

Wednesday
October 19, 2016

PSAT/NMSQT[®]

Preliminary SAT/National Merit Scholarship Qualifying Test

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1

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2

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Preliminary SAT/National Merit Scholarship Qualifying Test
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Reading Test

60 MINUTES, 47 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 1-9 are based on the following passage.

This passage is adapted from Isabel Allende, *Portrait in Sepia*. ©2001 by HarperCollins Publishers. The setting is Chile during the late nineteenth century.

There was a general consensus in the family that I was “going to come to a bad end.” By then the first woman doctor had graduated in Chile, and others had entered the university. That gave Nivea the idea
 5 that I could do the same, if only to defy the family and society in general, but it was obvious that I didn’t have the least aptitude for studying. Then Severo del Valle appeared with the camera and set it in my lap. It was a beautiful Kodak, precious in the details of
 10 every screw, elegant, smooth, perfect, made for the hands of an artist. I still use it, it never fails. No girl my age had a toy like that. I picked it up with reverence and sat looking at it without any idea how to use it. “Let’s see if you can photograph the dark
 15 shadows in your nightmares,” Severo del Valle said as a joke, never suspecting that that would be my one objective for months, and that in the task of deciphering that nightmare I would end up in love with the world. My grandmother took me to the
 20 Plaza de Armas, to the studio of Don Juan Ribero, the best photographer in Santiago, a curt man as dry as stale bread on the outside, but generous and sentimental inside.

“I’ve brought you my granddaughter to be your
 25 apprentice,” my grandmother said, laying a check on the artist’s desk while I clutched her skirttail with one hand and my brand-new camera in the other.

Don Juan Ribero, who was a half head shorter than my grandmother and half her weight, settled his
 30 eyeglasses on his nose, carefully read the amount written on the check, and then handed it back to her, looking her up and down with infinite scorn.

“The amount isn’t a problem. You set the price,” my grandmother wavered.

“It isn’t a question of price, but of talent, señora,” he replied, guiding Paulina del Valle toward the door.

During that exchange I’d had time to take a quick look around. Ribero’s work covered the walls:
 40 hundreds of portraits of people of all ages. Ribero was the favorite of the upper class, the photographer of the social pages, but the people gazing at me from the walls of his studio were not bigwig conservatives or beautiful debutantes, but
 45 Indians, miners, fishermen, laundresses, poor children, old men, many women like the ones my grandmother helped with her loans from the ladies club. There I saw represented the multifaceted and tormented face of Chile. Those people in the
 50 photographs touched something deep inside me; I wanted to know the story of every one of them. I felt a pressure in my chest, like a closed fist, and an uncontainable desire to cry, but I swallowed my emotion and followed my grandmother out with my
 55 head high. In the carriage she tried to console me: I shouldn’t worry, she said, we would get someone else to teach me to operate the camera, photographers were a dime a dozen; what did that second-rate lowborn think, anyway, talking in that arrogant tone

Test begins on the next page.

60 to her. Paulina del Valle! And she grumbled on and on, but I wasn't listening: I had decided that no one but Juan Ribero would be my teacher. The next day I left the house before my grandmother was up. I told the coachman to take me to the studio and
 65 planted myself in the street, prepared to wait forever. Don Juan Ribero showed up about eleven, found me at his door, and ordered me to go home. I was shy then—I still am—and very proud; I wasn't used to asking for anything because from the time I was born
 70 I was coddled like a queen, but my determination must have been very strong. I didn't move from the door. A couple of hours later, the photographer came out, threw me a furious glance, and started walking down the street. When he came back from his lunch,
 75 he found me still there with my camera clutched to my chest. "All right," he muttered, defeated, "but I warn you, little girl, that I won't give you any special consideration. Here you come to obey without talking back and to learn quickly, is that clear?" I
 80 nodded silently because my voice was stuck in my throat.

1 How did Paulina del Valle expect to persuade Don Juan Ribero to take on her granddaughter as an apprentice?

- A) By paying him generously
- B) By flattering him
- C) By appealing to his sympathy
- D) By supporting his social ambitions

2

The passage describes an important distinction between

- A) Paulina del Valle's behavior toward her relatives and her behavior toward those who are poor.
- B) Paulina del Valle's benevolence and Severo del Valle's benevolence.
- C) Don Juan Ribero's polite behavior and his rebellious feelings.
- D) Don Juan Ribero's professional activities and his preferred projects.

3

Which choice best supports the idea that Paulina del Valle feels that she is entitled to special treatment?

- A) Lines 24-25 ("I've . . . apprentice")
- B) Lines 56-60 ("we would . . . del Valle")
- C) Lines 60-61 ("And she . . . listening")
- D) Lines 62-65 ("The next . . . forever")

4

In the first paragraph, the narrator emphasizes the contrast between

- A) the benefits of a life of wealth and privilege and the rewards of determination and hard work.
- B) her earnest attitude and Severo del Valle's playful tone.
- C) the family's overwhelming preoccupation with materialism and her focus on art and beauty.
- D) her attempts to assert her own independence and the grandmother's authoritarian control over the family.

5

Lines 28-37 ("Don . . . door") primarily serve to

- A) portray the grandmother's response to a rejection.
- B) reveal Don Juan Ribero's personality through his behavior.
- C) point out Don Juan Ribero's changeable nature.
- D) emphasize the serious nature of a setback for Don Juan Ribero.

6

As used in line 33, "set" most nearly means

- A) post.
- B) apply.
- C) determine.
- D) waive.

7

As used in line 38, "exchange" most nearly means

- A) trade.
- B) difference.
- C) conversation.
- D) barter.

8

Which statement about Don Juan Ribero helps explain why he changes his mind about teaching the girl?

- A) He is desperate to continue working.
- B) He is not as unkind as he appears.
- C) He realizes he has much to lose otherwise.
- D) He recognizes the girl's talent.

9

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

- A) Lines 19-23 ("My . . . inside")
- B) Lines 41-48 ("Ribero . . . club")
- C) Lines 72-74 ("A couple . . . street")
- D) Lines 78-79 ("Here . . . clear")

Questions 10-18 are based on the following passage and supplementary material.

This passage is adapted from Peter W. Huber and Mark P. Mills, *The Bottomless Well*. ©2005 by Peter W. Huber and Mark P. Mills.

Though he was prepared to go quite a bit deeper when he turned on his steam-powered drill in Crawford County, Pennsylvania, in 1859,

Line Colonel Edwin Drake struck oil at 69 feet. The first
5 "deep water" oil wells stood in 100 feet of water in 1954. Today, they reach through 10,000 feet of water, 20,000 feet of vertical rock, and another 30,000 feet of horizontal rock.

Yet over the long term, the price of oil has held
10 remarkably steady. Ten-mile oil costs less than 69-foot oil did, and about the same as one-mile oil did two decades ago. Production costs in the hostile waters of the Statford oil field of the North Sea are not very different from costs at the historic
15 Spindletop fields of southeast Texas a century ago.

MC There have been price spikes and sags, but they have been tied to political and regulatory instabilities, not discovery and extraction costs. This record is all the more remarkable when one considers that the
20 amount of oil extracted has risen year after year. Cumulative production from U.S. wells alone has surpassed a hundred billion barrels. The historical trends defy all intuition.

It is easy enough to thank human ingenuity for
25 the relatively steady price of a finite and dwindling resource and leave it at that. But there is a second part to this story: it is energy itself that begets more energy. Electrically powered robots pursue new supplies of oil at the bottom of the ocean. Electricity
30 purifies and dopes the silicon that becomes the photovoltaic cell that generates more electricity. Lasers enrich uranium that generates more electricity that powers more lasers. Power pursues the energy that produces the power.

GA 35 "Energy supply" is determined not by "what's out there" but by how good we are at finding and extracting it. What is scarce is not raw energy but the drive and the logic that is able to locate, purify, and channel it to our own ends—the creation of still

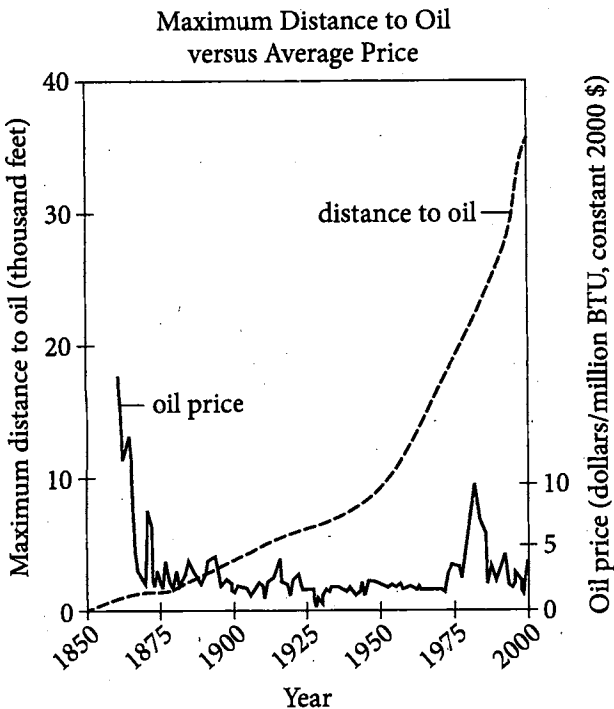
40 more logic paramount among them. For the first two centuries of industrial history, the powered technologies used to find and extract fuels improved faster than the horizon of supply receded. Hence our blue-whale¹ energy economy. End users consume
45 increasingly compact and intense forms of high-grade power, relying on suppliers to pursue and capture increasingly distant, dispersed, and dilute
ME NE sources of raw fuel. The gap is forever widening, as the history of oil extraction reveals, but that doesn't
50 stop us—the more energy we consume, the more we capture. It's a chain reaction, and it spirals up, not down. It is, if you will, a perpetual motion machine.

