine the relationship between different cell-sensing mechanisms used by a soil amoeba.

C) challenge the consensus view about a soil amoeba and the chemical stimuli it responds to.

D) suggest that further research into different strains of a soil amoeba is necessary to understanding bacterial signals.

22

According to the passage, the soil amoeba *D. discoideum* has been

A) a popular choice for experimentation because of its widespread availability.

B) an ideal proxy for studying immune cells because it readily detects invading organisms.

C) useful for research into chemotaxis and phagocytosis.

D) investigated for its ability to sense cAMP over long distances.

23

As used in line 35, "recognition" most nearly means

A) approval.

B) realization.

C) identification.

D) respect.

24

A student claims that *D. discoideum* will pursue Gram-positive bacteria only if there are no Gram-negative bacteria available. Does the information provided in the passage support this claim?

A) Yes, because the amoeba has shown a strong preference for Gram-negative bacteria when evaluated in paired assays.

B) Yes, because the amoeba can distinguish between Gram-positive and Gram-negative bacteria and exhibits chemotaxis by moving toward the Gram-negative bacteria.

C) No, because the amoeba was sometimes observed to pursue Gram-positive bacteria when both Gram-positive and Gram-negative bacteria were available.

D) No, because Gram-positive bacteria that do not secrete cAMP are preferred to Gram-negative bacteria that do not secrete cAMP.

25

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

A) Lines 21-23 ("But . . . hunt")

B) Lines 24-26 ("Now . . . Gram-positives")

C) Lines 39-42 ("Ostrowski . . . species")

D) Lines 42-43 ("In 21 . . . bacteria")

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26

It can reasonably be inferred from the passage that the design of the study by Ostrowski and her coauthor helps to minimize which potential criticism?

A) The behavior of only a single amoeba strain is not representative of the behavior of all strains of that amoeba.

B) The experiment did not include assays under a variety of environmental conditions.

C) The levels of cAMP secreted by the Gram-negative and Gram-positive bacteria were inconsistent across the assays.

D) The distances the amoebas were expected to travel in order to select a bacterial species were not equivalent in all of the assays.

27

Which conclusion about the relationship between *D. discoideum* and bacteria that produce cAMP is best supported by the passage?

A) While *D. discoideum* shows a preference for a strain of Gram-negative bacteria that produced larger than normal amounts of cAMP over a strain of the same bacteria that produced no cAMP, that preference does not fully account for the amoebas' hunting behavior.

B) While *D. discoideum* demonstrates chemotaxis toward cAMP under normal circumstances, in situations where the amoeba lacks the necessary receptor, movement toward cAMP is not observed.

C) While *D. discoideum* locates Gram-negative bacteria by the cAMP that they produce, it is not clear what chemotactic molecule the amoeba tracks in Gram-positive bacteria.

D) While *D. discoideum* moves toward *E. coli* producing high levels of cAMP in greater numbers than it moves toward a wild-type strain of the same bacteria, *D. discoideum* does not move toward other types of bacteria that overproduce cAMP.

28

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

A) Lines 56-61 ("In a . . . cAMP")

B) Lines 61-65 ("They . . . cAMP")

C) Lines 66-71 ("The experiments . . . at all")

D) Lines 75-80 ("She . . . Gram-positives")

29

Which statement about the response of *D. discoideum* strains studied is best supported by the data in figure 1?

A) In both bacterial species pairings used with the Texas strain, the number of *D. discoideum* migrating toward Gram-negative bacteria reached 150.

B) Across the bacterial species pairings used with all three strains, the number of *D. discoideum* migrating toward Gram-positive bacteria was higher in pair 2 than it was in pair 1.

C) A greater number of *D. discoideum* in the Massachusetts strain showed a preference for Gram-negative bacteria over Gram-positive bacteria in pair 2 than in pair 1.

D) In none of the bacterial species pairings did the number of *D. discoideum* migrating toward Gram-positive bacteria reach 50.

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30

Which statement about wild-type *E. coli* is best supported by the data in figure 2?

A) *D. discoideum* preferred wild-type *E. coli* over *E. coli* not producing cAMP, but it preferred *E. coli* overproducing cAMP over wild-type *E. coli*.

B) *D. discoideum* preferred wild-type *E. coli* over both *E. coli* overproducing cAMP and *E. coli* not producing cAMP.

C) Twice the number of *D. discoideum* migrated toward wild-type *E. coli* when paired with *E. coli* not producing cAMP than migrated toward wild-type *E. coli* when paired with *E. coli* overproducing cAMP.

D) The number of *D. discoideum* migrating toward *E. coli* overproducing cAMP over wild-type *E. coli* was smaller than the number of *D. discoideum* migrating toward *E. coli* not producing cAMP over the no-bacteria control.

31

As used in line 73, "manipulate" most nearly means

A) reveal.

B) control.

C) negotiate.

D) misrepresent.

Questions 32-42 are based on the following passages.

Passage 1 is adapted from a speech delivered to the Canadian House of Commons in 1978 by Leonard Jones. ©1978 by the Crown. Passage 2 is adapted from James S. Cox, "Three Reasons to End the Monarchy in Canada." ©2016 by The Vimy Report. Canada shares a constitutional monarchy with England, meaning that the Queen of England is also Canada's legal head of state.

Passage 1

Let me point out to you the major reasons why Canadians feel the Queen of Canada should be retained as an integral part of our federal democratic
Line system. First, the Queen as an hereditary figure
5 provides Canada with a continuous, constant, stable head of state. No matter what kind of confusion takes place at the political level, in a constitutional monarchy, which we now have, we are assured of the continuous presence of a most able ruler. In an
10 electoral system there is always a chance that the system will be stalemated. The presence of a constitutional monarch rules out the threat of a possible lack of government. Citizens in a democracy must be able to criticize and remove their leaders
15 without fear that there will be no one to take over.

Second, the presence of a constitutional monarch takes away the struggle for power which occurs in so many countries and often leads to dictatorship. The Queen ensures freedom in Canada. After all, the
20 system of a constitutional monarchy is certainly better than absolute leadership.

Third, elevation of rulers and the formation of courts and cliques is inevitable in governments of all kinds. A constitutional monarchy is not only less
25 dangerous and less costly than most of them, it also limits, although it does not prevent, this tendency to form potentates and courts which neither democratic theory nor electoral practice have been able to diminish. The presence of the Queen of Canada
30 ensures that [prime] ministers are in second place and are not the sole authority.

Fourth, the Queen presents to Canadians an aura of humanity amidst the vast realms of governmental bureaucracy. She is above partisan politics in
35 government. When a Canadian sees Her Majesty in our country, he or she does not have to wonder if she is visiting that certain portion of the country to get votes. The Canadian cannot lend political overtones to her phrases. The Queen is truly a head of state to
40 be respected.

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Passage 2

[O]ur model of governance is something of a pretend monarchy. The Queen does not really *rule* over Canada, she *reigns* abstractly, in a constitutionally neutered way. We could do away with the monarchy tomorrow and continue quite nicely with the same structure, under a truly Canadian Governor General overseeing a parliamentary republic, where *republic* is defined generically as a state governed by elected individuals exercising power according to the rule of law. Modern usage usually refers to states without a monarch. . . . more sat tests: www.satqas.com

We do not need a monarchy, constitutional or otherwise, or a royal family of any kind. Canadians have proven time and time again that they can manage their own affairs in their own way, without guidance from Britain. What then is the purpose of an off-shore, paternalistic institution ranking above the government of Canada?

As matters stand today, the Governor General is appointed by the Queen, on the advice of the Prime Minister, and serves functionally as Canada's Head of State. Why do we also need an abstraction in the form of *The Crown* to represent the Canadian state over and above the Governor General? Moreover, in our federal system, the Queen is also represented in each province by a Lieutenant Governor. What real purpose is served by having 11 vice-regal representatives within the same country?

Some will argue that, despite the occasional test, Canadian unity has endured under a constitutional monarchy, so why tinker with something that apparently works? There are three problems with this approach. First, it is based on a false premise. The existence of a constitutional monarchy has had nothing to do with constraining centrifugal forces in Canada. . . . Malcontents have been isolated and defeated because people decided that remaining in Canada was to their benefit, both economically and socially. Second, sticking with what we have ignores the impact of the growth and change which has occurred in Canada in past generations, and the maturing and development that will continue in future generations. . . . Third, since 1940, Canada has steadily drifted away from its strongly British heritage and linkage, to find comfort in an American sphere of influence. The notion of a constitutional monarchy seems oddly ill-fitted to western hemisphere republicanism.

32

Which choice best describes the overall structure of Passage 1?

A) The author highlights a well-known generalization and then provides reasons why people should reject that generalization.

