April 2023 QAS

1 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 Bich Ming Nguyen, *Pioneer Girl*. ©2014 by Bich Ming Nguyen. The narrator is remembering Rose, a friend of her family who was an American reporter on assignment in Vietnam in 1965.

Rose stopped by the café often during her week in Saigon, and though she and my grandfather talked for hours, he remembered little about her history. If Rose revealed her full name, if she spoke about her own mother and father, or anything about the roots of her family, he didn't remember. He recalled, instead, her lively voice, her many questions about Vietnam; he remembered how she always wore a hat. In anticipation of her visits, he reserved pineapple and lychees for her. He offered her delicacies usually eaten on holidays—sticky rice buns stuffed with sweet sausage, candied ginger snacks, curls of dried coconut. She ate them heartily. He gave her advice about lodgings in Da Lat and Hue and, whenever she bade farewell, he helped her cross the street. One day, when Rose complained of a cramp in her leg, he had my mother run out to fetch some balm that Rose later said cured her instantly. *You are lovely*, my mother remembered Rose saying. *The loveliest little family*.

Ten years later, when my mother and grandfather left Saigon for America, one of the few things they took with them was a small gold pin, engraved with a picture of a house, that had belonged to Rose. She had dropped it, perhaps, forgotten it. Left it sitting on the table where a plate would be. They had kept the pin safe, but Rose never came back.

When I was growing up my grandfather liked to tell these stories about Rose. Once in a while my mother joined in too. *That lady with a purse and a notebook*, she would say. *All by herself, in Saigon*. Her voice would take on a kind of tenderness, wonder, that I rarely heard otherwise.

We would usually be packed in the car when they got to remembering like this, but I didn't pay much attention until the time we moved from a town in southern Wisconsin to a town in central Illinois. I was eight years old and book-crazy, could read for stretches in the car without getting sick, while my brother, Sam, listened to the same music on his Discman over and over. Even then, at age nine, he had the ability to close himself down to everyone around him. That year, my obsession was the *Little House on the Prairie* box set my grandfather had given me for my birthday. As we drove toward our new town I imagined every farm we passed was Laura Ingalls Wilder's and that I could see her, calico-bonneted, walking in wheat. I'd been following her, book to book, from childhood to adulthood when, one Christmas, her new fiancé Almanzo gave her a present.

There in a nest of white cotton lay a gold bar pin. On its flat surface was etched a little house, and before it along the bar lay a tiny lake, and a spray of grasses and leaves.

It sounded just like Rose's pin, the narrow shape and delicate weight I'd known from helping my mother clean her jewelry.

Outside, wildflowers along the road blurred together as my mother accelerated to pass a minivan. She was a faster driver than my grandfather, who liked to point out the semis ahead.

Ong Hai, I said, which was what we all called him. Listen to this. I read the description aloud.

How funny, he said. Isn't that funny?

You read too much, my mother said to me.

I say Rose's pin was a gift too, my grandfather went on. Even if by accident. Can't refuse something like that.

My mother said nothing more, but I figured it must have meant the same for her. Why else would they have kept the pin, brought it to America?

We drove on, all of us confined together in the old car. We were, if nothing else, accounted for and heading in the same direction. A new restaurant. A new town. A new apartment. My mother and grandfather would take turns behind the wheel, fiddling with the temperature controls. In the back, Sam and I stared out the windows at the electric wires leading us deeper into the big Midwest that was the only landscape we knew.

I decided to pretend that the two pins were the same, that Almanzo's gift to Laura was not just based on a true story, but a real treasure now hidden away in my mother's jewelry box. In books, characters were always keeping secrets. This would be one of mine.

1

It can reasonably be inferred from the passage that the narrator's grandfather regarded Rose's visits as

A) special occasions to indulge a welcome guest.

B) humorous exchanges with a traveler.

C) rare opportunities to help a newcomer.

D) unexpected encounters with an intriguing stranger.

2

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

A) Lines 1-3 ("Rose . . . history")

B) Lines 3-6 ("If Rose . . . remember")

C) Lines 6-8 ("He recalled . . . a hat")

D) Lines 8-12 ("In anticipation . . . coconut")

3

In context, the family's treatment of Rose's pin illustrates how the family is

A) mystified as to why Rose left them her pin.

B) grateful to Rose for her generosity.

C) intent on finding Rose in America.

D) interested in maintaining a connection to Rose.

4

The primary purpose of the third paragraph (lines 26-31) is to

A) capture the grandfather's enjoyment in telling anecdotes about Rose.

B) explain the reason for the mother's reluctance to talk about Rose.

C) describe Rose's place in the family's shared memories.

D) recount the narrator's surprise at learning new details about Rose.

5

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

A) regular breaks.

B) continuous periods.

C) vigorous exercises.

D) challenging sessions.

6

The narrator indicates that her brother can appear to be

A) focused and reserved.

B) bashful and secretive.

C) worried and anxious.

D) bored and resentful.

7

Which statement best describes the interaction between the narrator and her grandfather in the passage?

A) She relies on him for the advice that her mother is reluctant to offer.

B) They have a close friendship that excludes her mother and brother.

C) He tells her stories about the past to inspire her to read more books as she gets older.

D) He encourages her interests and shows enthusiasm for them.

8

Which choice provides the best evidence to support the idea that the mother sometimes considers the narrator excessively imaginative?

A) Lines 42-47 ("As we . . . present")

B) Line 61 ("You read . . . to me")

C) Lines 65-66 ("My mother . . . her")

D) Lines 79-80 ("In books . . . mine")

9

As used in line 60, "funny" most nearly means

A) absurd.

B) comical.

C) odd.

D) deceptive.

10

Based on the passage, the narrator decides to link Rose's pin with Laura's pin primarily because she

A) rejects any distinctions between fact and fiction.