The machine is running faster today than ever before, but it has been running for quite some time.
55 Four billion years ago, life on Earth captured no solar energy at all, because there was no life. Life then got a foothold, and the capture and consumption of energy in the biosphere has been rising ever since. The thicker life grew on the surface of the planet, the
60 more energy the biosphere managed to capture. And it used all that energy to create more life.

Living green plants still capture today's solar energy about six times faster than we humans are able to dig up yesterday's solar energy preserved in
65 fossil fuels, but we'll overtake the rest of nature in due course. Perhaps someday we'll get to the point where we, too, can capture our energy directly from the sun. There's plenty of sunlight to spare—green plants currently capture only about one
70 three-thousandth of the golden cascade of solar power that reaches the Earth's surface.

But whether we catch our solar energy live, dig it up in fossilized form, or mine uranium instead is really just a detail. The one certainty is that we will
75 extract more energy from our environment, not less. Everything we think we know about "running out of energy" isn't just muddled and wrong; it's the exact opposite of the truth. The more energy we capture and put to use, the more readily we will capture
80 still more.

¹ A reference to the suggestion that a modern American uses about as much energy as a blue whale does



Adapted from WTRG Economics; EIA, *Annual Energy Review*. ©2003 by ExxonMobil; J. Ray McDermott Inc.

10

In the passage, the authors claim that the amount of energy available for human use is chiefly dependent on the

- A) desire of end users to conserve power wherever possible.
- B) ability to discover and draw from more sources of supply.
- C) success of new uranium enrichment technologies.
- D) future collection of solar energy directly from the sun.

11

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

- A) Lines 32-33 (“Lasers . . . more lasers”)
- B) Lines 35-37 (“Energy . . . it”)
- C) Lines 55-56 (“Four . . . no life”)
- D) Lines 66-68 (“Perhaps . . . sun”)

12

According to the passage, the relationship between energy extraction and use by humans is best characterized as

- A) taxed by excessive demand.
- B) self-propagating and propulsive.
- C) driven by political dissension.
- D) existing in competition with natural processes.

13

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

- A) Lines 24-26 (“It is . . . that”)
- B) Lines 37-39 (“What . . . ends”)
- C) Lines 51-52 (“It’s a . . . machine”)
- D) Lines 62-65 (“Living . . . fuels”)

14

As used in line 17, “tied to” most nearly means

- A) united with.
- B) connected to.
- C) bound by.
- D) equivalent to.

15

The details in lines 28-33 (“Electrically . . . lasers”) serve mainly to

- A) support a claim.
- B) complete a comparison.
- C) sketch a narrative.
- D) suggest a paradox.

16

As used in line 46, “pursue” most nearly means

- A) seek.
- B) chase.
- C) engage in.
- D) proceed with.

17

In the passage, the “gap” (line 48) refers to the disparity between the increasing

- A) distance of energy sources from Earth’s surface and the decreasing quality of high-grade power obtainable from them.
- B) concern over the environmental risks of extraction and the decreasing attention to the actual impact of current extraction methods.
- C) awareness of the history of extraction and the decreasing concern about likely future developments.
- D) concentration of energy as it is used and the decreasing concentration of supplies of unextracted energy.

18

According to the graph, the maximum distance to oil first reached 25,000 feet during which span of years?

- A) 1875–1900
- B) 1925–1950
- C) 1950–1975
- D) 1975–2000

Questions 19-28 are based on the following passage and supplementary material.

This passage is adapted from Lee Alan Dugatkin, *Principles of Animal Behavior*. ©2009 by W. W. Norton & Company, Inc.

In systems in which predators hone in on sounds made by their prey, one of the simplest things that an animal can do to avoid such predators is to be quiet.

Line With this in mind, Luke Ramage-Healey and his
5 colleagues examined the role of sound suppression in the antipredator repertoire of the Gulf toadfish.

Gulf toadfish are a major food staple of adult
bottlenose dolphins, making up 13 percent of the
dolphin's diet. Prior work had shown that dolphins
10 orient toward the "boatwhistle" sound produced by male toadfish during breeding season. That is, dolphins are eavesdropping on the sounds produced by toadfish to better orient toward their prey. Once a toadfish is located by eavesdropping, the dolphin
15 locks onto this prey and tracks it. Given this, the question Ramage-Healey and his colleagues addressed was whether the toadfish respond in kind, listening for sounds associated with bottlenose foraging behavior, and then reducing the boatwhistle
20 sounds they produce.

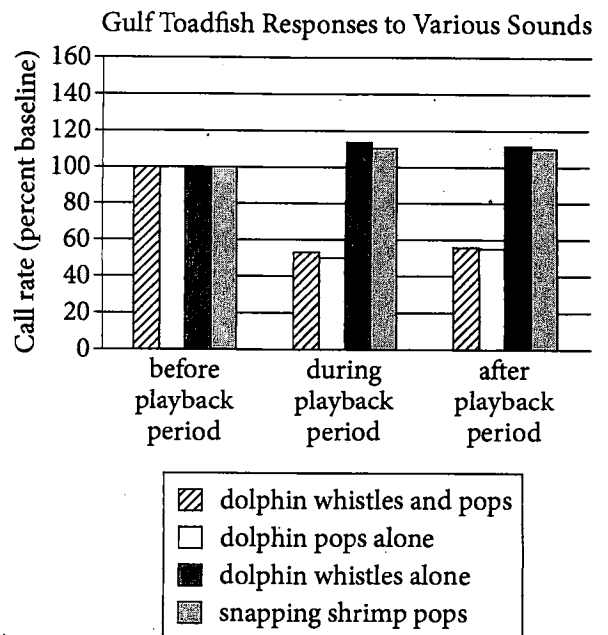
Bottlenose dolphins produce a variety of different sounds, ranging from high-frequency whistles used in dolphin-to-dolphin social communication (not foraging), as well as two sounds that are particularly
25 associated with foraging—"clicks" and low-frequency "pops." The pops are easiest for toadfish to hear, since this species hears most accurately in the low-frequency range, and so Ramage-Healey and his team focused on these dolphin sounds.

30 The researchers captured toadfish during the breeding season, and they kept individual males in tanks until the breeding season ended. The males soon began to emit boatwhistle sounds, presumably to attract females. At that point, toadfish males were
35 exposed to one of three sounds—the pops associated with dolphin foraging, the high-frequency whistles produced during dolphin social communication, and, as a control, the "snapping" sounds made by snapping shrimp. All sounds were broadcast using
40 underwater speakers, and the activity of toadfish was recorded for the five minutes before sounds were emitted, the five minutes during which the experimental sounds were broadcast, and the five minutes after the sounds were played.

45 Ramage-Healey found clear evidence of antipredator responses when the toadfish heard pop sounds. No differences were found in call rate between males before exposure to the experimental sounds. (See graph.) Males exposed to pop sounds,
50 however, reduced their call rates by 50 percent. In addition, males exposed to the pop sounds maintained their reduced calling rate for the five minutes following exposure to pops—that is, they eavesdropped on their predators and reduced
55 their activity in a way that made capture by a dolphin less likely. Males in the other treatments showed no changes in boatwhistle call rate when they heard the recorded sounds.

Ramage-Healey and his team followed up their
60 behavioral work on call rates and exposure to predators with a hormonal analysis that examined whether dolphin pops produce a stress response in the toadfish. After experimentally exposing the male toadfish to pops or snapping shrimp sounds, the
65 researchers drew blood from the males, and they measured their cortisol¹ levels. Males exposed to pops not only responded to the pops by reducing their own boatwhistle call, but they also showed higher levels of cortisol than males exposed to the
70 sound of snapping shrimp.

¹ A hormone produced in response to stress



19

The author mentions that toadfish are “13 percent of the dolphin’s diet” (lines 8-9), most likely to

- A) eliminate an irrelevant factor from consideration.
- B) suggest that an ambitious project is unlikely to succeed.
- C) explain a problem by way of analogy.
- D) clarify the reasoning behind a choice.

20

As used in line 15, “tracks” most nearly means

- A) marks.
- B) follows.
- C) observes.
- D) carries.

21

The passage indicates that the researchers chose dolphin pops to broadcast primarily because

- A) other dolphin foraging sounds are more difficult for male toadfish to hear.
- B) dolphin pops would be audible over the toadfish boatwhistles.
- C) dolphin pops bear a close resemblance to sounds made by snapping shrimp.
- D) toadfish call rates would remain relatively consistent in response to dolphin pops.

22

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

- A) Lines 26-28 (“The pops . . . range”)
- B) Lines 34-35 (“toadfish . . . three sounds”)
- C) Lines 51-53 (“males exposed . . . pops”)
- D) Lines 56-58 (“Males in . . . recorded sounds”)

23

The main purpose of the fifth paragraph (lines 45-58) is to

- A) summarize findings.
- B) evaluate a claim.
- C) revise an initial hypothesis.
- D) explain unanticipated consequences.

24

As used in line 62, “produce” most nearly means

- A) spread.
- B) compose.
- C) cause.
- D) offer.

25

The passage most strongly suggests that exposure to dolphin pops causes male toadfish to

- A) reduce their foraging behavior.
- B) emit only high-frequency sounds.
- C) shift their direction away from the pop sounds.
- D) undergo a hormonal stress response.

26

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

- A) Lines 45-47 (“Remage-Healey . . . sounds”)
- B) Lines 49-50 (“Males . . . percent”)
- C) Lines 59-63 (“Remage-Healey . . . toadfish”)
- D) Lines 66-70 (“Males exposed . . . shrimp”)

27

According to the graph, which of the following had the greatest effect on the call rates of Gulf toadfish?

- A) The length of the playback period
- B) Snapping shrimp pop sounds
- C) Dolphin pop sounds alone
- D) Dolphin whistle sounds alone

28

In the graph, the four bars showing the lowest call rates primarily support Remage-Healey's conclusion that

- A) bottlenose dolphins mimic boatwhistle sounds to improve foraging.
- B) male toadfish inhibit their boatwhistle sounds for self-protection.
- C) dolphin foraging behavior has a direct effect on toadfish reproduction.
- D) male toadfish vocalize less after playback than they do during playback.