B) The author proposes a new measure and then outlines the steps that should be followed to implement that measure.

C) The author introduces a common argument and then outlines the thinking underpinning that argument.

D) The author recounts an anecdote and then narrates a sequence of events that resulted from the occurrence described in that anecdote.

33

According to Passage 1, which important power enjoyed by citizens in a democracy is best protected when that democracy is a constitutional monarchy?

A) The ability to remove elected representatives without incurring a crisis in government

B) The political leverage to ensure elected representatives adhere to the rule of law

C) The legal authority to punish elected representatives who engage in corrupt political practices

D) The reassurance that elected representatives prioritize their constituents' needs

34

As used in line 27, "form" most nearly means

A) establish.

B) educate.

C) mold.

D) discipline.

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35

According to Passage 2, the Queen's control over Canada

A) has stifled the country's economic growth.

B) will weaken if the monarchy does not change with the times.

C) makes the elected parliamentary government ineffective.

D) is in reality largely nonexistent.

36

In lines 57-59, 63-65, and 67-69, Cox asks questions mainly to

A) highlight the redundancy of the Queen's role in the Canadian government.

B) address anticipated counterarguments against his characterization of the Queen's duties.

C) emphasize the controversial nature of his proposal to revise the Canadian constitution.

D) summarize the kinds of questions constituents might ask about the differences between a republic and a constitutional monarchy.

37

Which choice from Passage 1 best supports the idea that Jones believes that in democracies, people are generally suspicious of politicians' motives when they address their constituents?

A) Lines 29-31 ("The presence . . . authority")

B) Lines 32-34 ("Fourth . . . bureaucracy")

C) Lines 35-38 ("When . . . votes")

D) Lines 39-40 ("The Queen . . . respected")

38

As used in line 74, "approach" most nearly means

A) arrival.

B) strategy.

C) procedure.

D) advance.

39

It can most reasonably be inferred from Passage 2 that Cox believes that with respect to traditional institutions, societies should

A) find compromises that would make these institutions more compatible with modern attitudes.

B) accept the idea that these institutions still play a significant role in shaping the country's national identity.

C) be prepared to replace these institutions if they no longer address a nation's current needs.

D) be reluctant to allow foreign countries to have too much influence over how these institutions continue to evolve.

40

Which choice best describes a key difference between the passages' characterizations of the Queen's function in the Canadian government?

A) Passage 1 defends the current scope of the Queen's responsibilities, whereas Passage 2 recommends additional constitutional restrictions be imposed on her powers.

B) Passage 1 praises the Queen for the leadership she capably provides, whereas Passage 2 points out that the Queen's authority is merely ceremonial.

C) Passage 1 indicates that the general public has misunderstood the nature of the Queen's influence, whereas Passage 2 argues that the public feels strongly that the Queen's role is outdated.

D) Passage 1 details how the Queen's guidance has been useful to politicians, whereas Passage 2 suggests that the Queen has overstepped her prescribed responsibilities.

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1

41

Cox (Passage 2) would most likely respond to Jones's claim in lines 6-9, Passage 1 ("No matter . . . ruler") by arguing that

A) the government's ability to function is the result of public will rather than the influence of one ascendant leader.

B) the need for consensus is less important to Canadians than the idea that they can choose their representatives.

C) people find disputes among politicians to be less significant to their daily lives than economic matters that affect them personally.

D) Canadian history has shown that monarchs have tended to create more political tensions than they resolve.

42

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

A) Lines 53-54 ("We do . . . kind")

B) Lines 54-57 ("Canadians . . . Britain")

C) Lines 60-63 ("As matters . . . State")

D) Lines 70-73 ("Some . . . works")

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CONTINUE

1

Questions 43-52 are based on the following passage.

This passage is adapted from Elizabeth Gibney, "Astronomers Detect Light from the Universe's First Stars." ©2018 by Macmillan Publishers Limited, part of Springer Nature.

Astronomers have for the first time spotted long-sought signals of light from the earliest stars ever to form in the Universe—around
Line 180 million years after the Big Bang.

The signal is a fingerprint left on background radiation by hydrogen that absorbed some of this primordial light. The evidence hints that the gas that made up the early Universe was colder than predicted. This, physicists say, is a possible sign of dark matter's influence. If confirmed, the discovery could mark the first time that dark matter has been detected through anything other than its gravitational effects.

"This is the first time we've seen any signal from this early in the Universe, aside from the afterglow of the Big Bang," says Judd Bowman, an astronomer at Arizona State University in Tempe who led the work, which is published in *Nature*. "If it's true, this is major news," says Saleem Zaroubi, a cosmologist at the University of Groningen in the Netherlands. Other teams will need to confirm the signal but, so far, the finding seems to be robust, he says. "It's very exciting stuff. This is a period in the Universe's history we know very little about."

Physicists think that the Big Bang, 13.8 billion years ago, generated an ionized plasma, which cooled rapidly as the Universe expanded. After about 370,000 years, this soup began to form neutral hydrogen atoms. Over time—and under gravity's influence—these clumped together, forming stars that ignited. This transition is known as the cosmic dawn.

Light from these stars would now be so faint that detecting it with Earth-based telescopes is near impossible. But astronomers have long hoped to see it indirectly: the light would have subtly shifted the behaviour of the hydrogen that once filled the space between stars. This change would have allowed hydrogen gas to absorb radiation from the cosmic microwave background (CMB)—the afterglow of the Big Bang—at a characteristic radio wavelength of 21 centimetres, which leaves a dip in the intensity of the CMB.

To search for the signal, the team used a radio telescope called the Experiment to Detect the Global Epoch of Reionization Signature (EDGES), based at the Murchison Radio-astronomy Observatory in Western Australia. Because our own galaxy and human-generated FM radio generate waves in the same band as the signal, spotting the dip meant carefully filtering out these more powerful sources. But Bowman and his colleagues soon found the predicted signal at roughly the frequency they expected. And despite being a puny 0.1% drop in the radiation, it was still twice the magnitude predicted. The finding was so stark that the researchers spent two years checking that it didn't come from an instrumental effect or noise. They even built a second antenna and pointed their instruments at different patches of sky at different times. "After two years, we passed all of these tests, and couldn't find any alternative explanation," says Bowman. "At that point, we started to feel excitement."

Radiation from this period arrives stretched out by the expansion of the Universe, meaning the band in which the signal was found gives away its age. This allowed the team to date the latest onset of the cosmic dawn to 180 million years after the Big Bang. The signal's disappearance gives away a second milestone—when more-energetic X-rays from the deaths of the first stars raised the temperature of the gas and turned off the signal. Bowman's team puts that time around 250 million years after the Big Bang.

Understanding these primordial stars is important not only because they shaped the matter around them, but also because their explosive deaths created the soup of heavier elements, such as carbon and oxygen, from which later stars formed, says Bowman. "If we really want to understand the cosmic ladder of our origins, this is a critical step to understand," he says.

While the signal appeared at an expected frequency, its strength was utterly unexpected, says Rennan Barkana, a cosmologist at Tel Aviv University in Israel. "I was actually quite amazed," says Barkana, who has published a second, related paper. He says the strength suggests that either there was more radiation than expected in the cosmic dawn, or the gas was cooler than predicted. Both would be "very strange and unexpected", he says.

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1

The only explanation that makes sense to Barkana is that the gas was cooled by something. That points to dark matter, he says, which theories suggest should have been cold in the cosmic dawn.

43

The main purpose of the passage is to

A) present findings that illustrate the challenges of identifying dark matter in the early universe.

B) discuss an ongoing debate concerning the possibility of using radiation to date the earliest stars.

C) summarize research dating the first stars and pointing to a potential impact of dark matter.

D) describe efforts to measure the temperatures of primordial stars and determine their composition.

44

Which choice best supports the idea that the decrease in cosmic background radiation caused by the first stars has yet to be established conclusively?

A) Lines 7-9 ("The evidence . . . predicted")

B) Lines 9-10 ("This . . . influence")

C) Lines 14-18 ("This . . . *Nature*")

D) Lines 21-22 ("Other . . . says")

45

The main purpose of the quotation from Zaroubi in lines 22-24 ("It's very . . . about") is to

A) characterize the research approach used by the astronomers as unconventional.

B) convey the potential importance of the study's findings in the field of astronomy.

C) acknowledge the limitations of the study's findings for understanding early stars.

D) indicate the difficulty of replicating the astronomers' research findings.

46

As used in line 36, "shifted" most nearly means

A) repositioned.

B) displaced.

C) modified.

D) transferred.

47

As used in line 39, "allowed" most nearly means

A) enabled.

B) empowered.

C) admitted.

D) released.