B) hopes to remove Rose from the family's history.

C) would like to create a narrative of her own.

D) is inclined to disregard what her mother has said.

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

This passage is adapted from David Anderson, "Knotted Strings and Chili Peppers Add Up to New Evidence for Taxation in the Inka Empire." ©2019 by Forbes Media LLC.

In recent excavations, archaeologists in Peru encountered something never before seen in the archaeological record, caches of chili peppers, peanuts, and black beans, each with an associated knotted-string recording device known as a *khipu*.

As a large and bureaucratic state, the Inka empire was inordinately interested in tracking both labor and goods. Documents from Spanish chroniclers describe in detail the *mit'a*, an imperial system of tracking and organizing labor tribute forced upon the subjects of the empire. As the Inka expanded their territory, newly subjugated populations were often moved to other regions of the Andes where they would be required to work in the emperor's fields or were set to work producing textiles, ceramics, or other goods in demand.

Again, according to Spanish chroniclers, we know that the *mit'a* was tracked and organized by agents of the emperor using *khipus*. A standard *khipu* would consist of a horizontal base string from which multiple additional strings would hang. These additional strings would be tied into a series of different knots, each of which encoded information that could be read by those who understood the system of encoding. Discussions of how much information a *khipu* could record are ongoing, but at the very least we know they were used to make numerical counts.

Nevertheless, understanding the significance of an individual *khipu* today is difficult as we often do not know what they were recording or counting. The paper published by Gary Urton and Alejandro Chu, however, presents an exciting new development: *khipus* discovered in the context of an Inka storage facility.

In 2013 and 2014, Chu was conducting excavations at the site of Inkawasi, located along the southern coast of Peru. The site is located along the famed Inka road system and included large storage facilities built by the empire to collect goods generated by the *mit'a* labor system. While excavating one of these storage facilities, Chu and his team recovered 29 *khipus*, four of which were found in association with preserved caches of chili peppers and peanuts. This offered an unprecedented opportunity to compare the accounting records of each *khipu* with the good they were presumably used to track.

In analyzing the patterns of strings and knots found on these four *khipus*, the authors of the new study note an intriguing pattern. It appeared each *khipu* included a count of total goods along with a small "fixed count" that appeared to refer to a small percentage of goods that were being set aside. In three of the four cases, although the base numbers were different, the amount set aside turned out to be approximately 2% of the original total count.

While there is some room for debate, Urton and Chu argue in their paper that the most likely interpretation of the numbers laid out by these *khipus* is as a tax used to support the running of the storehouse. They note that "Inkawasi was a new kind of facility in the Inka imperial infrastructure, and as such, the management of the site stimulated new accounting procedures." The Inka empire was a dynamic entity, growing, developing, and changing all the way up until its downfall at the hands of European epidemic diseases just a few generations after this facility was built.

The empire was also a place where human desires and tastes thrived. Three of the four *khipus* examined in this study supported the idea of a flat 2% taxation rate, but the fourth *khipu* factored out to an approximately 11% taxation rate for the associated good, a cache of spicy chilis. At five-times the rate, the chilis were clearly highly valued by the people who ran the storage facility.

Name	Good	Total number of deposits	Average deposit size (number of units)	Fixed count	Tax rate (fixed count as % of average deposit size)
UR267B	chilis	24	517.5	10	1.9%
UR267A	chilis	24	133.9	15	11.2%
UR275	peanuts	25	2,257.8	47	2.1%
UR268	peanuts	27	10,242.9	208	2.0%

11

Which of the following best describes the overall structure of the passage?

A) The passage introduces a study, describes associated historical information, and then explains the study's findings.

B) The passage mentions a study's conclusion, places it in historical context, and then explains the reasoning that led to the conclusion.

C) The passage describes an unexpected finding in a study, discusses why it defied expectations, and then explains how the study resolved the apparent conflict.

D) The passage details a study's hypothesis, explains that it is controversial, and then argues against a competing hypothesis.

12

The passage most strongly suggests that *khipus* were particularly useful to the Inka Empire at the time Inkawasi was operating because the empire

A) needed to increase the size of the labor force.

B) attempted to replace the *mit'a*.

C) was routinely producing new kinds of goods.

D) was extensive in size and structure.

13

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

A) Lines 1-5 ("In recent . . . *khipu*")

B) Lines 6-7 ("As a . . . goods")

C) Lines 16-18 ("Again . . . *khipus*")

D) Lines 20-23 ("These . . . encoding")

14

According to the passage, the system of labor tribute in the Inka Empire was used to

A) produce food more often than other types of goods.

B) generate different goods depending on current needs.

C) expand the empire through peaceful means.

D) share the *khipu* technology with people outside the empire.

15

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

A) influence.

B) merit.

C) meaning.

D) reliability.

16

Which choice provides the best evidence for the idea that Urton and Chu's conclusions about the *khipus* are based in part on an assumption they made?

A) Lines 33-35 ("In 2013 . . . Peru")

B) Lines 35-38 ("The site . . . system")

C) Lines 38-41 ("While . . . peanuts")

D) Lines 41-44 ("This . . . track")

17

Which choice best describes the difference between the use of "patterns" in line 44 and the use of "pattern" in line 46?

A) The first refers to the arrangement of the strings on the *khipus*, and the second refers to the arrangement of the knots on the strings.

B) The first refers to the apparent similarities among the *khipus*, and the second refers to the apparent differences between the *khipus*.

C) The first refers to the physical attributes of the *khipus*, and the second refers to a trend observed across the *khipus*.

D) The first refers to the *khipus* seemingly recording a total count of the goods, and the second refers to the *khipus* seemingly recording a fixed count.

18

The passage most strongly suggests that before the development of facilities like that at Inkawasi, the Inka Empire had NOT needed to develop

A) a counting method.