Questions 29-38 are based on the following passage.

This passage is adapted from Gifford Pinchot, *The Fight for Conservation*. Originally published in 1910. Pinchot was a US politician and forest conservationist.

No man may rightly fail to take a great pride in what has been accomplished by means of the destruction of our natural resources so far as it has gone. It is a paradoxical statement, perhaps, but nevertheless true, because out of this attack on what nature has given we have won a kind of prosperity and a kind of civilization and a kind of man that are new in the world. For example, nothing like the rapidity of the destruction of American forests has ever been known in forest history, and nothing like the efficiency and vigor and inventiveness of the American lumberman has ever been developed by any attack on any forests elsewhere. Probably the most effective tool that the human mind and hand have ever made is the American axe. So the American business man has grasped his opportunities and used them and developed them and invented about them, thought them into lines of success, and thus has developed into a new business man, with a vigor and effectiveness and a cutting-edge that has never been equaled anywhere else. We have gained out of the vast destruction of our natural resources a degree of vigor and power and efficiency of which every man of us ought to be proud.

Now that is done. We have accomplished these big things. What is the next step? Shall we go on in the same lines to the certain destruction of the prosperity which we have created, or shall we take the obvious lesson of all human history, turn our backs on the uncivilized point of view, and adopt toward our natural resources the average prudence and average foresight and average care that we long ago adopted as a rule of our daily life?

The conservation movement is calling the attention of the American people to the fact that they are trustees. The fact seems to me so plain as to require only a statement of it, to carry conviction. Can we reasonably fail to recognize the obligation which rests upon us in this matter? And, if we do fail to recognize it, can we reasonably expect even a fairly good reputation at the hands of our descendants?

Business prudence and business common-sense indicate as strongly as anything can the absolute necessity of a change in point of view on the part of

the people of the United States regarding their natural resources. The way we have been handling them is not good business. Purely on the side of dollars and cents, it is not good business to kill the goose that lays the golden egg, to burn up half our forests, to waste our coal, and to remove from under the feet of those who are coming after us the opportunity for equal happiness with ourselves. The thing we ought to leave to them is not merely an opportunity for equal happiness and equal prosperity, but for a vastly increased fund of both.

Conservation is not merely a question of business, but a question of a vastly higher duty. In dealing with our natural resources we have come to a place at last where every consideration of patriotism, every consideration of love of country, of gratitude for things that the land and the institutions of this Nation have given us, call upon us for a return. If we owe anything to the United States, if this country has been good to us, if it has given us our prosperity, our education, and our chance of happiness, then there is a duty resting upon us. That duty is to see, so far as in us lies, that those who are coming after us shall have the same opportunity for happiness we have had ourselves. Apart from any business consideration, apart from the question of the immediate dollar, this problem of the future wealth and happiness and prosperity of the people of the United States has a right to our attention.

29

The author's central claim in the passage is that

- A) future generations' success matters more than the continued prosperity of today's generation.
- B) businesses are learning to regulate their environmental impact.
- C) conservation is necessary to ensure a prosperous future.
- D) America had to use natural resources at an elevated rate to gain its current wealth.

30

Over the course of the passage, the main focus shifts from

- A) condemnation of the destruction that has taken place in the name of progress to discussion of the role of business in that destruction.
- B) acknowledgment of the benefits America has enjoyed by depleting natural resources to a call to use those resources more wisely.
- C) analysis of the damage done to America's forests to proposal of a practice to reverse that damage.
- D) appealing to people's sense of duty to conserve resources to examining the dangers of failing to conserve.

31

The author characterizes environmental conservation primarily as a

- A) responsible form of civic engagement.
- B) practical means of increasing economic productivity.
- C) belated attempt to address an ongoing crisis.
- D) controversial approach to a sensitive issue.

32

The questions in lines 27-42 ("What . . . descendants") mainly serve to

- A) illustrate the author's feelings of uncertainty.
- B) suggest the complexity of the choices to be made.
- C) underscore the necessity of the approach the author advocates.
- D) encourage the reader to weigh different options.

33

Repetition of the word “average” in lines 32-33 emphasizes the author’s point by suggesting that

- A) the efforts needed to bring about desired changes would not be extraordinary.
- B) all eras have similar experiences of initially controversial reforms.
- C) new strategies would rapidly become standard practice.
- D) unpopular policies should be clarified for the general public.

34

One financial justification that the author offers for greater conservation is that businesses will

- A) be able to operate more cost-effectively.
- B) become more adept at problem solving.
- C) avoid costly environmental regulations.
- D) have continued availability of natural resources.

35

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

- A) Lines 15-22 (“So the . . . else”)
- B) Lines 47-48 (“The way . . . business”)
- C) Lines 48-53 (“Purely . . . ourselves”)
- D) Lines 54-56 (“The thing . . . both”)

36

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

- A) responsibility.
- B) assignment.
- C) tax.
- D) promise.

37

Based on the passage, the author would most likely agree with which of the following statements?

- A) Government policies can be more effectively framed and implemented if public opinion is consulted only sparingly.
- B) Future generations have a right to enjoy the same advantages that previous generations have enjoyed.
- C) Political leaders should prioritize citizens' happiness over the enduring health of the economy.
- D) Voluntary actions on the part of businesses achieve conservation more effectively than government regulation does.

38

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

- A) Lines 27-34 ("Shall . . . life")
- B) Lines 57-58 ("Conservation . . . duty")
- C) Lines 58-63 ("In dealing . . . return")
- D) Lines 67-74 ("That . . . attention")

Questions 39-47 are based on the following passages.

Passage 1 is adapted from Edwin Hubble, *The Realm of the Nebulae*. ©1982 by Yale University Press. Originally published in 1936. Passage 2 is adapted from Gary Taubes, "Beyond the Soapsuds Universe." ©1997 by Kalmbach Publishing Co. Throughout Passage 1, Hubble refers to galaxies as "stellar systems" and our galaxy, the Milky Way, as "the stellar system."

Passage 1

The sun is a star among the many millions which form the stellar system. The stellar system is a swarm of stars isolated in space. It drifts through the universe as a swarm of bees drifts through the summer air. From our position somewhere within the system, we look out through the swarm of stars, past the borders, into the universe beyond.

The universe is empty, for the most part, but here and there, separated by immense intervals, we find other stellar systems, comparable with our own. They are so remote that, except in the nearest systems, we do not see the individual stars of which they are composed. These huge stellar systems appear as dim patches of light. Long ago they were named "nebulae" or "clouds"—mysterious bodies whose nature was a favorite subject for speculation.

But now, thanks to great telescopes, we know something of their nature, something of their real size and brightness, and their mere appearance indicates the general order of their distances. They are scattered through space as far as telescopes can penetrate. We see a few that appear large and bright. These are the nearer nebulae. Then we find them smaller and fainter, in constantly increasing numbers, and we know that we are reaching out into space, farther and ever farther, until, with the faintest nebulae that can be detected with the greatest telescope, we arrive at the frontiers of the known universe.

This last horizon defines the observable region of space. It is a vast sphere, perhaps a thousand million light-years in diameter. Throughout the sphere are scattered a hundred million nebulae—stellar systems—in various stages of their evolutionary history. The nebulae are distributed singly, in groups, and occasionally in great clusters, but when large volumes of space are compared, the tendency to cluster averages out. To the very limits of the telescope, the large-scale distribution of nebulae is approximately uniform.

Passage 2

Margaret Geller first met the stickman in the fall of 1986. While the exact date has faded from her recollection, she remembers the time as midafternoon and her reaction as a kind of euphoria. No one had ever seen the stickman before—at least, not really. Valérie de Lapparent noticed it but says she was too inexperienced to understand its implication. John Huchra says he took one look at the stickman and assumed he had botched his observations. It took Geller's eye to recognize the stickman as something real and important.

Geller, Huchra, and de Lapparent had mapped the nearby universe, taking several months to carefully measure the distance to 1,000 galaxies, some as near as 30 million light-years away, others as far as 650 million. De Lapparent had fed the distance and positions of those galaxies into a computer program that printed out a two-dimensional representation of their three-dimensional distribution in the universe. On the printout was this slice of the northern sky, sprinkled with 1,000 distant galaxies, and smack in the middle, says Geller, was this remarkable stickman figure. The distribution of galaxies looked like a child's drawing of a somewhat bowlegged person. It's a whimsical name for a grand figure: the stickman extended 500 million light-years across the universe. Its torso was composed of hundreds of galaxies, a massive congregation known to astronomers as the Coma cluster. Its arms were two more sheets of galaxies streaming across the night sky.

The stickman was grand not just in dimension but in destiny. You might even say it changed our understanding of the universe. Until the stickman, the universe appeared to be a smooth and homogeneous place. Astronomers believed that galaxies were distributed at random, although they might occasionally form clusters like Coma containing as many as a thousand or so galaxies like the Milky Way. There was even some evidence that the universe contained at least one enormous void, in the constellation Boötes, which seemed to extend for some 200 million light-years—and other suggestions that galaxies could be found strung out on long filaments. But in 1985 most astronomers assumed these structures were products not of the universe itself but of the methods used to survey it.

Then Geller saw the stickman, which constituted compelling evidence that galaxies were congregating on two-dimensional structures, as though they had condensed out of the cosmic nothingness on the surfaces of invisible bubbles.

39

Passage 1 indicates that Earth's sky is filled with stars because the Sun is located

- A) within a system containing millions of stars.
- B) in the space between stellar systems.
- C) on the edge of a vast system of nebulae.
- D) at the frontiers of the observable universe.

40

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

- A) movement.
- B) probability.
- C) spread.
- D) extension.

41

In Passage 2, the author characterizes Geller as someone who

- A) questioned her own ability to make accurate observations.
- B) knew her research had uncovered something of significance.
- C) had long believed an existing scientific model was flawed.
- D) lacked the experience needed to recognize a pattern in her data.