48

The fourth paragraph (lines 25-32) mainly serves to

A) describe the circumstances that physicists believe led to the formation of the first stars in the universe.

B) explain how physicists determined that the Big Bang occurred 13.8 billion years ago.

C) underscore a point of disagreement among physicists as to how quickly the universe expanded.

D) reveal how physicists first identified the signals of light from the earliest stars.

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CONTINUE

49

It can reasonably be inferred from the passage that the experiment conducted by Bowman's team helped to exclude the possibility that

A) the intensity of the signal differed when measured by researchers in the Southern Hemisphere.

B) radio waves from the signal were in the same band as the waves from more powerful sources on Earth.

C) the signal's strength was due to an isolated phenomenon observed only in one location.

D) the intensity of the signal fluctuated as the telescope scanned for longer periods of time.

50

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

A) Lines 44-48 ("To search . . . Australia")

B) Lines 48-51 ("Because . . . sources")

C) Lines 56-58 ("The finding . . . noise")

D) Lines 58-60 ("They . . . times")

51

Based on the passage, which finding would likely have led Bowman's team to arrive at a different conclusion about the onset of the cosmic dawn?

A) The gas making up the early universe was colder than Bowman's team had predicted.

B) The signal was determined to be 1.5 times the magnitude Bowman's team had predicted.

C) The drop in radiation was greater than the 0.1% drop that Bowman's team discovered.

D) The signal was found at a much different frequency than Bowman's team had expected.

52

The last paragraph mainly serves to

A) call into question the previous methods of dating early stars.

B) offer a rationale for the unexpected strength of early star signals.

C) suggest that the research on signals from early stars is still in the initial stages.

D) address a potential criticism of the astronomers' findings on the cosmic dawn.

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2

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.

Thoreau and *Cosmos*

"Every poet has trembled on the verge of science," wrote Henry David Thoreau, the 1 American: essayist, poet, and naturalist. Like Thoreau, many Western philosophers and artists of the late eighteenth and early nineteenth centuries—including the idealists in

1

A) NO CHANGE
B) American essayist, poet,
C) American—essayist, poet
D) American essayist; poet

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2

Germany, the Romantics in Britain, and the transcendentalists in the United States— 2 struggled with what they saw as the cold, impersonal empiricism stemming from the scientific revolution and Enlightenment era. Science diminished the mystery of the natural world with every new discovery, they argued, and as a result, nature was best experienced through more subjective means, such as art and intuition. Thoreau, however, found a way to balance the objectivity of science with the subjectivity of the imagination: the key lay in the writings of 3 the well-known scientist whose work was widely celebrated, Alexander von Humboldt.

2

Which choice most effectively sets up the discussion of science that follows in the paragraph?

A) NO CHANGE
B) were at least similar to scientists in that they too passionately pursued what they believed to be truth.
C) felt that works containing technical and scientific language would not be very interesting for the everyday reader.
D) placed special emphasis on the wilderness and sublime landscapes.

3

A) NO CHANGE
B) one of the preeminent scientists of the day,
C) a well-known scientist, the famous
D) a preeminent scientist who was prominent at the time,

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CONTINUE

2

[1] A gifted polymath, Humboldt contributed to the modern conceptualization of nature as an interconnected web of life. [2] Humboldt argued that viewing science as a collection of unconnected facts would lead one to believe that 4 scientists detailed measurements "chill the feelings" as well as "diminish the nobler enjoyments, attendant upon a contemplation of nature." [3] However, if one considered precise observations as a way to gain knowledge of a larger, connected whole, then science could reveal the "unity in diversity of phenomena." 5

4

A) NO CHANGE
B) scientist's detailed measurement's
C) scientists' detailed measurement's
D) scientists' detailed measurements

5

The writer wants to add the following sentence to this paragraph.

> His five-volume book, *Cosmos: A Sketch of a Physical Description of the Universe* (first published in 1845), provided an accessible introduction to the physical world for nonacademic readers, covering everything from astronomy to geology to biology.

The best placement for the sentence is

A) before sentence 1.
B) after sentence 1.
C) after sentence 2.
D) after sentence 3.

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2

Upon reading *Cosmos*, Thoreau began **6** charting details about the changing seasons. Earlier in his life, Thoreau had kept separate books for recording poetry and **7** facts. In 1849, in contrast to those earlier years, Thoreau began keeping one solitary journal, which he filled with details from his daily walk in the woods. **8** Combining meticulous notes about nature, such as the dates of the first flowering of dozens of plant species around his hometown of Concord, Massachusetts, with musings on the relationship between humanity and the cosmos. Reflecting on **9** our approach, Thoreau wrote, "A true account of the actual is the rarest poetry."

6

Which choice most effectively sets up the examples that follow in the paragraph?

A) NO CHANGE
B) working for Louis Agassiz, a Harvard researcher who studied animals and their environments.
C) challenging the theories of nature put forth by earlier transcendentalist writers.
D) using detailed observations as a means to contemplate human beings' place in the universe.

7

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

A) facts, but in 1849 he began keeping a single, unified
B) facts; later, in 1849, Thoreau afterward kept one solitary
C) facts, which was a contrast to the years that would follow, when Thoreau instead kept a single, unified
D) facts because these early books were followed by Thoreau's later, unified

8

A) NO CHANGE
B) Thoreau combining
C) A combination of
D) His entries combined

9

A) NO CHANGE
B) his
C) its
D) my

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CONTINUE

2

Thoreau's journal eventually grew to more than two million words, and its contents **10** detected their route into his literary works, such as *Walden*, whose manuscript he revised six times to include his growing knowledge of the ecology of Walden Pond. Humboldt had provided Thoreau with a worldview that allowed him—as historian Andrea Wulf puts it—to **11** be "deeply affected by the rhythm of the natural world."

10

A) NO CHANGE
B) made their avenue
C) discovered their route
D) found their way

11

Which quotation from Andrea Wulf's article in *The Atlantic* about Thoreau and Humboldt provides the most logical conclusion to the passage?

A) NO CHANGE
B) "set up a new and systematic daily regimen."
C) combine "the factual and the wonderful."
D) wonder "whether anything he ever wrote could be better than his journal."

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2

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

Self-Domesticating Mice

Animal domestication—the process of breeding tame animals over time to be more docile and suitable for human care and use—doesn't just result in animals that are behaviorally different from their wild counterparts; it also **12** turns out critters with a whole lot of physical differences. These differences—which include white patches in the fur, floppy **13** ears, and diminished snout, tooth, and brain size—are collectively known as "domestication syndrome." Scientists have long believed that deliberate human intervention is the cause of domestication syndrome, **14** a process that began when humans first selectively bred wild animals for desirable traits around 10,000 to 15,000 years ago.

Dr. Anna Lindholm and her colleagues at the University of Zurich **15** discovered this phenomenon by examining a population of wild house mice, *Mus musculus domesticus*, in an empty barn in Illnau, Switzerland. **16** Meanwhile, from 2007 to 2016, the researchers monitored the mice and measured various physical aspects of the animals, including their head length, body weight, and presence of white patches. Although they had to be occasionally handled for measuring, the mice were otherwise left alone, allowing them to reproduce without intentional human selection.

12

A) NO CHANGE
B) brings forth animals with a great multitude
C) produces animals with an array
D) makes for creatures with a bunch

13

A) NO CHANGE
B) ears—and
C) ears; and
D) ears, and,

14

Which choice best introduces the passage's main discussion?

A) NO CHANGE
B) which has been shown to occur through three distinct evolutionary pathways: commensal, prey, and directed.
C) which may occur when humans intentionally tame wild species for use as farm animals or pets.
D) but recent research has shown that traits corresponding to this syndrome can occur simply through animals' prolonged exposure to humans.

15

A) NO CHANGE
B) were discovering
C) had discovered
D) could have discovered

16

A) NO CHANGE
B) On the other hand,
C) For this reason,
D) DELETE the underlined portion, adjusting the capitalization as needed.

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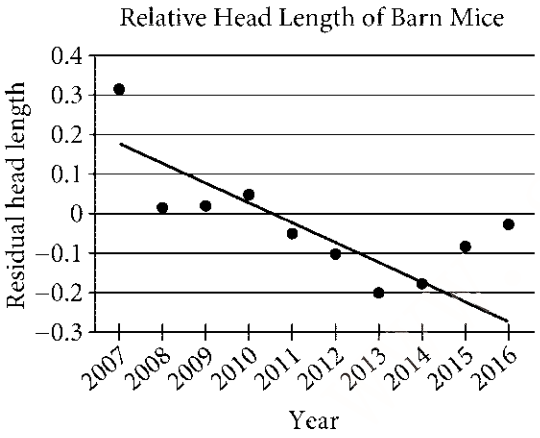
CONTINUE

2

Over several reproductive generations, the mice showed physiological changes consistent with domestication syndrome. Body weight decreased significantly, while the number of adult mice with white patches increased from one to thirty-two. Similarly, the researchers found that there was a considerable decrease in head length relative to body weight (residual head length) from **17** 2014 to 2016 and that the trend in residual head length generally decreased over the course of the examination period. The results suggested that **18** although the residual head length was nearly identical in 2008 and 2009, simple exposure to humans had caused domestication syndrome in the mice.