B) the *mit'a* system of labor.

C) a method for long-term storage.

D) the fixed-count tax system.

19

For the *khipus* shown in the table, the one with the lowest tax rate has the

A) lowest fixed count.

B) highest fixed count.

C) lowest average deposit size.

D) highest average deposit size.

20

Taken together, the passage and table most strongly suggest that the people who ran the storage facility at Inkawasi

A) typically prized peanuts about the same as they prized chilis.

B) prized some chilis much more highly than other chilis.

C) prized some peanuts much more highly than other peanuts.

D) prized chilis and peanuts highest among the goods stored at Inkawasi.

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

This passage is adapted from Peter Rüegg, "A Battery with a Twist." ©2019 by Eidgenössische Technische Hochschule Zürich.

Today's electronics industry is increasingly focusing on computers or smartphones with screens that can be folded or rolled. Smart clothing items make use of wearable micro-devices or sensors to monitor bodily functions, for example. However, all these devices need an energy source, which is usually a lithium-ion battery. Unfortunately, commercial batteries are typically heavy and rigid, making it fundamentally unsuitable for applications in flexible electronics or textiles.

A remedy for this problem is now being created by Markus Miederberger and his team. The researchers have developed a prototype for a flexible thin-film battery that can be bent, stretched and even twisted without interrupting the supply of power.

What makes this new battery special is its electrolyte—that part of the battery through which lithium-ions move when the battery is charged or discharged. This electrolyte was discovered by Xi Chen, lead author of the study.

Following the design of commercial batteries, this new type of battery is built in layers like a sandwich. However, it marks the first time that researchers have used flexible components to keep the whole battery bendable and stretchable. "To date, no one has employed exclusively flexible components as systematically as we have in creating a lithium-ion battery," Niederberger says.

The two current collectors for the anode and the cathode[1] consist of bendable polymer composite that contains electrically conductive carbon and that also serves as the outer shell. On the interior surface of the composite, the researchers applied a thin layer of micron-sized silver flakes. Due to the way the flakes overlap like roof tiles, they don't lose contact with one another when the elastomer is stretched. This guarantees the conductivity of the current collector even if it is subjected to extensive stretching. And in the event that the silver flakes do in fact lose contact with each other, the electrical current can still flow through the carbon-containing composite, albeit more weakly.

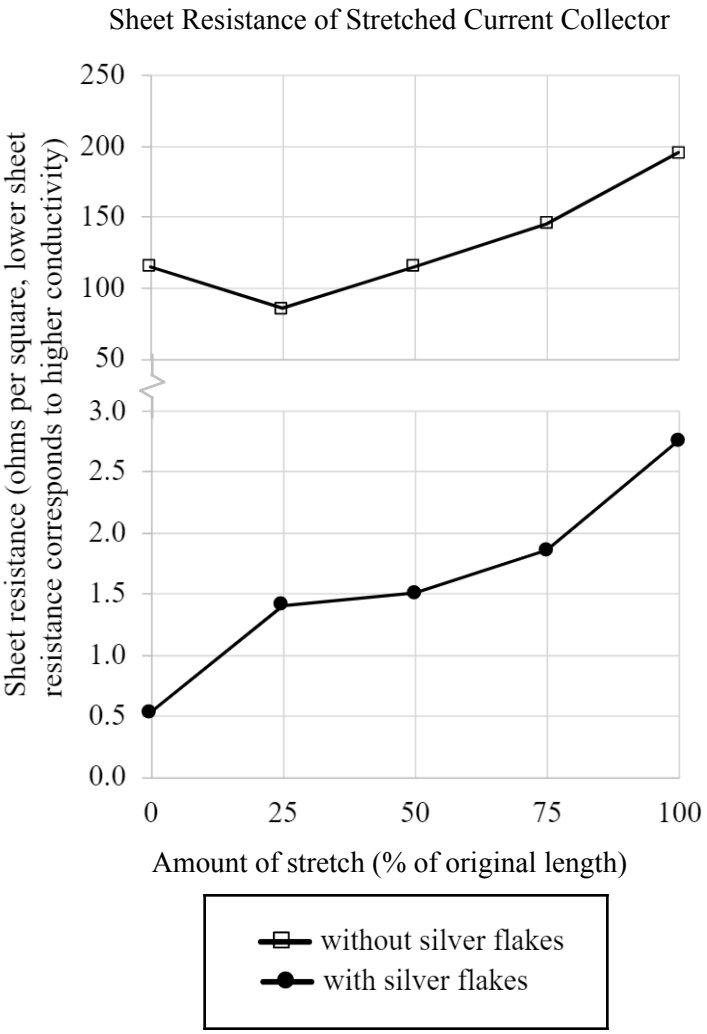
With the help of a mask, the researchers then sprayed anode and cathode powder onto a precisely defined area of the silver layer. The cathode is composed of lithium manganese oxide and the anode is a vanadium oxide.

In the final step, the scientists stacked the two current collectors with the applied electrodes on top of each other, separated by a barrier layer similar to a picture frame, while the gap in the frame was filled with the electrolyte gel.

Niederberger emphasizes that this gel is environmentally more friendly than the commercial electrolytes: "Liquid electrolyte[s] in today's batteries are flammable and toxic." In contrast, the gel electrolyte that Chen developed contains water with a high concentration of a lithium salt, which not only facilitates the flow of lithium ions between cathode and anode while the battery is charging or discharging, but also keeps the water from electrochemical decomposition.

The scientists joined the various parts of their prototype together with adhesive. "If we want to market the battery commercially, we'll have to find another process that will keep it sealed tight for a longer period of time," Niederberger says.

Niederberger stresses that more research is necessary to optimize the flexible battery before they consider commercializing it. Above all, the team has to increase the amount of electrode material it can hold.