42

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

- A) luxurious.
- B) tasteful.
- C) gallant.
- D) imposing.

43

Passage 2 most strongly suggests that prior to the discovery of the stickman, most astronomers believed that galaxies

- A) were scattered haphazardly throughout space.
- B) existed mostly along two-dimensional structures.
- C) were usually found in enormous clusters.
- D) were separated by numerous, vast regions of empty space.

44

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

- A) Lines 52-53 (“Geller . . . universe”)
- B) Lines 60-63 (“On the . . . figure”)
- C) Lines 75-79 (“Astronomers . . . Milky Way”)
- D) Lines 87-91 (“Then . . . bubbles”)

45

Which choice best states the relationship between the two passages?

- A) Passage 2 supports a controversial point of view stated in Passage 1.
- B) Passage 2 suggests practical benefits of a breakthrough described in Passage 1.
- C) Passage 2 describes a discovery that was not anticipated in Passage 1.
- D) Passage 2 proposes an experiment that could confirm a hypothesis offered in Passage 1.

46

In which lines does the author of Passage 2 most directly acknowledge the view of nebula arrangement asserted by the author of Passage 1?

- A) Lines 52-56 (“Geller . . . 650 million”)
- B) Lines 63-64 (“The distribution . . . person”)
- C) Lines 73-75 (“Until . . . place”)
- D) Lines 84-86 (“But in . . . it”)

47

Based on the passages, it can reasonably be concluded that before 1985, the universe was thought to

- A) consist of nearby galaxies.
- B) lack large-scale structure.
- C) extend a short distance past the Milky Way.
- D) have a limit beyond which no galaxies existed.

STOP

If you finish before time is called, you may check your work on this section only.

Do not turn to any other section.

No Test Material On This Page

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.

Portraits by Cameron

A woman emerges from a dark background, half in shadow. She wears a curious expression that, while it doesn't register happiness, doesn't entertain sadness either. She regards the viewer frankly, much as a viewer might regard her. This photograph, displayed at the Metropolitan Museum of Art in New York City, was taken in 1867, **1** so it feels immediate, as if its subject were staring back at the viewer in the present moment. It

- 1
- A) NO CHANGE
 - B) while
 - C) although
 - D) since

is the work of photographer Julia Margaret Cameron, who is sometimes thought of as a painter who used a camera as her canvas. **2**

Cameron began taking pictures at the advent of photography. Whereas Victorian society was fascinated by the camera's ability to document detail without ornament, Cameron **3** encompassed artifice, carefully choosing her subjects and controlling each sitting to express her own unconventional, sometimes whimsical, sense of the world. She socialized with the luminaries of her time: painters, writers, and **4** scientists. Many of whom sat for her camera in her Isle of Wight studio, where she created some of the era's most iconic portraits. In addition to portraits, Cameron produced a series of **5** highly theatrical, stylized, sepia-toned photographs known as tableaux, which often starred members of her family as allegorical figures meant to depict a character trait or an emotion.

2

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

Although Cameron was born in India, for much of her adult life she lived and worked in the Isle of Wight village of Freshwater, which was then and still remains a popular seaside tourist destination.

Should the writer make this addition here?

- A) Yes, because it helps explain why Cameron's studio attracted many well-known people.
- B) Yes, because it foreshadows the discussion of Cameron setting up allegorical tableaux.
- C) No, because it doesn't mention that her studio was on the Isle of Wight.
- D) No, because it introduces a loosely related fact about Cameron, not about her photography.

3

- A) NO CHANGE
- B) enveloped
- C) embraced
- D) embellished

4

- A) NO CHANGE
- B) scientists, many
- C) scientists, but many
- D) scientists: many

5

- A) NO CHANGE
- B) highly theatrical, stylized, sepia-toned, photographs,
- C) highly, theatrical, stylized sepia-toned photographs
- D) highly theatrical, stylized sepia-toned, photographs

6 Cameron was somewhat famous. Of an 1864 exhibit, *Photographic Journal* wrote, "In these pictures all that is good in photography has been neglected, and the shortcomings of the art are prominently exhibited." This may seem like potent criticism, but Cameron herself might well have approved. 7 For instance, she endeavored to highlight her medium's limitations and to turn them into virtues. 8 She manipulated light so that it might fall on only half a face. Her manipulation of light revealed the shadows beneath the eyes. She used a chemical process to develop her film that resulted in

6

Which sentence best introduces this paragraph?

- A) NO CHANGE
- B) Cameron developed an interesting signature style her family didn't like.
- C) In her own time, Cameron's photographs were roundly criticized.
- D) Cameras in Cameron's time produced very different images from those produced by today's digital cameras.

7

A) NO CHANGE

- B) Besides,
- C) In fact,
- D) Therefore,

8

Which choice most effectively combines the underlined sentences?

- A) Her way of manipulating light was that it might fall on only half a face; this would reveal the shadows beneath the eyes.
- B) She manipulated light in such a way that this manipulation might cause the light to fall on only half a face; that would reveal the shadows beneath the eyes.
- C) Manipulating light so that it might fall on only half a face, she was revealing the shadows beneath the eyes.
- D) She manipulated light so that it might fall on only half a face, revealing the shadows beneath the eyes.

many blemishes— **9** imperfections she actively sought out. Leaving the lens open longer caused a slight blur as her subjects squirmed. **10** Apart from the affect on the portraits (she said the blur was like capturing breath), Cameron’s unorthodox manipulations challenged expectations for what photography could be.

These choices and others resulted in pictures that fall outside of the paradigm of photography as a documentary format. Photographers who came later have appreciated what Cameron’s contemporaries could not: the camera can turn away from the material world and its literalism **11** being an artistic interpretation of life.

9

Which choice provides information about Cameron that is most in keeping with what the passage has already said about her?

- A) NO CHANGE
- B) that’s one reason her family wasn’t interested in helping with her hobby.
- C) which is why no one knew who she was until recently.
- D) which she cleaned up before displaying the portrait.

10

- A) NO CHANGE
- B) A part from the affect
- C) Apart from the effect
- D) A part from the effect

11

- A) NO CHANGE
- B) toward
- C) from
- D) beside

Questions 12 -22 are based on the following passage.

Speaking in Public

[1] They speak to millions every day. [2] Their turns of phrase and tones of voice [12] were widely imitated. [3] Yet their names and faces generally remain unknown. [4] They are the men and women who provide recorded public address announcements for the world's many transit systems. [5] It might seem as if almost anyone could do their job. [6] But make no mistake: most transit announcers are highly trained voice-over artists. [7] After all, how much skill does it take to announce "Next stop: Forty-Second Street, Times Square"? [13]

Cities generally [14] adhere to a hesitant pace when selecting announcers for their transit systems. Some take a scientific [15] approach, consulting carefully screened focus groups to help them decide which voice best suits their population. [16] Selection committees are typically looking for a voice that strikes a certain balance—one that sounds authoritative enough to inspire passengers' trust and obedience but friendly enough to make

12

- A) NO CHANGE
- B) are
- C) had been
- D) will have been

13

To make this paragraph most logical, sentence 7 should be placed

- A) where it is now.
- B) after sentence 1.
- C) after sentence 4.
- D) after sentence 5.

14

- A) NO CHANGE
- B) exercise great care in
- C) take their sweet time when
- D) act with the utmost gravity in

15

- A) NO CHANGE
- B) approach; consulting
- C) approach, they consult
- D) approach; and consult

16

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

- A) The scientific approach has its merits but is not always the best method to employ.
- B) Others hold open auditions and invite feedback from the general public.
- C) Transit announcers can therefore take a very long time to be chosen.
- D) Some never fully develop a concrete idea of what they are looking for and how to find it.

passengers feel comfortable riding a bus or subway. The messages themselves may be quite perfunctory and provide little scope for dramatic **17** interpretation: but they still must be read with just the right intonation and emphasis.

After an announcer is chosen, he or she is asked to record hundreds of words or short **18** phrases that will be electronically strung together as needed to form the transit announcements that so many people hear every day. In some cases standard announcements, such as **19** these warning passengers to stay away from the platform edge, are recorded in a single, long take.

17

- A) NO CHANGE
- B) interpretation, but they
- C) interpretation, however they
- D) interpretation; but

18

Which choice best expands on the information provided in the sentence?

- A) phrases—not at all very lengthy—
- B) phrases—such as “northbound” and “local train”—
- C) phrases—and they are recorded individually—
- D) phrases, with enunciation that is done carefully,

19

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

20 Once this happens, the announcer's voice can take on a kind of celebrity of its own. Some announcers have even engaged in creating lighthearted parodies of their transit messages. In 2012, Bernie Wagenblast, one of the voices of New York City's subway system, was asked by the *New York Times* to record a number of fake subway announcements that had been suggested by readers. The messages ranged from comic 21 to romantic, and gritty too; one reader sent in a rap, which Wagenblast duly recorded, with subway noises added to the background for effect. 22 The recorded announcements were then published as audio files. They were published on the newspaper's website. While parodies like these may never be played over a public announcement system for all to enjoy, they nevertheless help give previously anonymous transit announcers some of the recognition they deserve.

20

- A) NO CHANGE
- B) After this,
- C) However, sometimes
- D) Once the recordings go live,

21

- A) NO CHANGE
- B) to romantic to gritty;
- C) to romantic, and to gritty ones;
- D) messages, as well as romantic and gritty;

22

Which choice most effectively combines the underlined sentences?

- A) The recorded announcements were then published as audio files, and they were published on the newspaper's website.
- B) The recorded announcements, published as audio files, were then published on the newspaper's website.
- C) The recorded announcements were then published as audio files on the newspaper's website.
- D) The newspaper's website then published the audio files, which were what the announcements were recorded as.