Adapted from Madeleine Geiger, Marcelo R. Sánchez-Villagra, and Anna K. Lindholm, "A Longitudinal Study of Phenotypic Changes in Early Domestication of House Mice." ©2018 by Madeleine Geiger, Marcelo R. Sánchez-Villagra, and Anna K. Lindholm.

17

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

A) NO CHANGE
B) 2007 to 2008
C) 2011 to 2016
D) 2013 to 2014

18

The writer is considering deleting the underlined portion. Should the underlined portion be kept or deleted?

A) Kept, because it provides an explanation for a seeming inconsistency between the data in the graph and the researchers' conclusions.
B) Kept, because it uses relevant information from the graph to show that some mice did not show signs of domestication syndrome until later in the study.
C) Deleted, because it highlights data from the graph that are not relevant to the sentence's claim about the study's overall results.
D) Deleted, because it provides inaccurate information from the graph.

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2

The researchers suggest that the population of wild house mice self-domesticated, a theory supported by genetic evidence. Scientists attribute domestication to a deficit in neural crest cells, a type of stem cell, during **19** development that results in smaller, less active adrenal glands (responsible for stress and fear responses) and therefore more docile animals. These stem cells also influence snout size and fur color. The mice that had this deficit were likely more comfortable with human interaction, a key component of **20** tameness, stayed around the barn, while the more apprehensive mice fled. Over time, the tamer mice reproduced, passing that tameness on to **21** one's offspring, eventually resulting in a domesticated population. These results have important implications for understanding the domestication of other species and demonstrate how **22** they may be unknowingly affecting the animals around them.

19

A) NO CHANGE
B) advancement
C) acceleration
D) progress

20

A) NO CHANGE
B) tameness, they
C) tameness; but
D) tameness, and

21

A) NO CHANGE
B) those
C) its
D) their

22

A) NO CHANGE
B) the results
C) humans
D) DELETE the underlined portion.

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CONTINUE

2

Questions 23-33 are based on the following passage.

"Story of Your Life"

In the early 1990s, acclaimed science fiction writer Ted Chiang was suffering from a stubborn case of writer's block. That changed when he was suddenly 23 hit unexpectedly with a concept for a new story: a woman is tasked with translating an alien species' language, one so different from human languages that it changes her perception of reality. Although Chiang finally had 24 one, he felt unprepared to convincingly convey the experience of learning such a language.

23

A) NO CHANGE
B) hit by an idea and concept
C) struck with the idea
D) struck by a fresh idea that he could use

24

A) NO CHANGE
B) it,
C) a story,
D) recognition,

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CONTINUE

2

[1] To solve this problem, Chiang decided to develop an understanding of linguistics, the study of the nature, structure, and history of language. [2] During his research, he learned about a theory known as linguistic determinism, which **25** assert that language is not only a tool to communicate information about the world but also a lens through which people perceive the world. [3] For instance, linguists have found that some Australian Aboriginal languages always express the location of one's limbs in terms of cardinal directions—one might speak of one's "east hand" rather than "left hand"— **26** which speakers of these languages are constantly aware of their geographic orientation as a result. **27** more sat tests: www.satqas.com

25

A) NO CHANGE
B) have asserted
C) are asserting
D) asserts

26

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

27

The writer wants to add the following sentence to this paragraph.

> Chiang felt that linguistic determinism would apply perfectly to his story.

The best placement for the sentence is

A) before sentence 1.
B) after sentence 1.
C) after sentence 2.
D) after sentence 3.

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CONTINUE

2

After more than four years of research, Chiang was able to use this knowledge to create the novella "Story of Your Life." In it, the **28** protagonist: Dr. Louise Banks, discovers that members of the alien species, known as heptapods, write their sentences as geometric patterns that look "like frost on a windowpane" and have no separate words or word order. **29** On the other hand, heptapods perceive time simultaneously rather than sequentially. **30** Dr. Banks spends increasing amounts of her time attempting to communicate with the heptapods—she experiences the events of her life all at once rather than in order, allowing her to remember the life of the daughter she hasn't yet had. **31** The man with whom she will eventually have her daughter is a physicist whose work informs her understanding of time in the story. "I remember one afternoon when you are five years old," Banks narrates. "You'll be coloring with your

28

A) NO CHANGE
B) protagonist, Dr. Louise Banks,
C) protagonist Dr. Louise Banks,
D) protagonist, Dr. Louise Banks

29

A) NO CHANGE
B) As a result,
C) To begin with,
D) For instance,

30

Which choice most effectively sets up the information that follows in the sentence?

A) NO CHANGE
B) As Dr. Banks becomes fluent in this language, she begins to perceive life as a heptapod does—
C) While other experts focus on the heptapods' scientific and mathematical knowledge, Dr. Banks deciphers their language—
D) Dr. Banks learns that the heptapods conceive of free will in a different way than humans do—

31

Which choice most effectively sets up the quotation from "Story of Your Life"?

A) NO CHANGE
B) Personal responsibility is one of several major themes that arise in the story.
C) This mental rewiring is cleverly portrayed in the story's mixing of tenses.
D) The story raises complicated questions about the impact our choices have on our lives.

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2

crayons while I grade papers." Chiang uses this narrative to explore 32 how to add greater meaning to individual moments. The narrative suggests that one way of doing so is to view life as a whole.

When it was published in 1998, "Story of Your Life" 33 will have become a favorite of fans and critics alike. It won the prestigious Nebula Award for science fiction and was adapted into the 2016 Oscar-winning Hollywood film *Arrival*. Chiang's long, meticulous effort to bring his story to life paid off; he'd produced one of the most beloved science fiction stories ever written.

32

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

A) how viewing life as a whole can add greater meaning to individual moments.

B) ways in which one can add greater meaning to moments, like by viewing one's life as a whole.

C) the way that adding meaning to individual moments can be done by viewing life as a whole.

D) how, if one views one's life as a whole, it can add meaning to one's moments.

33

A) NO CHANGE

B) became

C) had become

D) was becoming

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CONTINUE

2

Questions 34-44 are based on the following passage.

Open the Books

In a 1995 book on management, author John 34 Case tells the story, of a hotel that was losing money because it was only two-thirds full (an average nightly occupancy rate of 67 percent). 35 Satisfied with these results, the hotel manager consulted a successful CEO, Jack Stack, who advised him to tell all his employees, from front-desk staff to housekeepers, about the low occupancy rate and its implications. The 36 manager, in doing that and more, displayed the occupancy rate every day. He also offered a bonus to every employee if the rate rose to 72 percent and stayed there. Staff began to work together to raise the rate by improving conditions at the hotel, and after eighteen months the rate was an astounding 85 percent. Stack's method, known as open-book management 37 (OBM); may seem like common sense, but relatively few top companies have adopted it. Here's why they should.

34

A) NO CHANGE
B) Case tells the story
C) Case, tells the story
D) Case, tells the story,

35

Which choice provides the most effective transition to the information that follows in the paragraph?

A) NO CHANGE
B) In spite of such difficulties,
C) Hoping for a turnaround,
D) Although he needed advice,

36

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

A) manager did that and more, displaying the occupancy rate every day and offering
B) manager, who did that and more, displayed the occupancy rate every day, also offering
C) manager did that and more; he also displayed the occupancy rate every day and offered
D) manager (who did that and more) displayed the occupancy rate every day; plus, he offered

37

A) NO CHANGE
B) (OBM)
C) (OBM),
D) (OBM)—

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2

OBM has two core components: making financial and other corporate data available to all employees and 38 training those employees in OBM practices. Stack's company, SRC, which rebuilds engines for trucks and other heavy equipment, shows how it works. SRC posts information about the company's productivity and financial health throughout 39 its facilities. Because all employees either own stock in the company or earn bonuses based on the company's financial performance, they see a tangible link between the company's financial data and their own rewards, which motivates them to make an extra effort. Research supports the wisdom of the OBM approach: a recent study conducted by the National Center for Employee Ownership on over fifty OBM companies showed that these companies 40 on an annual basis enjoyed yearly sales-growth increases as much as 2.2 percent greater than those of non-OBM competitors.

38

Which choice most effectively sets up the information that follows in the paragraph?