Adapted from Xi Chen et al., "Fully Integrated Design of a Stretchable Solid-State Lithium-Ion Full Battery." ©2019 by Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim.

[1] The anode and cathode are the negative and positive electrodes of a battery, respectively.

21

An important function of the first paragraph is to

A) identify a limitation that the research discussed in the passage is meant to address.

B) introduce competing ideas about how the research discussed in the passage should be put to use.

C) give an overview of the methods used in the research discussed in the passage.

D) explain the consensus view that is challenged by the research discussed in the passage.

22

As used in line 20, "following" most nearly means

A) copying.

B) obeying.

C) accompanying.

D) pursuing.

23

It can most reasonably be inferred from the passage that in previous battery research, researchers had been successful at

A) reducing the amount of adhesive needed to hold battery parts together.

B) creating some individual battery components that are flexible.

C) developing flexible batteries without relying on lithium-ion technology.

D) standardizing the thickness of the layers of batteries.

24

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

A) Lines 5-9 ("However . . . textiles")

B) Lines 20-21 ("Following . . . sandwich")

C) Lines 22-26 ("However . . . says")

D) Lines 59-62 ("If we . . . says")

25

As used in line 31, "applied" most nearly means

A) requested.

B) placed.

C) assigned.

D) engaged

26

It can most reasonably be inferred from the passage that one advantage the new electrolyte material has over some other electrolytes is that the new material

A) is less likely to cause problems if it leaks out of a damaged battery.

B) allows less loss of lithium ions when the battery is discharged.

C) has a consistency that makes construction of the entire battery more efficient.

D) can more completely fill the space between stacked current collectors.

27

The passage indicates that one limitation of the battery developed by Niederberger and his team is that the

A) battery requires more electrode material than do comparably sized inflexible batteries.

B) need for silver flakes in the current collector makes the battery's cost too high for commercial use.

C) adhesive used in the battery reduces the flow rate of the current.

D) battery's components are not connected to one another in a durable way.

28

According to the figure, which value is closest to the sheet resistance of the current collector with silver flakes when it was stretched by 75% of its original length?

A) 0.5 ohm per square

B) 1.0 ohm per square

C) 1.5 ohms per square

D) 2.0 ohms per square

29

The data in the figure best support which statement about the current collector with silver flakes?

A) It had lower sheet resistance than the current collector without silver flakes at all amounts of stretch.

B) It had more variable sheet resistance, in ohms per square, than the current collector without silver flakes.

C) Its sheet resistance matched that of the current collector without silver flakes when both collectors were stretched by 25% of their original length.

D) Its sheet resistance was 200 ohms per square when it was stretched by 100% of its original length.

30

Taken together, the figure and the passage most strongly suggest that for the stretched current collector with silver flakes, there likely was

A) an interaction between the adhesive and the silver flakes.

B) excess vanadium oxide but insufficient lithium manganese oxide on the silver flakes.

C) a positive correlation between the thickness of the individual flakes and the sheet resistance.

D) a slight loss of contact between flakes as the amount of stretch increased.

31

In conjunction with the figure, which choice from the passage provides the best evidence for the answer to the previous question?

A) Lines 27-30 (“The two . . . shell”)

B) Lines 30-32 (“On the . . . flakes”)

C) Lines 32-39 (“Due . . . weakly”)

D) Lines 40-43 (“With . . . oxide”)

Questions 32-42 are based on the following passage.

Passage 1 is adapted from W. J. Shaxby, An Eight-Hours Day. Originally published in 1898. Passage 2 is adapted from Sidney Webb, The Case For an Eight Hours Bill. Originally published in 1891. Shaxby and Webb discuss a proposal to limit the workday in England to eight hours.

Passage 1

All employers and all partizans, both socialist and anti-socialist alike, are now pretty well agreed that the reduction of working hours to the lowest number possible is desirable—that is, as far as is consistent with the prosperity and welfare of the commercial life of the nation, and as far as is necessary for the health and citizen life of the workmen.

The whole matter is really a question of contract, "labour" forming the commodity for sale. The contract needs but two parties to it—the seller of labour and the buyer of it; and in this there is no necessity for the State to interfere. . . .

It is well nigh impossible to overrate the advantages of fair and open discussion between employer and employed for the drawing up of the mutual agreement or contract upon the conditions of labour. The hours for local industries—industries in which there can be no competition, properly so-called (e.g, railways, tramways, gas-making, etc.)—can be arranged in this way without friction, without injury to either side from a material point of view, and without dislocation of trade.

We grant, therefore, that a workman, in order to advance himself physically, mentally, and morally, has a right to claim on his side of the labour contract such hours as will ensure him health to enjoy physical recreation [and] as will give him leisure to cultivate his mind. . . . We grant also that it should be the aim of every employer to accede to fair demands of this nature, providing that they secure his business interests, on which, be it noted, the interests of the employed wholly depend. But, if the conditions of trade will permit only of excessive hours of labour, the workman is free to accept or reject them or to compromise. The trade must stand or fall by the decision of the labourers. If a trade can only be carried on at the expense of the health, if not of the life, of its workers, they themselves have the power to kill that trade. A country's industries and the Legislature ought not to occupy the positions of a child and a nurse. . . . Ultra-protection and grandmotherly legislation place the workers in a humiliating position that would not be tolerated for a moment did they once clearly understand it. The duties of the Legislature are to serve the country's interests, not to tyrannically fetter and control them.

Passage 2

Some people are afraid that an Eight Hours Bill would destroy the personal independence of the English working man. Yet they know that the Factory Acts[1] . . . limit the hours of every man who works in a cotton-mill. Have the Lancashire operatives less personal independence than they had when their masters fixed the hours of labor at fifteen per day? Are the East-end tailors really freer than the men who work under the Factory Acts in the Yorkshire cloth mills? . . .