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

The Chemical Defense of the Sponges

In most Caribbean coral reefs, sponges are replacing the corals that have long characterized those environments. Sponges are colorful and provide a habitat for other organisms, but they do not contribute to the backbone of a reef like corals do. Corals are made up of and linked together by calcium carbonate, which gives a reef its mechanical strength. The changing balance of life on a reef has attracted the attention of **23** scientists.

Who are concerned with the important role reefs play in protecting our shorelines.

Sponges compete with other **24** organisms, including other sponges, to occupy space on a reef. One strategy sponges use to compete is the production of chemical compounds that deter the growth of nearby competitors. Until recently, because of reefs' inaccessibility, scientists have struggled to study the chemical interactions of these organisms.

[1] Sebastian Engel and Joseph Pawlik, **25** biologist's at the Center for Marine Science, developed a way to investigate the chemical interactions between sponges and their competitors in a more accessible location.

[2] The biologists designed small (15 × 15 centimeter) gel **26** plates, 15 cm on each side, each with nine square wells arranged like the squares on a tic-tac-toe board.

23

- A) NO CHANGE
- B) scientists who are concerned with
- C) scientists: who are concerned with
- D) scientists; concerning

24

- A) NO CHANGE
- B) organisms including other sponges;
- C) organisms, including other sponges
- D) organisms: including other sponges,

25

- A) NO CHANGE
- B) biologists,
- C) biologists
- D) biologists'

26

- A) NO CHANGE
- B) plates,
- C) plates, only 15 cm to a side,
- D) plates, having a small size,

[3] Two experimental wells in each plate were filled with a gel-like growth medium containing an extract derived from sponges, and two control wells in each plate

27 were filled with only the growth medium. [4] At the end of twenty-one days, they measured the competitor's overgrowth—the percent of the wells' surface covered by the competitor. [5] The biologists then attached a small segment of a competing organism to the empty center well and submerged the plate just below the surface of the ocean to facilitate easy retrieval and data collection. **28**

After testing many combinations of sponge extracts and competitors, Engel and Pawlik found that 30 percent of the sponge extracts tested have chemical deterrents inhibiting competitor growth. **29** Extracts of the sponge species *Dysidea etheria* and *Ectyoplasia ferox* deterred the

27

- A) NO CHANGE
- B) filled
- C) was filled
- D) is filled

28

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

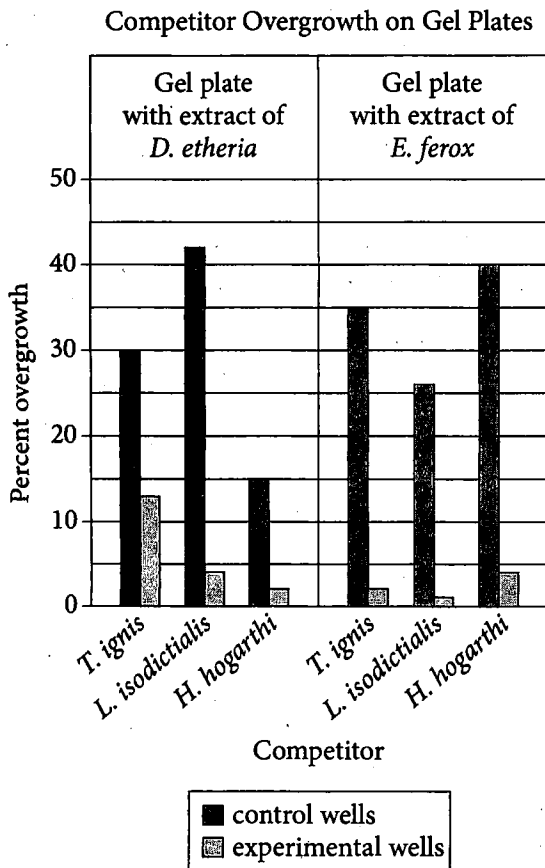
- A) where it is now.
- B) after sentence 1.
- C) after sentence 2.
- D) after sentence 5.

29

At this point, the writer is considering using the figure to support the claim made in the previous sentence. Based on the data in the figure, would this be an effective choice?

- A) Yes, because the data show that approximately 30 percent of the experimental wells on both gel plates were covered by competitor overgrowth.
- B) Yes, because the data show that control wells on the gel plate with extract of *E. ferox* deterred the growth of *L. isodictialis*.
- C) No, because the data show that all of the extracts tested have a chemical deterrent.
- D) No, because the data do not show numbers or percentages of the total number of sponge extracts tested having the chemical deterrents.

growth of all three competitors that were **30** tested *Tedania ignis*, *Lissodendoryx isodictialis*, and *Haliclona hogarathi*. The competing organism *L. isodictialis*, **31** for example, showed approximately 4 percent overgrowth onto **32** experimental wells containing extract of *E. ferox*, compared with approximately 42 percent overgrowth onto the plate's control wells.



Adapted from Sebastian Engel and Joseph R. Pawlik, "Allelopathic Activities of Sponge Extracts." ©2000 by Inter-Research.

30

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

31

- A) NO CHANGE
- B) to point out,
- C) in addition,
- D) however,

32

Which choice makes the writer's description of data represented in the figure most accurate?

- A) NO CHANGE
- B) control wells on the gel plate with extract of *E. ferox*,
- C) control wells on the gel plate with extract of *D. etheria*,
- D) experimental wells containing extract of *D. etheria*,

Engel and Pawlik's gel plates allowed scientists to better understand the emerging role of sponges as **33** dominant organisms in Caribbean coral reefs. This creative experiment outside of a reef environment was a small but important step toward understanding how sponges compete for space on coral reefs.

33

- A) NO CHANGE
- B) the living bosses
- C) organisms in charge
- D) the alive dominators

Questions 34-44 are based on the following passage.

The Art of (Mis)Labeling

The term “artisan” has justifiably been adopted by food producers who create their foods in small batches, have an intimate knowledge of their ingredients, and **34** the use of techniques that have been handed down for generations. Staff at the Davidovich Bakery in New York City, **35** instead, roll their artisan bagels by hand and boil them in kettles rather than steam them in large batches. Many consumers find artisan foods appealing because of these foods’ high quality and association with tradition. However, because there is no official definition of artisan food, a number of corporations have begun to exploit the term’s prestige by using the term **36** indiscriminately, one national restaurant chain did in 2011 when it promoted its mass-market “Artisan Pizza.” Such unregulated use of the term “artisan” diminishes the integrity of the word and the concept behind it.

34

- A) NO CHANGE
- B) use
- C) by using
- D) are using

35

- A) NO CHANGE
- B) for example,
- C) on the other hand,
- D) moreover,

36

- A) NO CHANGE
- B) indiscriminately, as
- C) indiscriminately. While
- D) indiscriminately, in which

A solution to this increasing co-optation of “artisan” by the mainstream food industry is to regulate the labeling of artisan foods in a manner similar to that used for organic foods. For any product to be labeled with the US Department of Agriculture organic seal, it must **37** harmonize with standards set by the USDA and contain 95 percent or more organic content. **38** Certification agencies periodically **39** verify that producers are following USDA organic regulations. Although some consumers and farmers feel that the certification process is not rigorous **40** enough: organic labeling regulations allow consumer groups and small organic producers to bring challenges when they believe the label has been misused.

37

- A) NO CHANGE
- B) keep pace with
- C) blend with
- D) conform to

38

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

Because of the complex factors involved in monitoring farming systems, the USDA has not yet been able to develop regulations for the organic label “pasture raised.”

Should the writer make this addition here?

- A) Yes, because it qualifies the claim made about the USDA in the paragraph.
- B) Yes, because it can be used to challenge the effectiveness of the USDA.
- C) No, because it does not detail any of the complex factors it mentions.
- D) No, because it diverts attention from the paragraph’s more general discussion of organic labeling.

39

- A) NO CHANGE
- B) authorize
- C) authenticate
- D) ratify

40

- A) NO CHANGE
- B) enough. Organic
- C) enough; organic
- D) enough, organic

Creating an official “artisan seal” and regulating businesses that wish to use this seal would similarly help prevent or rectify inappropriate use of the term “artisan.” Admittedly, **41** manufacturers would have to absorb the costs of the certification process. Just as manufacturers today can describe a product without the USDA organic seal as “organic,” so too could industrial producers label a product without an official artisan seal as “artisan.” Consumers would nonetheless benefit from the existence of a regulated artisan seal, as many companies would be **42** motivated, if not by ethics, at least by a desire to avoid public backlash—to adhere to the new guidelines.

41

Which choice most effectively sets up the explanation provided in the next sentence?

- A) NO CHANGE
- B) consumers would benefit from the enhanced knowledge that official seals guarantee.
- C) the creation of such a seal would not eliminate unauthorized uses altogether.
- D) regulated seals would limit the possibility of misleading advertisements.

42

- A) NO CHANGE
- B) motivated—if not by ethics—
- C) motivated. If not by ethics,
- D) motivated—if not by ethics,

Legitimate artisan producers would benefit as well: not only would many industrial producers be **43** dissociated from using the term “artisan” inappropriately, but true artisans (and the consumer groups that support them) could also seek relief when the artisan regulations were violated. Whatever dubious benefits industrial producers gain by labeling their foods “artisan” are more than outweighed by the disadvantages of this practice to consumers and actual artisan producers. **44**

43

- A) NO CHANGE
- B) dissuaded
- C) dispelled
- D) disseminated

44

The writer is considering adding this sentence as a conclusion to the passage.

After all, market researcher Datamonitor found that between 2008 and 2011, more than 800 new food products were labeled “artisan” in some way.

Should the writer make this addition here?

- A) Yes, because it helps the reader understand the magnitude of the labeling issue the passage discusses.
- B) Yes, because it substantiates claims made in the passage about how widespread the use of the “artisan” label is.
- C) No, because neither the specificity of the information nor its relationship to what is presented earlier is appropriate.
- D) No, because it does not distinguish between legitimate and illegitimate artisan labels.