A) NO CHANGE
B) attracting customers away from rival companies.
C) clearing up misconceptions about OBM.
D) tying employees' compensation to that data.

39

A) NO CHANGE
B) it's
C) their
D) they're

40

A) NO CHANGE
B) annually enjoyed yearly
C) enjoyed annual
D) enjoyed yearly annual

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CONTINUE

2

[1] So why aren't more companies using OBM? [2] Business leaders have voiced a couple of concerns. [3] One is that sensitive financial data, if disclosed, could be exploited by competitors. [4] A second is that employees who learn how much a company makes and spends, **41** regardless of whether the company is making large profits, might become resentful about having to

41

Which choice best supports the point being made in the sentence?

A) NO CHANGE

B) even though they don't have comparable data from other companies,

C) assuming a company's spending changes from year to year,

D) especially if some of the spending seems wasteful or unfair,

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economize in their own work. [5] However, evidence suggests that employees who **42** had understood the relationship between their daily responsibilities and the company's overall financial **43** health are likely to become more cost conscious, not less. **44**

In short, more business leaders should open their books to employees. It may feel like a risk at first, but as John Case, Jack Stack, and others have shown, it's a risk worth taking.

42

A) NO CHANGE
B) understand
C) are understanding
D) will understand

43

A) NO CHANGE
B) health, they
C) health;
D) health, so they

44

The writer wants to add the following sentence to this paragraph.

> OBM practitioners counter that employees whose compensation is tied to company performance will be reluctant to leak information that could hurt the company.

The best placement for the sentence is

A) after sentence 1.
B) after sentence 2.
C) after sentence 3.
D) after sentence 4.

STOP

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

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Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

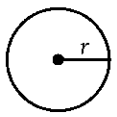
DIRECTIONS

For questions 1-15, solve each problem, choose the best answer from the choices provided, and fill in the corresponding bubble 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.

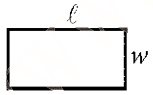
NOTES

1. The use of a calculator **is not permitted**.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. 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.

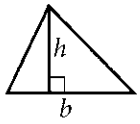
REFERENCE



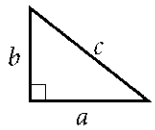
$A = \pi r^2$
$C = 2\pi r$



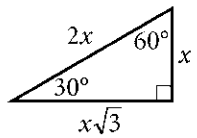
$A = \ell w$

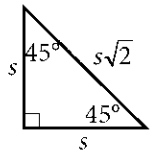


$A = \frac{1}{2}bh$

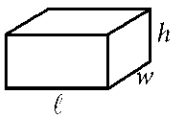


$c^2 = a^2 + b^2$

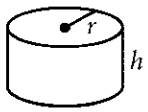




Special Right Triangles

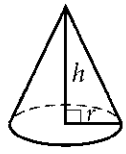


$V = \ell wh$

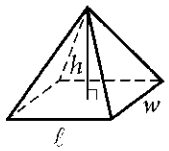


$V = \pi r^2 h$

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



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



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

The number of degrees of arc in a circle is 360.
The number of radians of arc in a circle is 2π.
The sum of the measures in degrees of the angles of a triangle is 180.

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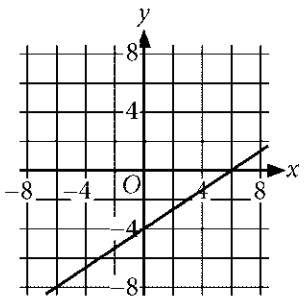
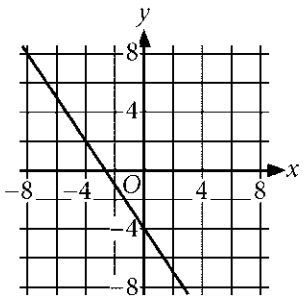
1

What is the graph of $y = \frac{3}{2}x - 4$?

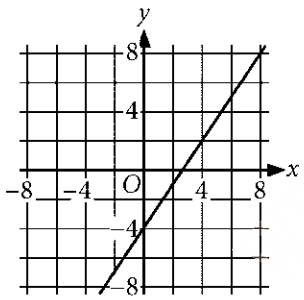
A)



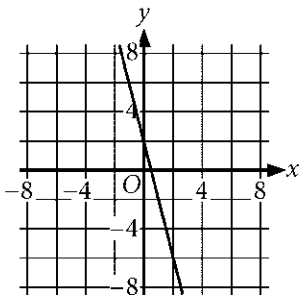
B)



C)



D)



2

If $|2x - 5| = 10$, what is the value of $|4x - 10|$?

A) 5

B) 10

C) 15

D) 20

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CONTINUE

3

$$9x - 2y = 8$$
$$2x - 9y = -\frac{5}{2}$$

What is the solution (x, y) to the given system of equations?

A) $\left(-1, -\frac{1}{4}\right)$

B) $\left(-1, \frac{1}{2}\right)$

C) $\left(1, \frac{1}{4}\right)$

D) $\left(1, \frac{1}{2}\right)$

4

Which system of linear equations has exactly one solution?

A) $x + 3y = 5$
$2x + 6y = 9$

B) $x + 2y = 3$
$2x + 3y = 3$

C) $x + 2y = 3$
$2x + 4y = 5$

D) $x + 2y = 3$
$2x + 4y = 6$

5

The value of y is 5 more than twice the value of x. Which of the following represents y in terms of x ?

A) $y = 2x + 5$

B) $y = 5x + 2$

C) $y = 7x + 2$

D) $y = 7x + 5$

6

$$2dx - 3cx = 2cd - x$$

The given equation relates the real numbers c, d, and x, where $c < 0$ and $d > 0$. Which equation correctly expresses x in terms of c and d ?

A) $x = \frac{3d}{2d - 3c}$

B) $x = \frac{2d + 3c}{1 - c}$

C) $x = \frac{2c + 2}{3d + 2c}$

D) $x = \frac{2cd}{2d - 3c + 1}$

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7

Which expression is equivalent to $p^{\frac{3}{16}}\left(p^{\frac{1}{4}}\right)^{\frac{3}{4}}$,

where $p > 0$?

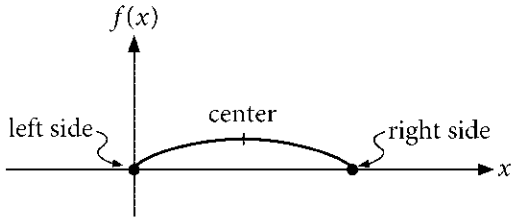
A) $\sqrt[8]{p^3}$

B) $\sqrt[4]{p^3}$

C) $\sqrt[3]{p^2}$

D) $\sqrt{p}$

8



Some football field surfaces in the United States are higher in the center than at the sides, as represented in the figure above, so that water drains from the field. The height difference, $f(x)$, in feet, between the left side and a point x feet from the left side is represented by the function $f(x) = -0.00026(x - 80)^2 + 1.666$. In the xy-plane, which of the following is the best interpretation of $f(40) = 1.25$ in this context?

A) The surface 40 feet from the left side is approximately 1.25 feet higher than the surface at the left side.

B) The surface 40 feet from the left side is approximately 1.25 times as high as the surface at the left side.

C) The surface 40 feet from the left side is approximately 1.25 feet lower than the surface at the left side.

D) The surface 40 feet from the right side is approximately 1.25 times as high as the surface at the left side.

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CONTINUE

9

Which of the following ordered pair (x, y) satisfies the inequality $y > -3x + 2$?

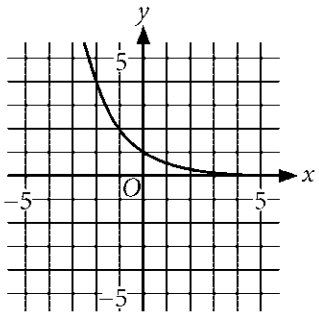
A) $(2, -4)$

B) $(2, 0)$

C) $(0, 2)$

D) $(-3, 1)$

10



What is an equation of the graph shown?

A) $y = 0.5^x$

B) $y = 1^x$

C) $y = 1.5^x$

D) $y = 2^x$

11

$$f(x) = x^5 + ax^4 + bx^3$$
$$g(x) = x^5 + sx^4 + tx^3$$

In the polynomial functions f and g above, a, b, s, and t are constants. If the polynomial $h(x) = f(x) + g(x)$ is divisible by x^4, which of the following must be true?

A) $a = s = 0$

B) $a + s = 0$

C) $b = t = 0$

D) $b + t = 0$

12

Line k is defined by $y = 4x + 1$. Line j is perpendicular to line k in the xy-plane and passes through the point $(1, 1)$. Which equation defines line j ?