Why, indeed, should it injure the personal independence or the valiant self-reliance of working-men voters for them to fix by law their own hours of labor? Why should all the moral qualities of manliness be supposed to depend, in some mysterious way, upon the worker being exposed to long hours or any other form of industrial tyranny? No! Personal independence is produced, not by overwork and fear and suspicion, but by bodily and mental health, by regularity of life, and by that feeling of security which comes when humane conditions of employment are guaranteed to the workers by the only power which they know to be stronger than their masters: and that is the Power of the Law.

It may, indeed, be contended that the prevention of excessive hours of labor is one of the essential duties of Government in an advanced industrial community. It is universally admitted to be the primary duty of Government to prescribe the plane on which it will allow the struggle for existence to be fought out. . . . We prohibit the weapon of deceptive labels and trade-marks. . . . [W]e rule that adulteration[2] is not a legally permissible form of competition. We forbid slavery. . . . [and] we even refuse to uphold a life-long contract of service. The whole history of Government is, indeed, one long series of definitions and limitations of the conditions of the struggle, in order to raise the quality of the fittest who survive. This service can be performed only by Government. No individual competitor can lay down the rules for the combat.

[1] The Factory Acts were a series of laws enacted in the United Kingdom beginning in the early 1800s to regulate working conditions in factories, particularly in the textile industry.

[2] diluting or altering products in a way that misleads consumers about their quality or content

32

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

A) fashioning.

B) developing.

C) constituting.

D) starting.

33

As used in line 16, "conditions" most nearly means

A) surroundings.

B) forms.

C) disorders.

D) terms.

34

According to Shaxby in Passage 1, railways, tramways, and gas-making are industries in which

A) the length of the workday can be negotiated relatively easily.

B) profits will suffer most if the Eight Hours Bill is passed.

C) workers are likely to be discontented with their employers.

D) working hours have already been reduced to eight hours per day.

35

According to Shaxby in Passage 1, if a company subjects its workers to unhealthy conditions, those workers

A) may decide to unionize and issue formal demands to their employer.

B) may cause that company to fail by refusing to work there.

C) should request the government's aid in negotiating a new labor contract.

D) will be forced to look for employment in a different kind of trade.

36

In Passage 2, Webb most strongly implies that the Eight Hours Bill, if passed, would

A) face resistance among workers who would prefer to work longer hours.

B) spur further interventions by the government on behalf of workers.

C) resemble measures with which voters are already familiar.

D) address other grievances in addition to those concerning working hours.

37

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

A) Lines 44-46 ("Some . . . man")

B) Lines 46-48 ("Yet . . . cotton-mill")

C) Lines 53-59 ("Why . . . tyranny")

D) Lines 69-72 ("It is . . . out")

38

In the context of Webb's overall argument in Passage 2, the sentences in lines 73-77 ("We prohibit . . . service") mainly serve to

A) praise the government's commitment to protecting vulnerable groups from exploitation.

B) illustrate the claim that the government has long interfered in business affairs for the sake of the public good.

C) make the point that legislation once viewed as controversial may eventually be embraced by the public at large.

D) suggest that the aims of the Eight Hours Bill are relatively modest compared with other laws the government has adopted.

39

Based on the passages, Shaxby (Passage 1) and Webb (Passage 2) would most likely agree that for industrial workers, working hours should

A) be limited so as to promote workers' health and well-being.

B) vary in accordance with the individual desires of workers.

C) be negotiated by employers and their employees.

D) depend primarily on market demand and the needs of employers.

40

Based on Passage 1, Shaxby would object most strongly to Webb's assumption in Passage 2 that workers

A) have the right to refuse to enter into labor contracts that they regard as unfair.

B) desire a system of employment that will preserve their personal independence.

C) are more likely to secure fair working hours in some industries than in others.

D) lack the power to obtain concessions from employers who impose excessive work hours.

41

Which choice from Passage 1 provides the best evidence for the answer to the previous question?

A) Lines 1-7 ("All . . . workmen")

B) Lines 8-9 ("The whole . . . sale")

C) Lines 30-33 ("But . . . compromise")

D) Lines 42-43 ("The duties . . . them")

42

Based on Passage 2, Webb would most likely respond to Shaxby's claim in lines 39-43, Passage 1 ("Ultra-protection . . . understand it") by

A) maintaining that workers are willing to sacrifice a degree of their personal independence in exchange for legal protections.

B) asserting that workers will benefit from the legislation regardless of whether they fully grasp its implications.

C) observing that many workers hold the view that legislation is unnecessary for securing fair working hours.

D) countering that a legal remedy for excessive working hours reflects the desires of workers and is a means of empowering them.

Questions 43-52 are based on the following passage.

This passage is adapted from David Dickinson, "Apollo Astronauts Warmed the Moon." ©2018 by F+W Media, Inc.

In 1971 and 1972, the Apollo 15 and 17 missions deployed Apollo Lunar Surface Experiments Packages (ALSEP) that included a set of Heat Flow Experiment (HFE) monitors. The ALSEP packages, designed to probe the lunar interior over an extended period of time, were powered by a plutonium radioisotope thermoelectric generator (RTG) in order to survive through the two week long lunar night.

The astronauts placed the HFE monitors a few meters into the lunar surface to access soil undisturbed by the month-long day/night cycle. Lunar scientists planned to use the data to measure the flow of heat from the Moon's core to the surface, in hopes of characterizing geologic activity on the Moon.

Surprisingly, investigators noticed that the temperature of the regolith increased gradually at both the Apollo 15 and Apollo 17 sites, by 1.8% 10 3.6°F (1° to 2°C). The warming continued until the sensors fell silent in 1977. The thermal gradient decreased at both sites to the same degree, and the warming was more apparent at shallow depths than deeper down. The HFE sensors on the Moon were placed far enough away from the ALSEP RTG that radioactive heat wasn't a factor—so what was warming up the soil?