STOP

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

No Test Material On This Page



Math Test – No Calculator

25 MINUTES, 17 QUESTIONS

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

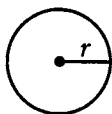
DIRECTIONS

For questions 1-13, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. For questions 14-17, solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 14 on how to enter your answers in the grid. You may use any available space in your test booklet for scratch work.

NOTES

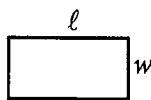
- The use of a calculator **is not permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated,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

REFERENCE

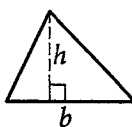


$$A = \pi r^2$$

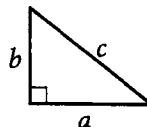
$$C = 2\pi r$$



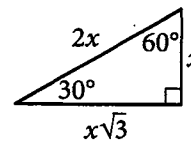
$$A = \ell w$$



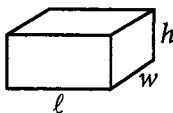
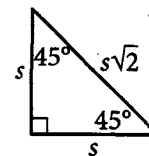
$$A = \frac{1}{2}bh$$



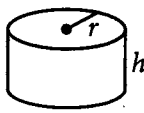
$$c^2 = a^2 + b^2$$



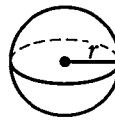
Special Right Triangles



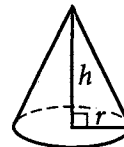
$$V = \ell wh$$



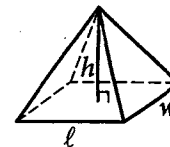
$$V = \pi r^2 h$$



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



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



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

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

The number of radians of arc in a circle is 2π .

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



1

$$6x + 9 = 4x + 11$$

Which of the following values satisfies the equation above?

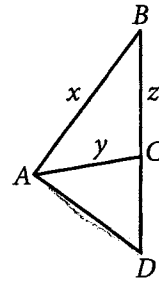
- A) -2
- B) -1
- C) 1
- D) 2

2

A babysitter charges \$8 per hour for each babysitting job she works and charges a travel allowance of \$10 for each job. Which of the following equations gives the number of hours, h , the babysitter worked at a job for which she charged \$78?

- A) $18h = 78$
- B) $10h + 8 = 78$
- C) $8h + 10 = 78$
- D) $8(10 + h) = 78$

3



In triangle ABD shown above, \overline{AC} bisects $\angle DAB$. Which of the following is equivalent to the ratio $AD:DC$?

- A) $x : z$
- B) $y : z$
- C) $z : x$
- D) $z : y$

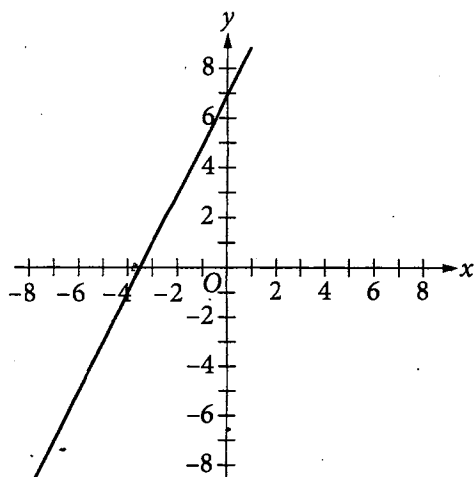
4

The expression $3x^2 + 12x^2y^2 + 6x^4$ is equivalent to which of the following?

- A) $(6x^2 + y)^2$
- B) $(6x^2 + y)(x - 3)$
- C) $x(3 + 12y^2 + 6x^2)$
- D) $3x^2(1 + 4y^2 + 2x^2)$



5



The graph of line k in the xy -plane is shown above. Which of the following is an equation of a line that, when graphed in the xy -plane, could be parallel to line k ?

- A) $y = -2x - 7$
- B) $y = -\frac{1}{2}x + 2$
- C) $y = x + 7$
- D) $y = 2x - 6$

6

Janelle wants to buy meat and vegetables for a barbecue. At her grocery store, the cost per pound of meat is x dollars, and the cost per pound of vegetables is y dollars. The equation $6x + 3y = 42$ shows how x and y are related when Janelle spends a total of \$42 on meat and vegetables. Based on the equation, which of the following statements must be true?

- A) The cost per pound of meat is \$6.
- B) Janelle can buy a maximum of 7 pounds of meat.
- C) Janelle can buy a maximum of 14 pounds of vegetables.
- D) Janelle buys twice as many pounds of meat as pounds of vegetables.

7

Which of the following expressions is equivalent to $\sqrt[3]{x^7}$?

- A) x^{10}
- B) x^4
- C) $x^{\frac{7}{3}}$
- D) $x^{\frac{3}{7}}$



8

The interior temperature of a particular gas oven is determined by its dial setting, which goes from 1 (lowest) to 10 (highest). The relationship between the dial setting N and the corresponding temperature $T(N)$ is linear. When the dial setting is 2, the temperature is 150°C , and when the dial setting is 6, the temperature is 202°C . Which of the following functions represents the temperature as a function of the dial setting?

- A) $T(N) = 13N + 150$
- B) $T(N) = 13N + 124$
- C) $T(N) = \frac{1}{13}N + 154$
- D) $T(N) = \frac{1}{13}N + 150$

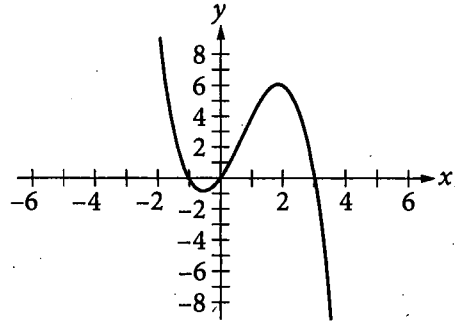
9

$$f(x) = -\sqrt{-x}$$

If the range of the function f above is the set of all real numbers less than or equal to zero, then which of the following describes the domain of f ?

- A) The set of all real numbers
- B) The set of all real numbers less than or equal to zero
- C) The set of all real numbers less than or equal to one
- D) The set of all real numbers greater than or equal to zero

10

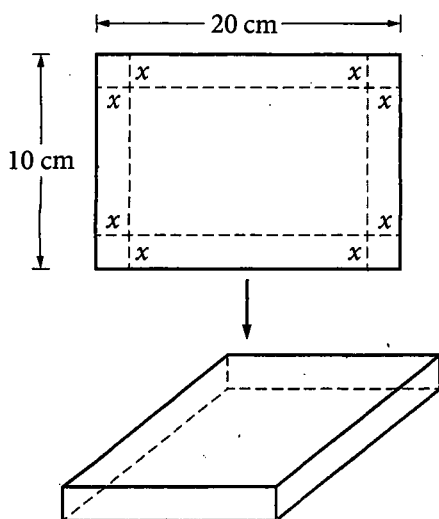


Which of the following is an equation of the graph shown on the xy -plane above?

- A) $y = x^3 + 2x^2 - 3$
- B) $y = x^3 - 2x^2 - 3x$
- C) $y = -x^3 + 2x^2 + 3x$
- D) $y = -x^3 - 2x^2 + 3$



11



A box with an open top is formed by cutting out square corners, each with an area of x^2 square centimeters, from a rectangular piece of cardboard and then folding up the sides, as shown. Which of the following forms of the equation for the volume, in cubic centimeters, of the box includes an expression that represents the area, in square centimeters, of the base of the box?

- A) $V = 4x^3 - 60x^2 + 200x$
 B) $V = x(4x^2 - 60x + 200)$
 C) $V = (20 - 2x)(10x - 2x^2)$
 D) $V = (20x - 2x^2)(10 - 2x)$

12

If $\frac{x-10}{x-4} = \frac{3x}{x-2}$ for $x \neq 4$ and $x \neq 2$, what is the value of $2x^2$?

- A) $\sqrt{10}$
 B) $2\sqrt{10}$
 C) 10
 D) 20

13

The cost C , in dollars, to make n units of a certain product is given by $C = an^2 + b$, where a and b are constants. If it costs \$17.00 to make 3 units and \$62.50 to make 10 units, what is the value of b ?


- A) 0.25
 B) 0.50
 C) 7.50
 D) 12.50



DIRECTIONS

For questions 14-17, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
4. Some problems may have more than one correct answer. In such cases, grid only one answer.

5. **Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or 7/2. (If  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

	7	/	1	2
Write answer in boxes.	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	0	0	0	
	1	1	<input checked="" type="radio"/>	1
	2	2	2	<input checked="" type="radio"/>
	3	3	3	3
	4	4	4	4
	5	5	5	5
	6	6	6	6
	<input checked="" type="radio"/>	7	7	7
	8	8	8	8
	9	9	9	9

← Fraction line

	2	.	5
	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
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	0	0	0
	1	1	1
	2	<input checked="" type="radio"/>	2
	3	3	3
	4	4	4
	5	5	<input checked="" type="radio"/>
	6	6	6
	7	7	7
	8	8	8
	9	9	9

← Decimal point

Grid in result.

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

	2	/	3
	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	0	0	0
	1	1	1
	2	<input checked="" type="radio"/>	2
	3	3	<input checked="" type="radio"/>
	4	4	4
	5	5	5
	6	6	6
	7	7	7

.	6	6	6
	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
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	0	0	0
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	3	3	3
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	5	5	5
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	7	7	7

.	6	6	7
	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	0	0	0
	1	1	1
	2	2	2
	3	3	3
	4	4	4
	5	5	5
	6	<input checked="" type="radio"/>	<input checked="" type="radio"/>
	7	7	<input checked="" type="radio"/>

Answer: 201 – either position is correct

	2	0	1
	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	0	<input checked="" type="radio"/>	0
	1	1	<input checked="" type="radio"/>
	2	<input checked="" type="radio"/>	2
	3	3	3

	2	0	1
	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	<input checked="" type="radio"/>	0	0
	1	1	<input checked="" type="radio"/>
	<input checked="" type="radio"/>	2	2
	3	3	3

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



14

Edgar earns \$12 per hour at his job during weekdays. His hourly earnings are increased by 50% when he works during weekends. Edgar worked 20 hours this week on weekdays. What is the minimum whole number of hours Edgar will have to work during this weekend in order to earn at least \$400 this week?