A) $y = -\frac{1}{4}x + 1$

B) $y = -\frac{1}{4}x + \frac{5}{4}$

C) $y = \frac{1}{4}x + \frac{3}{4}$

D) $y = \frac{1}{4}x + 1$

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13

The radius of circle A is 3 times the radius of circle B. If the area of circle B is π, what is the area of circle A ?

A) $\frac{1}{9}\pi$

B) $\frac{1}{3}\pi$

C) 3π

D) 9π

14

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$$f(x) = -6.5x + 15$$

The given function f models the temperature, in degrees Celsius, at an altitude of x kilometers (km) in Earth's lower atmosphere. According to the model, what is the decrease in temperature, in degrees Celsius, corresponding to an altitude increase of 1 km?

A) 6.5

B) 8.5

C) 15

D) 21.5

15

Which of the following is equivalent to $\tan(x°)$?

A) $\frac{\sin(90° - x°)}{\cos(90° - x°)}$

B) $\frac{\cos(90° - x°)}{\sin(90° - x°)}$

C) $-\tan(90° - x°)$

D) $\sin(x°) - \cos(x°)$

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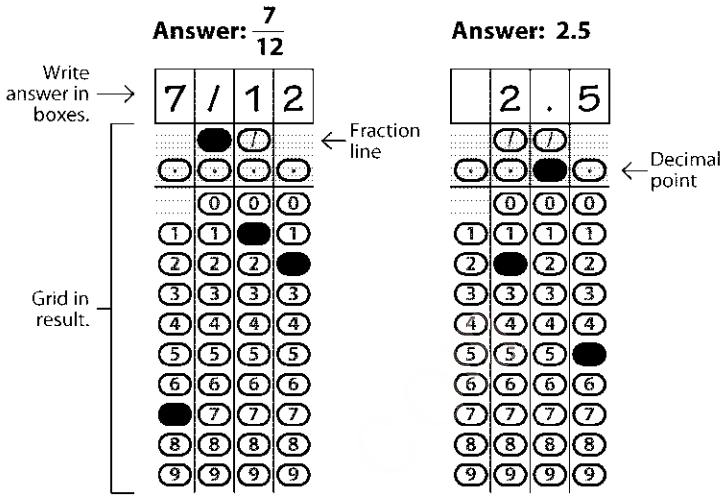
CONTINUE

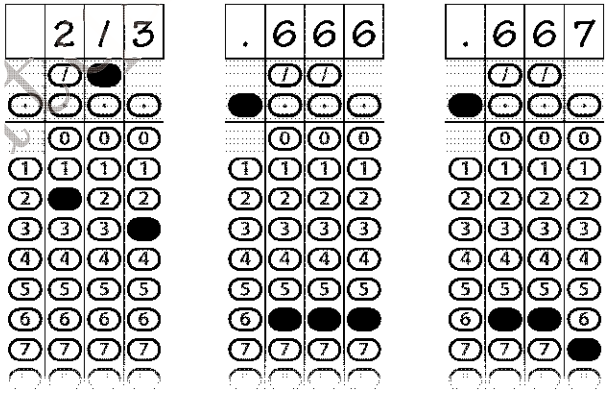
DIRECTIONS

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

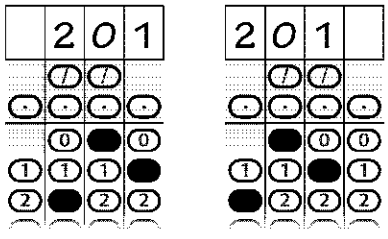
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the bubbles accurately. You will receive credit only if the bubbles are filled in correctly.
2. Mark no more than one bubble in any column.
3. No question has a negative answer.
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 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.



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



Answer: 201 – either position is correct



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

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16

If $\frac{x}{x-2} = 4$, what is the value of x ?

17

If $4(2x + 6) = 48$, what is the value of $3x$?

18

x	$f(x)$
0	7
2	8
5	0

For a function f, the table gives some values of x and their corresponding values of $f(x)$. What is the y-coordinate of the y-intercept of the graph of $y = f(x)$ in the xy-plane?

19

In the xy-plane, what is the x-coordinate of the center of the circle with equation $x^2 - 6x + y^2 + 2y = -1$?

20

$$g(n) = 12{,}000(0.66)^{\frac{n}{12}}$$

The function g above can be used to determine the value, in dollars, of a piece of equipment after n months. If the value of the equipment decreases each year by $x\%$ of its value the preceding year, what is the value of x ?

STOP

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

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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 bubble 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

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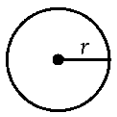
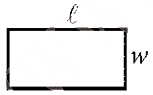
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the domain of a given function f is the set of all real numbers x for which $f(x)$ is a real number.

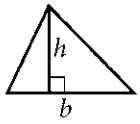
REFERENCE



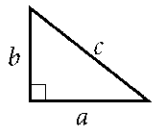
$A = \pi r^2$
$C = 2\pi r$



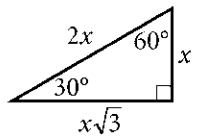
$A = \ell w$

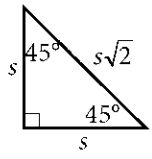


$A = \frac{1}{2}bh$

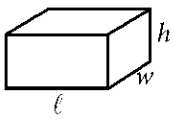


$c^2 = a^2 + b^2$

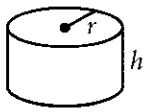




Special Right Triangles

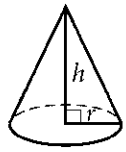


$V = \ell wh$

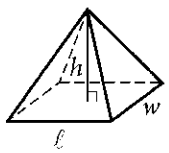


$V = \pi r^2 h$

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



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



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

The number of degrees of arc in a circle is 360.
The number of radians of arc in a circle is 2π.
The sum of the measures in degrees of the angles of a triangle is 180.

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CONTINUE

1

Which expression is equivalent to $6x^4 + 7x^2 + 2$?

A) $x^2(6x + 7) + 2$

B) $x^2(6x^2 + 7x + 2)$

C) $(3x + 2)(2x + 1)$

D) $(3x^2 + 2)(2x^2 + 1)$

2

Angkor Wat in Cambodia is a temple structure covering a land area of 500 acres. The construction of Angkor Wat lasted 37 years. Which of the following values is closest to the average number of acres of construction per year?

A) 12

B) 14

C) 16

D) 18

3

The table shows the areas, in square centimeters, for 4 triangles.

Triangle	Area
W	14
X	30
Y	17
Z	19

What fraction of the triangles have areas less than 20 square centimeters?

A) $\frac{1}{4}$

B) $\frac{2}{4}$

C) $\frac{3}{4}$

D) $\frac{4}{4}$

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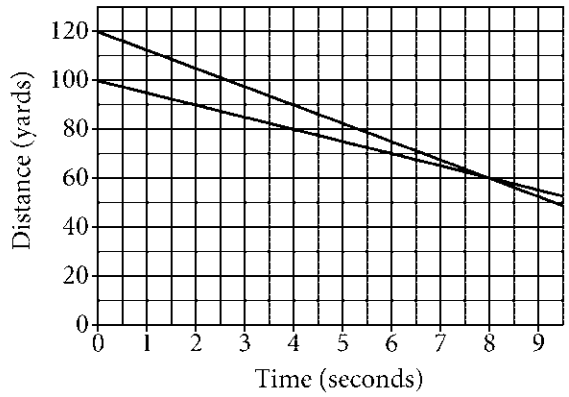
4



A marine biologist tracked the distance of two bottlenose dolphins from an ocean beacon. The graph shows the distance of each dolphin from the beacon after the marine biologist began tracking them. After how many seconds were the dolphins the same distance from the beacon?

A) 2
B) 8
C) 20
D) 60

5

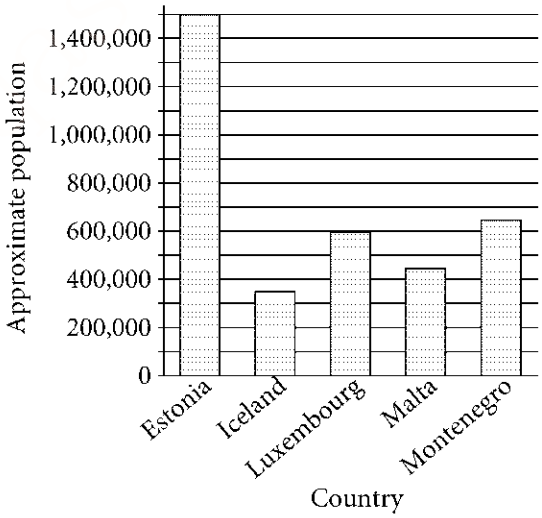
Burning methane produces 891 kilojoules of energy per mole of methane molecules. Which of the following is closest to the number of moles of methane molecules required to produce 5,500 kilojoules of energy from burning?