A hint came from mission differences in sensor placement: Apollo 15 astronauts had a problem drilling into the lunar soil and weren't able to reach the targeted 2.5-meter depth for their HFE sensor. Apollo 17 featured an improved drilling mechanism, and the astronauts were able to place the sensor deeper. In fact, data from the Apollo 15 sensors was not considered valid until it was compared with Apollo 17 sensors years later. Astronauts installed a number of different sensors at multiple depths at both the Apollo 15 and 17 sites.

Remarkably, the shallower sensors saw the anomalous heating first—just what you would expect if the heating mechanism was coming from the surface instead of the core below.

Now, a new study uses data recovered from the mid-1970s to demonstrate the cause of this anomalous heating: the astronauts themselves.

The study wouldn't have been possible without some detective work. NASA had only archived data from 1971 to 1974, storing it on magnetic tape at the National Space Science Data Center at the Goddard Space Flight Center in Greenbelt, Maryland. But the data collected in later years had gone missing.

A breakthrough came when researchers discovered an additional set of 440 archive tapes at the Washington National Records Center in Suitland, Maryland. Then researchers came across a set of weekly logs with hundreds of heat-flow temperature readings that filled in the gaps from 1973 to 1977. These logs had been stored at the Lunar and Planetary Institute in Houston, Texas.

The additional data solved the mystery of the warming Moon: as the astronauts walked and drove the lunar rover around the site, they disturbed the Moon's smooth surface. The rumpled surface better absorbed heat from the sunlight.

For those who often look up at the Moon, this conclusion may seem odd at first. We know that even though the full Moon appears to be a bright pearly white, its albedo or reflectivity is actually quite low (12% on average), about the same as worn asphalt. Astronauts described Moon dust as comparable in color and texture to coal dust. The material darkens over time due to interaction with the solar wind, a process called space weathering. Beneath this dark surface coating is more reflective material—this is why bright ejecta rays surround newer craters, as the impact has excavated brighter material from underneath the surface. So one might think that disturbing the surface would expose brighter material.

However, even though it's more reflective, the regolith underneath the dusty surface is coarser—and pebbles can hold on to heat for longer than fine dust can. So as the astronauts disturbed the dust, they exposed this coarser, more heat-absorbent material, and warmed the surface.

"A key piece of information was the photographic images obtained by the Lunar Reconnaissance Orbiter (LRO) camera," says geophysicist Seiichi Nagihara. The LRO had photographed the Apollo landing sites from low lunar orbit, providing evidence that backs up the temperature readings. "The images show that the places where the astronauts walked and drove their rovers turned darker, absorbing more solar heat than brighter soil."

43

As used in line 3, "included" most nearly means

A) welcomed.

B) contained.

C) admitted.

D) counted.

44

It can most reasonably be inferred from the passage that one likely reason scientists initially believed the data from the Apollo 15 sensors were potentially unreliable was that

A) temperature readings from HFE sensors above a certain depth may have been affected by factors other than the Moon's heat flow.

B) power from the RTG did not last long enough to collect sufficient data concerning the flow of heat from the Moon's core.

C) temperature readings of the regolith varied depending on whether the examined lunar soil was near a crater or not.

D) conflicting data prevented scientists from accurately determining the amount of heat retained by lunar soil.

45

Which choice best supports the idea that the investigators are uncertain how long the warming trend continued in the lunar soil in the sites studied by the astronauts?

A) Lines 15-17 ("Surprisingly . . . to 2°C")

B) Lines 17-18 ("The warming . . . 1977")

C) Lines 19-21 ("The thermal . . . down")

D) Lines 30-32 ("In fact . . . later")

46

Based on the passage, it can most reasonably be inferred that the Apollo 15 and Apollo 17 astronauts initially took steps to minimize the likelihood that their data were affected by

A) heat flowing from the Moon's core to the regolith they studied.

B) heat emitted by the instruments they used to collect temperature readings.

C) alterations in the Moon's surface as a result of space weathering.

D) variations in the depth at which the temperature sensors were placed.

47

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

A) Lines 1-4 ("In 1971 . . . monitors")

B) Lines 9-11 ("The astronauts . . . cycle")

C) Lines 21-24 ("The HFE . . . soil")

D) Lines 65-67 ("The material . . . weathering")

48

In context, the phrase in lines 36-38 ("just . . . below") mainly serves to

A) underscore the idea that the Apollo scientists anticipated a particular outcome.

B) point out a misperception the author believes many people would have.

C) establish that the Apollo astronauts' approach was somewhat flawed.

D) suggest the reasonableness of a particular explanation for a phenomenon.

49

As used in line 40, "demonstrate" most nearly means

A) perform.

B) protest.

C) reveal.

D) support.

50

Based on the passage, if the researchers' hypothesis (lines 55-59) is correct, which claim regarding astronauts' activities during the Apollo 15 and Apollo 17 missions can most reasonably be inferred?

A) The astronauts' activities caused an increase in the release of heat from the Moon's core in places where they walked and drove.

B) The astronauts' activities affected temperature readings taken at the Apollo 17 sites more than those taken at the Apollo 15 sites.

C) The astronauts' activities altered the lunar surface to a greater extent during the Apollo 15 mission than during the Apollo 17 mission.

D) The astronauts' activities led to the warming of subsurface lunar soil that neither they nor their vehicles came into direct contact with.

51

In context, the author's mention of "worn asphalt" (line 64) mainly serves to

A) clarify an aspect of the Moon's appearance by offering a familiar frame of reference.

B) help account for the difficulty astronauts faced when drilling into lunar soil.

C) convey astronauts' initial impressions of the appearance of the Moon's surface.