15

$$4x(x - 2) - 5 = 7$$

What is the sum of the solutions to the equation shown above?

16

$$y = 2x^2 + 5$$

$$y = 2x + 9$$

If (x, y) is the solution to the system of equations above such that $x < 0$ and $y > 0$, what is the value of y ?

17

$$4x - 9 = -y$$

$$2x = 3y - 5$$

According to the system of equations above, what is the value of y ?

STOP

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

No Test Material On This Page



Math Test – Calculator

45 MINUTES, 31 QUESTIONS

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

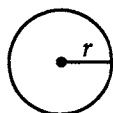
DIRECTIONS

For questions 1-27, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. For questions 28-31, solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 28 on how to enter your answers in the grid. You may use any available space in your test booklet for scratch work.

NOTES

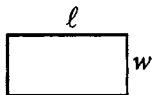
1. The use of a calculator is permitted.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the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

REFERENCE

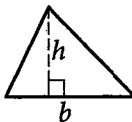


$$A = \pi r^2$$

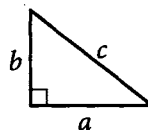
$$C = 2\pi r$$



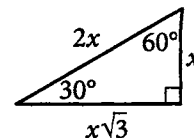
$$A = \ell w$$



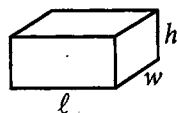
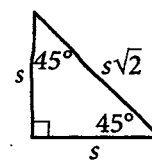
$$A = \frac{1}{2}bh$$



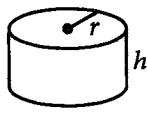
$$c^2 = a^2 + b^2$$



Special Right Triangles



$$V = \ell wh$$



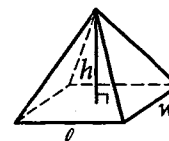
$$V = \pi r^2 h$$



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



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



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

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.



1

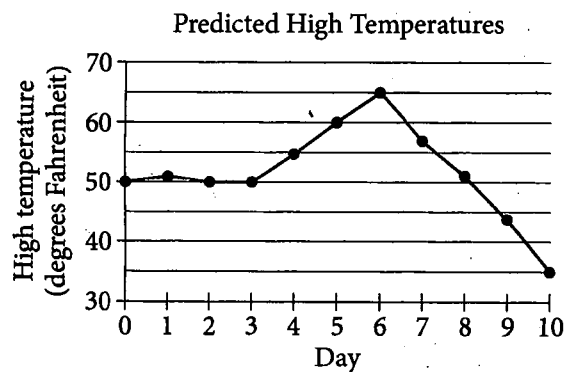
Abigail can read 200 words in one minute. If she were to read at this rate for 30 minutes each day, how many days would Abigail take to read 30,000 words of a book?

- A) 4
- B) 5
- C) 6
- D) 7

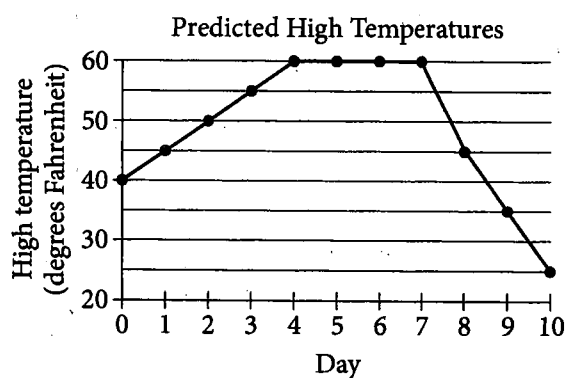
2

A meteorologist predicted the high temperatures, in degrees Fahrenheit, for the next 10 days. The meteorologist predicted that the high temperatures will increase at a constant rate from today's high temperature for 4 days, remain about the same for the following 3 days, and then decrease rapidly for the final 3 days. Which graph best represents this trend in the high temperatures for the next 10 days, where today is Day 0?

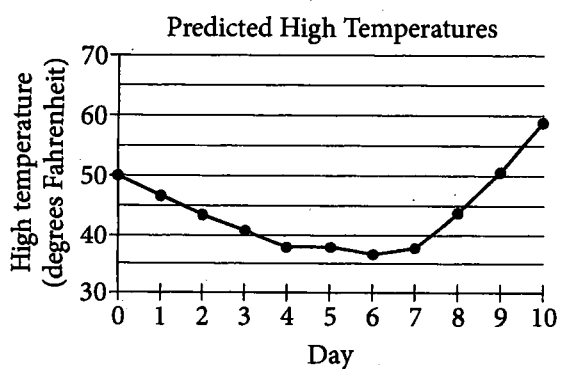
A)



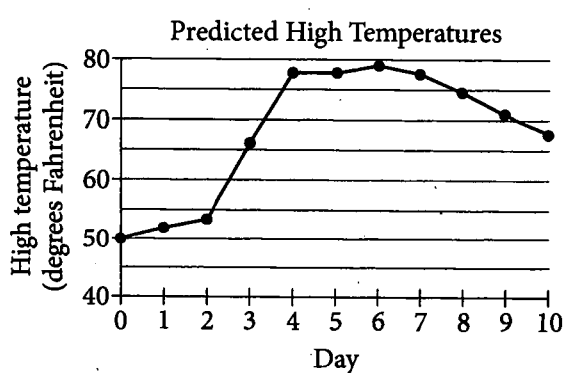
B)



C)



D)





3

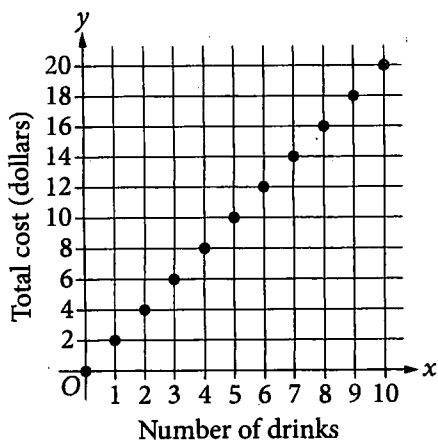
A journalist earns \$50 for an article that appears in an online publication, plus \$0.08 per word in the article. If the journalist earned a total of \$70 for the article, how many words were in the article?

- A) 250
- B) 625
- C) 875
- D) 925

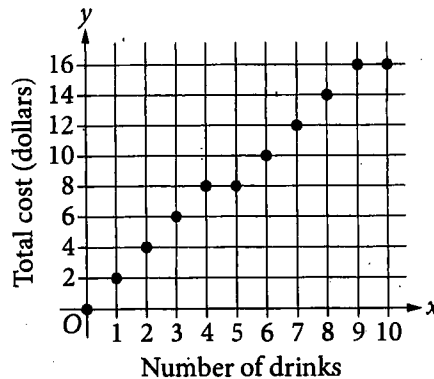
4

A coffee shop has a customer loyalty program. For every 4 drinks a customer orders for \$2 each, the next drink the customer orders is free. Which of the following graphs represents the relationship between x , the number of drinks a customer orders, and y , the total cost, in dollars, of the drinks, for $x \leq 10$?

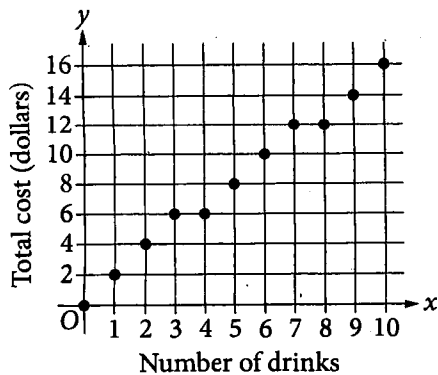
A)



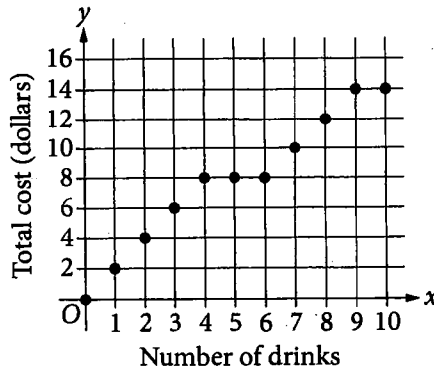
B)



C)



D)





5

$$\frac{5}{9}(d - 12) = 10$$

A linear equation is shown above. Which of the following values of d is a solution to the equation?

- A) 6
- B) 18
- C) 30
- D) The equation has no solution.

6

Which of the following situations exhibits exponential growth over time?

- A) The amount of money in a retirement account that is decreasing in value by 4% each year
- B) The salary of an employee who receives a \$2,000 increase in salary at the end of each year
- C) The amount of rent for an apartment when the landlord raises the rent by \$125 every 12 months
- D) The amount of money in a savings account that earns 1% annual interest compounded monthly

7

At a factory, there were 60 defective items produced in 2012. From 2012 to 2013, this number decreased by 10 percent. How many defective items were produced at the factory in 2013?

- A) 50
- B) 54
- C) 55
- D) 66



Questions 8 and 9 refer to the following information.

Record Monthly Temperatures for
New York City, in Degrees Fahrenheit

Month	Record low (°F)	Record high (°F)
January	-6	72
February	-15	75
March	3	86
April	12	96
May	28	99
June	44	101
July	52	106
August	50	104
September	39	102
October	28	94
November	7	84
December	-13	75

The table above gives the record-low and record-high monthly temperatures for New York City.

8

To the nearest percent, what percent of the record-high monthly temperatures in New York City were at least 100 degrees Fahrenheit?