A) 0.16
B) 6.2
C) 4,600
D) 4,900,000

Questions 6 and 7 refer to the following information.

The table shows the approximate land area, in square kilometers (km^2), of 5 European countries in 2018. The bar graph gives the approximate population of each of these countries in 2018.

Country	Land area (km^2)
Estonia	42,000
Iceland	100,000
Luxembourg	2,600
Malta	350
Montenegro	13,500



6

Which of the following is closest to the land area, in square miles (mi^2), of Malta? (Use $1\ km^2 = 0.39\ mi^2$.)

A) 8.97
B) 136.5
C) 350
D) 897

7

Which of the following statements best compares the mean and the median of the populations for these 5 countries?

A) The mean is greater than the median.

B) The mean is less than the median.

C) The mean is equal to the median.

D) There is not enough information to compare the mean and the median.

8

The equation $5D - R = 40$ gives the relationship between the dew point D, in degrees Celsius (°C), and relative humidity R, as a percent, when the air temperature is 28°C. At that temperature, what is the relative humidity, as a percent, when the dew point is 14°C?

A) 30

B) 42

C) 70

D) 110

9

Five students each combined 500 milliliters (mL) of water with 500 mL of cooking oil and measured the volume of the combination. Their results are shown in the table.

Student	Combined volume (mL)
1	1,000
2	990
3	1,005
4	995
5	1,005

What is the mean, in mL, of the combined volumes listed in the table?

A) 500

B) 999

C) 1,002

D) 1,005

10

A linear model estimates that a cat's weight was 4 ounces when it was born and 76 ounces 150 days after it was born. Which function defines this model where $f(x)$ is the cat's weight, in ounces, x days after it was born, for $0 \leq x \leq 150$?

A) $f(x) = 0.48x$

B) $f(x) = 2.08x$

C) $f(x) = 0.48x + 4$

D) $f(x) = 2.08x + 4$

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CONTINUE

11

The function h is defined by $h(x) = \frac{2}{3}x + 4$. For what value of x does $h(x) = -3$?

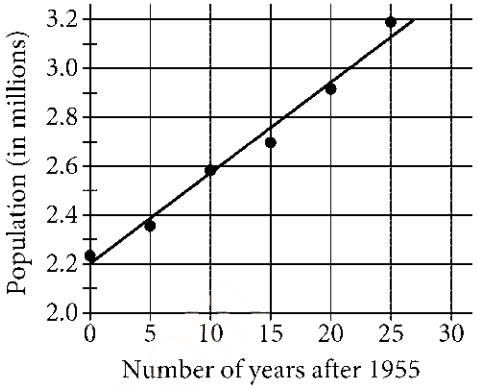
A) $-\frac{14}{3}$

B) $\frac{1}{3}$

C) $-\frac{21}{2}$

D) $\frac{3}{2}$

Questions 12 and 13 refer to the following information.



The scatterplot shows the relationship between the number of years, n, after 1955 and the population of Puerto Rico P, in millions. A line of best fit for the data is also shown.

12

Which of the following is the closest to the predicted population of Puerto Rico, in millions, in 1955?

A) 2.2

B) 2.4

C) 2.6

D) 2.8

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13

Which of the following is closest to the percent increase in Puerto Rico's population from 1965 to 1970?

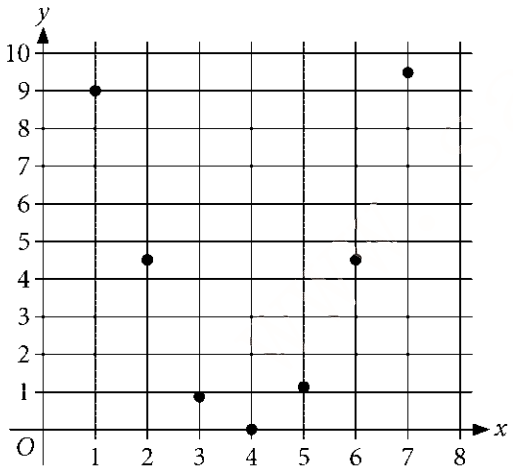
A) 4%

B) 9%

C) 40%

D) 90%

14



The scatterplot shows the relationship between two variables, x and y. Which equation is the most appropriate quadratic model for the data shown?

A) $y = 4x^2$

B) $y = -4x^2$

C) $y = (x - 4)^2$

D) $y = -(x - 4)^2$

15

For a study, a botanist grew seedlings in two separate groups. The ratio of the number of seedlings in group A to the number of seedlings in group B is 1 to 2. If a total of 300 seedlings were used in the study, how many were in group B?

A) 50

B) 100

C) 150

D) 200

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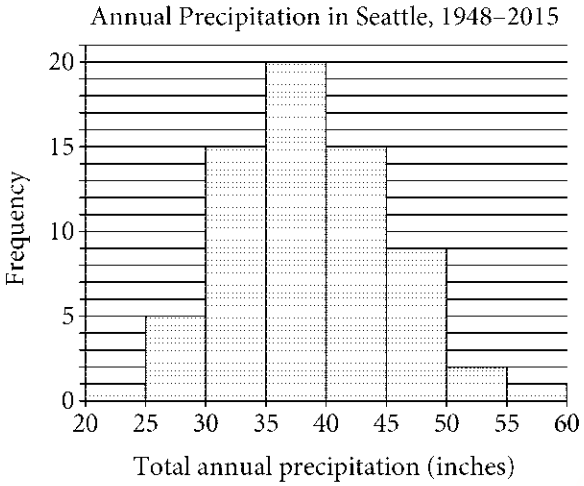
16

The histogram summarizes the distribution of the total annual precipitation, in inches, for the city of Seattle for 68 years. The first bar shows the number of years with total annual precipitation of at least 20 inches but less than 25 inches, the second bar shows the number of years with total annual precipitation of at least 25 inches but less than 30 inches, and so on.



How many years had at least 50 inches of total annual precipitation?

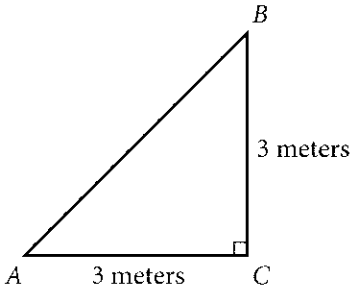
A) 3

B) 9

C) 12

D) 27

17



Which of the following expressions gives the length, in meters, of $\overline{AB}$ for triangle ABC shown?

A) $\sqrt{3+3}$

B) $\sqrt{3^2 \cdot 3^2}$

C) $\sqrt{3^2-3}$

D) $\sqrt{3^2+3^2}$

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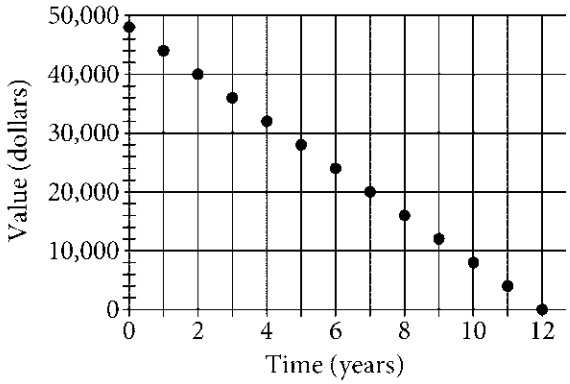
18

The graph shows the predicted value $V(n)$ of a truck, in dollars, with respect to the time n, in years, since the truck was purchased.



Which function best describes the predicted value of the truck, in dollars, as a function of n ?

A) $V(n) = 48{,}000 - 4{,}000n$

B) $V(n) = 48{,}000 - 12{,}000n$

C) $V(n) = 48{,}000n - 12{,}000n$

D) $V(n) = 48{,}000n - 12{,}000$

19

If $5(x - 8) + 3(x - 8) = 80$, what is the value of $x - 8$?

A) 4

B) 6

C) 8

D) 10

20

x is 63% of y. If $x > 0$, which expression represents y in terms of x ?

A) $\frac{10}{63}x$

B) $\frac{100}{63}x$

C) $\frac{37}{10}x$

D) $\frac{37}{100}x$

21

Which of the following linear equations has no solution?

A) $4(x + 2) = 4x + 8$

B) $4(x + 2) = 8x + 4$

C) $4(x + 2) = 4x + 2$

D) $4(x + 2) = 2x + 4$

22

Which quadratic equation has exactly one distinct real solution?