D) explain how human disturbance affects the lunar surface by providing a comparison.

52

According to the passage, the researchers believe that astronauts' movements affected the temperature of the lunar surface by

A) uncovering particles of the regolith, which then retained heat from the sunlight that reached them.

B) crushing surface particles into fine dust, which then absorbed heat from the Sun.

C) darkening the dust on the surface, which then interacted with the solar wind.

D) dispersing particles of regolith, which then increased in reflectivity.

STOP

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

April 12, 2023 QAS: Writing & Language

Questions 1-11 are based on the following passage and supplementary material.

Choose Your Own Job Title

Google has a captain of moonshots; Quicken Loans, an energy focuser; and the Motley Fool, a chief rabble rouser of the highest order. These job titles may seem unusual, but they represent a recent trend in the business world: employee self-titling. Advocates of the practice argue that 1 if employees are allowed to pick their own job titles, that is good for them. Being allowed to pick their own titles ultimately improves their psychological well-being—a claim supported by a study conducted by researchers from the University of Pennsylvania and the London Business School.

1

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

A) it is good for employees to be allowed to pick their own job titles, and also, picking titles

B) when employees are allowed to pick their own job titles, picking them

C) allowing employees to pick their own job titles

D) picking their own job titles affects employees: when they pick them, it

[1] Working with the employees of a health care system in the southeastern United States, researchers studied how self-titling affects emotional exhaustion, self-verification (ability to express and affirm oneself at work), and psychological safety (comfort level with coworkers and managers). [2] First, employees completed a pretest, using a seven-point scale to rate their agreement with 2 statements such as "I feel burned out from my work" and "I feel that people at work understand who I am." [3] The researchers then separated employees into three groups. [4] In the first group, employees attended a workshop where they created self-titles to supplement their existing titles. [5] To rule out the possibility that simply attending a workshop (and not self-titling itself) could affect employee attitudes, the researchers 3 use the second group as a nonequivalent control. [6] These employees also attended a workshop, but instead of creating self-titles, they collaborated with managers on a problem-solving scenario. [7] The third group acted as a pure 4 control, these workers—did not attend any workshop at all. [8] After five weeks, employees in each group completed a posttest. 5

2

A) NO CHANGE
B) statements—
C) statements,
D) statements;

3

A) NO CHANGE
B) will be using
C) could use
D) used

4

A) NO CHANGE
B) control, these workers:
C) control these workers
D) control: these workers

5

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

> For example, an infectious disease doctor chose the title Germ Slayer, and a pediatric nurse dubbed herself Quick Shot.

The best placement for the sentence is

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

Researchers compared the pretests and posttests and found that the self-titling group experienced reduced emotional exhaustion, going from an average rating of 6 5.18 to 4.91. This group also saw increased self-verification and psychological safety, with averages changing from 5.38 to 5.69 and from 4.71 to 4.97, respectively. Conversely, in both control groups, averages for 7 emotional exhaustion and self-verification increased while those for psychological safety decreased.

6

Which choice most accurately represents the data in the table?

A) NO CHANGE
B) 3.02 to 2.70.
C) 5.13 to 5.10.
D) 4.88 to 4.70.

7

Which choice most accurately represents the data in the table?

A) NO CHANGE
B) emotional exhaustion increased while those for self-verification and psychological safety
C) self-verification increased while those for emotional exhaustion and psychological safety
D) psychological safety and self-verification increased while those for emotional exhaustion

Emotional Outcomes of Employee Self-Titling

Test group	Emotional exhaustion		Self-verification		Psychological safety	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
Self-titling workshop	3.02	2.70	5.38	5.69	4.71	4.97
Nonequivalent control	2.94	3.11	5.30	5.08	5.13	5.10
Pure control	2.80	3.08	5.18	4.91	4.88	4.70

1 indicates the lowest agreement, and 7 indicates the highest agreement.

Adapted from Adam M. Grant, Justin M. Berg, and Daniel M. Cable, "Job Titles as Identity Badges: How Self-Reflective Titles Can Reduce Emotional Exhaustion." ©2014 by the Academy of Management.

These results suggest that self-titling does, in fact, have psychological benefits. By using self-titles, employees may think of themselves as capable and unique among their 8 colleagues. Providing a way to maintain what researchers call the "'me' within the 'we'" of an organization. 9 However, companies 10 might not want to embrace self-titling just yet: the authors of the study warn that more research is needed before 11 they can be applied to all industries.

8

A) NO CHANGE
B) colleagues; providing
C) colleagues, providing
D) colleagues, this provides

9

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

> Regular performance-review meetings between managers and their employees may also help improve employee productivity.

Should the writer make this addition here?

A) Yes, because it provides additional support for the study's findings about self-titling.
B) Yes, because it creates an effective transition to the sentence that follows in the paragraph.
C) No, because it unnecessarily repeats information about self-titling provided earlier in the passage.
D) No, because it makes a point that is irrelevant to the topic of the passage.

10

A) NO CHANGE
B) should hold their horses about self- titling:
C) might want to wait and see how this whole self-titling thing plays out:
D) shouldn't get all excited about self-titling right now:

11

A) NO CHANGE
B) their results
C) one
D) each of them

Questions 12-22 are based on the following passage.

A New Verdict on Ancient Flight

Archaeopteryx ("old wing") was a raven-sized dinosaur that lived 150 million years ago. 12 On the other hand, when paleontologists first uncovered *Archaeopteryx* fossils in 13 1861. They were surprised to find that the animal had feathered wings, and, ever since, they have debated whether and (if so) how *Archaeopteryx* flew. Most paleontologists agree that *Archaeopteryx* was a climber that used its wings to glide down from treetops, but a critical question remains: could it *only* glide or was it also capable of self-powered flight, flapping its wings to lift off the ground?