- A) 4%
- B) 17%
- C) 25%
- D) 33%

9

What is the median of the record-low monthly temperatures for New York City for November, December, January, February, and March?

- A) -15°F
- B) -6°F
- C) 3°F
- D) 39°F



10

A company surveyed 73 employees selected at random to determine if they opposed additional security at the office entrance. The survey showed that 64 were opposed to the additional security. Based on the results of the survey, how many of the 657 employees who work in the office would be estimated to not be opposed to the additional security?

- A) 244
- B) 178
- C) 81
- D) 75

11

A farmer will plant 120 acres of land, some with corn and some with soybeans. This year, corn is estimated to yield 158.8 bushels per acre planted and soybeans are estimated to yield 43.3 bushels per acre planted. The farmer expects to harvest 12,126 bushels of corn and soybeans. Which of the following systems of equations describes this situation, where C is the number of acres of corn planted and S is the number of acres of soybeans planted?

- A) $\begin{cases} C + S = 120 \\ 158.8C + 43.3S = 12,126 \end{cases}$
- B) $\begin{cases} C + S = 12,126 \\ 158.8C + 43.3S = 120 \end{cases}$
- C) $\begin{cases} 60C = 158.8 \\ 60S = 43.3 \end{cases}$
- D) $\begin{cases} C + S = 120 \\ 60C + 60S = 12,126 \end{cases}$

12

Marco randomly sampled 100 students from his high school to determine whether they were in favor of a new school dress code. Of the 100 students surveyed, 65% were not in favor of the policy, 28% were in favor of the policy, and the rest did not respond. Marco estimated that 210 students in the school were in favor of the new dress code. What additional information did Marco need to reach this conclusion?

- A) The number of teachers in the high school
- B) The number of students in the high school
- C) The ages of the 100 students in his sample
- D) The number of students who did not respond

13

A certain county has a population of 83,952 residents and a land area of 954 square miles. A demographer determines that there is one housing unit for every 2.75 residents of the county. On average, how many housing units per square mile does the county have?

- A) 32
- B) 88
- C) 242
- D) 347



14

A concert hall representative surveyed a group of audience members selected at random to determine which type of musical performances they would like to see at the concert hall. The table below displays the results of the survey summarized by age group. Each respondent chose exactly one type of musical performance.

		Age		
		21 to 30	31 to 40	Over 40
Type of music performance	Blues	12	8	10
	Classical	7	9	11
	Jazz	7	6	8
	Rock	9	9	12
Total		35	32	41

Of all the respondents who would like to see a blues or jazz music performance at the concert hall, what percentage, rounded to the nearest percent, were over 40 years old?

- A) 44%
- B) 35%
- C) 21%
- D) 17%

15

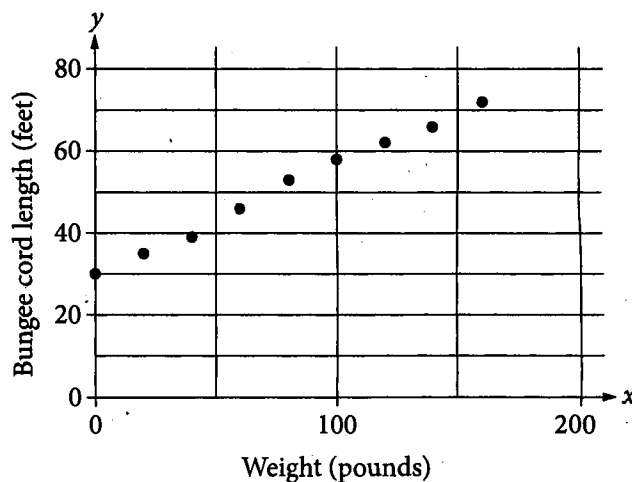
In the expression below, a is an integer.

$$x^2 - 3x + a$$

For which of the following values of a could this trinomial be rewritten in the form $(x + b)(x + c)$, where b and c are integers?

- A) -9
- B) -6
- C) 2
- D) 10

16



The scatterplot above shows the length y , in feet, of a bungee cord when a weight of x pounds is attached to it. Which of the following best approximates an equation for the line of best fit for the data?

- A) $y = 30x + 4$
- B) $y = 4x + 30$
- C) $y = 4x$
- D) $y = \frac{1}{4}x + 30$



Questions 17 and 18 refer to the following information.

The relationship between the density, D , in grams per cubic centimeter (g/cm^3) of liquid mercury and the temperature, T , of the liquid, in degrees Celsius, is modeled by the equation $D = 13.628 - 0.002T$.

17

If the equation above is graphed on a coordinate plane with T on the horizontal axis and D on the vertical axis, what is the slope of the line?

- A) -13.628
- B) 13.628
- C) -0.002
- D) 0.002

18

Which of the following could be a correct interpretation of 13.628 in the context of the model?

- A) The average density of liquid mercury in g/cm^3
- B) The density, in g/cm^3 , of a sample of liquid mercury at temperature 0 degrees Celsius
- C) The temperature, in degrees Celsius, of a sample of liquid mercury with density 0
- D) The rate of change of the density of liquid mercury with respect to temperature in degrees Celsius



19

$$T = 3(ak - 1) + 4$$

In the equation above, which of the following is equivalent to ak ?

- A) $\frac{T-1}{3}$
- B) $T-3$
- C) $\frac{T+1}{3}$
- D) $\frac{T+7}{3}$

20

A student has an average (arithmetic mean) score of 88 for the first 3 tests in a class. What is the lowest score that the student can earn on the fourth test to have an average score of at least 90 for the 4 tests?

- A) 92
- B) 93
- C) 94
- D) 96

21

A circle in the xy -plane has equation

$(x-3)^2 + (y-4)^2 = 36$. What is the radius of the circle?

- A) 3
- B) 5
- C) 6
- D) 18

22

The average annual housing costs, in dollars, for US families for the years 1990 through 2009 can be modeled by the function $f(x) = 8,673(1.038)^x$, where x represents the number of years since 1990. Based on the model, the average housing costs in 1993 were how many times as great as the average housing costs in 1992?

- A) 1.038
- B) $(1.038)^2$
- C) $8,673(1.038)$
- D) $8,673(1.038)^2$



Questions 23-25 refer to the following information.

A botanist conducted a 20-year study of the growth patterns of red maple trees and silver maple trees in a nature preserve. The growth rate for a species is defined as the average number of inches taller the trees in the species grew each year. The growth factor for a species is the factor by which the diameter of a tree trunk of the species, measured in inches at 5 feet above ground level, is multiplied to determine the age of the tree.

The results of the study are given in the table below.

Growth Rate and Growth Factor
for Two Tree Species

Tree species	Growth rate (inches per year)	Growth factor (years per inch)
Red maple	0.30	4.5
Silver maple	0.49	3.0

To estimate the heights of the trees in the study, the botanist used the formula $h = gt + b$, where h is the height of a tree in inches, g is the growth rate, t is the amount of time in years since the study began, and b is the height of the tree at the beginning of the study.

23

At the beginning of the study, a certain silver maple tree was 82.50 inches tall and a certain red maple tree was 85.35 inches tall. Assuming the two trees grew at the average growth rate determined in the study, approximately how many years after the beginning of the study did the silver maple reach the same height as the red maple?

- A) 5
- B) 15
- C) 25
- D) The silver maple did not reach the height of the red maple during the study.

24

Which formula gives the growth rate of the trees in terms of the other variables?

- A) $g = t(b - h)$
- B) $g = \frac{h}{t} - b$
- C) $g = \frac{h - b}{t}$
- D) $g = \frac{b - h}{t}$

25

Which of the following functions can be used to determine the age in years, $a(d)$, of a silver maple tree whose trunk has a diameter of d inches measured at 5 feet above ground level?

- A) $a(d) = 4.5d$
- B) $a(d) = 3d$
- C) $a(d) = 0.49d$
- D) $a(d) = 0.3d$



26

$$y = -x^2 + 10x - 27$$

$$y + 9 = x$$

Which of the following gives all of the ordered pairs (x, y) that satisfy the system of equations above?

- A) $(6, -3)$
- B) $(3, 6)$ and $(3, -6)$
- C) $(3, -6)$ and $(6, -3)$
- D) There is no solution to this system of equations.

27

On a map, Marcel measures the distance between two cities to be about $1\frac{5}{8}$ inches. The scale of the map shows that $\frac{1}{8}$ inch is equal to 25 miles. If 1 kilometer is approximately 0.6214 miles, what is the best approximation of the actual distance between the two cities, in kilometers?

- A) 65
- B) 202
- C) 325
- D) 523


DIRECTIONS

For questions 28-31, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or 7/2. (If

3	1	/	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

 is entered into the grid, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Write answer in boxes. →

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

7	/	1	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

Answer: 2.5

	2	.	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

← Decimal point

Grid in result.

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

	2	/	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7

.	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7

.	6	6	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7

Answer: 201 – either position is correct

	2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3

	2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3

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



28

A store manager needs to order two different products. Product X costs \$12 per unit, and Product Y costs \$9 per unit. The manager has \$115 to spend on a combination of these products. If the manager decides to buy 5 units of Product X, what is the maximum whole number of units of Product Y that the manager can buy?

29

$$t^2 - 7t + 12 = 0$$

What is the positive difference of the two values of t that satisfy the equation above?



Questions 30 and 31 refer to the following information.

One month prior to a local election, 150 adults were randomly selected and asked whom they were planning to vote for. The partially complete two-way table below summarizes data from the sample.

	Male	Female	Total
Candidate A	x	y	100
Candidate B			50
Total	90	60	150

30

If the ratio of x to y is 3:2, what is the value of x ?

31

To the nearest tenth percent, what is the difference between the percent of votes for Candidate A and the percent of votes for Candidate B, based on the data in the table? (Ignore the percent sign when gridding your answer. For example, if your answer is 78.2%, then grid 78.2)

STOP

If you finish before time is called, you may check your work on this section only.

Do not turn to any other section.

No Test Material On This Page