A) $x^2 + 2 = 0$

B) $x^2 + x = 0$

C) $x^2 + x + 1 = 0$

D) $x^2 + 2x + 1 = 0$

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23

The number of employees in Jorge's business can be modeled by the equation $E(t) = 4(1.2)^t$, where t is the number of years since the business opened. Which of the following is the best interpretation of the number 4 in this context?

A) The increase in the number of employees each year

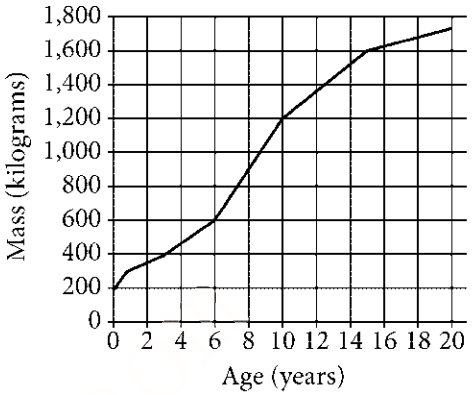
B) The number of years the business has been open

C) The number of employees when the business opened

D) The percent increase in the number of employees each year

24

The graph shows the mass, in kilograms, of an African elephant from birth to age 20 years.



What was the average rate of change in mass, in kilograms per year, of the elephant from age 6 years to age 10 years?

A) 600

B) 450

C) 300

D) 150

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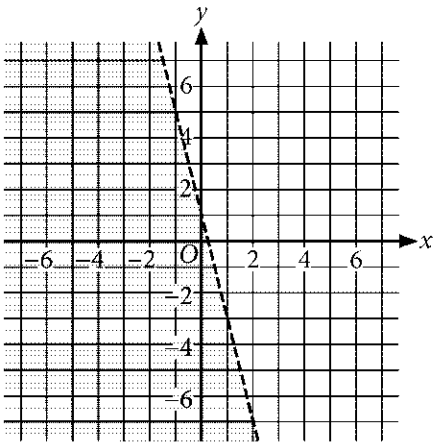
25



The shaded region shown represents the solutions to which inequality?

A) $y < -4x + 1$

B) $y < -\frac{1}{4}x + 1$

C) $y > -4x + 1$

D) $y > -\frac{1}{4}x + 1$

26

x	$f(x)$
0	−1
3	−2
12	−5

Some values of x and their corresponding values of $f(x)$ for the linear function f are shown in the table. What is the value of $f(-6)$?

A) 1

B) 0

C) −1

D) −3

27

Year	Amount spent
2008	$66
2009	$56
2010	$66

The average amount spent, in dollars, by each attendee at a conference from 2008 to 2010 is shown in the table. Which of the following quadratic functions best models the average amount spent $f(x)$, by attendees at the conference from 2008 to 2010, where x is the number of years after 2008?

A) $f(x) = 10(x - 1)^2 - 56$

B) $f(x) = 10(x - 1)^2 + 56$

C) $f(x) = 10(x + 1)^2 - 56$

D) $f(x) = 10(x + 1)^2 + 56$

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CONTINUE

28

A landscape-supply company sells mulch at a rate of $30 per cubic yard. What price does the company charge for 54 cubic feet of mulch? (1 yard = 3 feet)

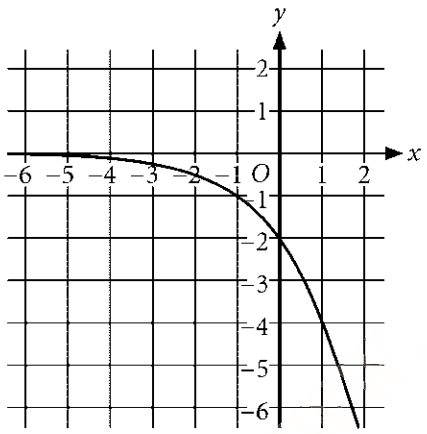
A) $54

B) $60

C) $810

D) $1,620

29



The graph of $y = f(x) - 2$ is shown. Which equation defines function f?

A) $f(x) = -2(2)^x + 2$

B) $f(x) = -2(2)^x + 1$

C) $f(x) = -2^x + 2$

D) $f(x) = -2x + 1$

30

The mean score of a basketball team for its last 8 games was 64.5. If the highest score of these games is removed, the mean score of the remaining games becomes 63. What was the highest score of the last 8 games?

A) 75

B) 71

C) 63

D) 55

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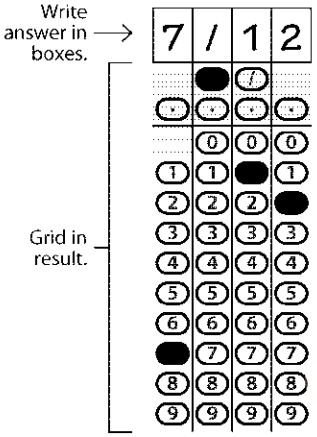
CONTINUE

DIRECTIONS

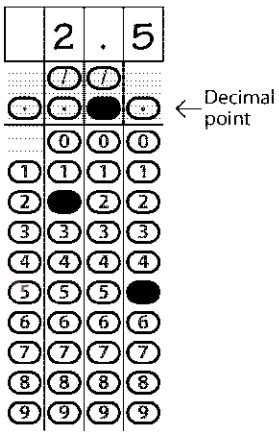
For questions 31-38, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

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 bubbles accurately. You will receive credit only if the bubbles are filled in correctly.
2. Mark no more than one bubble 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 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.

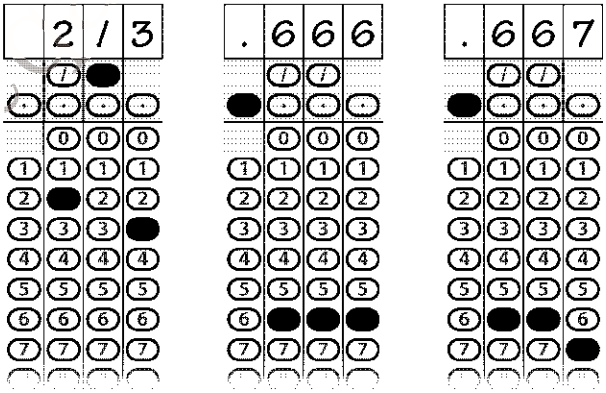
Answer: $\frac{7}{12}$



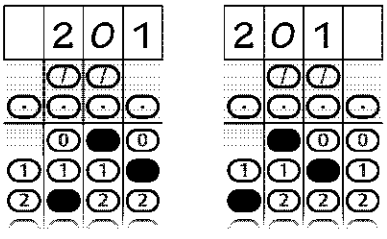
Answer: 2.5



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



Answer: 201 – either position is correct



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

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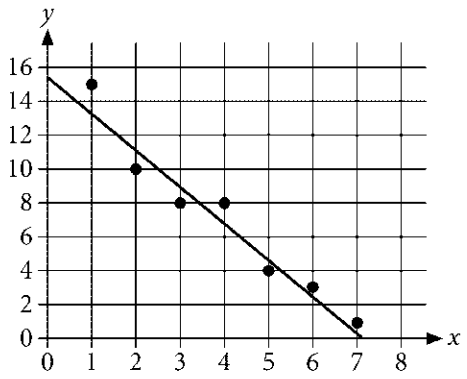
31

28 is p% of 35. What is the value of p ?

32

The scatterplot shows the relationship between two variables, x and y. A line of best fit for the data is also shown.



For how many data points does the line of best fit predict a y-value greater than the y-value of the actual data point?

33

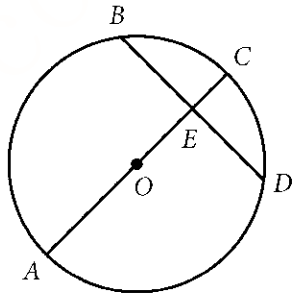
What is the x-coordinate of the x-intercept of the line with equation $\frac{2}{3}x + \frac{1}{3}y = 1$ when it is graphed in the xy-plane?

34

$$x + 9y = 37$$
$$x + y = 5$$

The solution to the given system of equations is (x, y). What is the value of $8y$?

35



Note: Figure not drawn to scale.

In the circle above, point O is the center, and diameter $\overline{AC}$ bisects $\overline{BD}$ at point E. The radius of the circle is 8, and $EC = 1$. If $BE = \sqrt{k}$, what is the value of k ?

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36

An exponential model indicates that 136 thousand humanities degrees were earned in 1975, and this number decreased by 8% each year until 1985. According to the model, when rounded to the nearest thousand, x thousand degrees were earned in 1977. What is the value of x ?

37

$$|m - 5| + 15 = 40$$

What is the sum of the solutions to the given equation?

38

In the xy-plane, the circle with radius 5 and center $(8, 3)$ contains the point $(w, 0)$ What is one possible value of w ?

STOP

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

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