12

A) NO CHANGE
B) As a result,
C) Similarly,
D) DELETE the underlined portion, adjusting the capitalization as necessary.

13

A) NO CHANGE
B) 1861, they
C) 1861, and they
D) 1861 they

[1] Using modern bird anatomy for comparison, many paleontologists have argued that *Archaeopteryx* was limited to gliding because it was incapable of creating the powerful wing flaps necessary to achieve self-powered flight. [2] Modern flying birds have bony, keel-shaped sternums (breastbones) that anchor the large chest muscles required for producing strong downward flaps. [3] Additionally, bird shoulders **14** admit a "pulley" **15** system: the end of the supracoracoideus muscle (a muscle in the chest) curves around the shoulder blade before attaching to the wing, allowing birds to raise their wings with their chests instead of their backs or shoulders. **16**

14

A) NO CHANGE
B) meld
C) consolidate
D) incorporate

15

A) NO CHANGE
B) system—the end of the supracoracoideus muscle—
C) system, the end of the supracoracoideus muscle
D) system; the end of the supracoracoideus muscle,

16

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

> *Archaeopteryx* lacks both features, so some researchers concluded that it exclusively used its wings to glide.

The best placement for the sentence is

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

Nevertheless, other scientists contend that *Archaeopteryx* 17 had been classified by paleontologists as the first bird 150 years ago. Recently, a team of researchers in Europe led by Dennis F. A. E. Voeten used intense synchrotron X-rays to generate detailed cross-sectional images of *Archaeopteryx* fossils. The team examined *Archaeopteryx*'s wing bones, paying close attention to the bones' hard outer layers, or cortical walls. In the wing bones of modern flying birds, the cortical walls provide the structure and strength needed for the bone to withstand the stresses of flight. Voeten and his 18 team discovered that—*Archaeopteryx*'s cortical walls resemble 19 pheasants and turkeys, birds that spend most of their time on the ground but are capable of short bursts of self-powered flight. 20 Voetens findings suggest that *Archaeopteryx* was similarly capable of self-powered flight for short periods.

17

Which choice most effectively anticipates the researchers' findings described in the paragraph?

A) NO CHANGE
B) somehow achieved a degree of self-powered flight.
C) shared the feather and head structure of the earliest birds.
D) was in the process of losing its ability to fly.

18

A) NO CHANGE
B) team, discovered that,
C) team discovered that
D) team discovered: that

19

A) NO CHANGE
B) those found in pheasants and turkeys,
C) that found in pheasants and turkeys,
D) DELETE the underlined portion.

20

A) NO CHANGE
B) Voetens findings'
C) Voeten's findings
D) Voeten's finding's

If *Archaeopteryx* did in fact achieve self-powered flight—even in bursts—it 21 must have done so with a wing flap unlike that of modern birds. Without the keeled sternum and supracoracoideus pulley configuration, *Archaeopteryx* may have instead flapped its 22 wings. It did this with muscles that attached at the shoulder, not at the chest. Ultimately, further research into *Archaeopteryx* anatomy may write a new chapter in the history of dinosaur flight.

21

Which choice most effectively establishes the main discussion of the paragraph?

A) NO CHANGE
B) would have spent most of its time foraging for food.
C) normally would have been more comfortable remaining on the ground.
D) probably did not employ such locomotion except in an emergency.

22

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

A) wings and done so
B) wings
C) wings in a manner that moved them
D) wings; it accomplished it

Questions 23-33 are based on the following passage.

A Virtual Deep Dive

23 Virtual reality programs that give people the impression of swimming in the ocean can use some improvement. Schools of colorful fish swim by, and the seabed beneath you 24 have been festooned with breathtaking coral reefs, seagrass, and sea snails. Suddenly, the scene changes: the crystal-clear water muddies, and red-brown algae 25 will be engulfing the surrounding sea life. Such a scenario depicts the kind of devastation that results from ocean acidification, a process that is driven by rising

23

Which choice most effectively leads into the discussion that follows in the paragraph?

A) NO CHANGE
B) Imagine yourself underwater in a picturesque bay off the coast of Italy.
C) Wildlife conservation is a career field that involves addressing issues in ecosystems such as the following.
D) Ask any scuba diver why they love diving and they will likely tell you that they love the tranquility and adventure.

24

A) NO CHANGE
B) are
C) are being
D) is

25

A) NO CHANGE
B) had engulfed
C) engulf
D) would engulf

atmospheric levels of carbon dioxide. Ordinarily, few people could experience these circumstances 26 firsthand. However, anyone can experience these circumstances now, thanks to Stanford University, where a recent virtual reality program was created for this purpose not long ago. Furthermore, a growing body of research suggests that conservationists should take advantage of this technology to spread awareness of environmental threats and encourage eco-friendly behavior.

26

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

A) firsthand, but thanks to a recent virtual reality program created at Stanford University, now anyone can.

B) firsthand; however, this experience can now be had by anyone, thanks to a virtual reality program created recently at Stanford University.

C) firsthand; however, recently thanks to Stanford University, a virtual reality program was created so that anyone can experience these circumstances.

D) firsthand, but a virtual reality program, created recently at Stanford University, thankfully changed this so all people can now.

[1] Like many environmental problems, ocean acidification is a difficult concept for most people to fully grasp, since it often occurs out of sight and happens over long periods of time. [2] People who might otherwise never be 27 accosted by the problem can "experience what ocean acidification can do to marine life," says 28 ecologist Kristy Kroeker a consultant for the project. [3] The immersiveness of the experience can also help elicit an emotional response, so that users not only learn about the issue but also start to care about it. 29

27

A) NO CHANGE
B) encountered by
C) confronted with
D) in contention with

28

A) NO CHANGE
B) ecologist Kristy Kroeker,
C) ecologist—Kristy Kroeker,
D) ecologist, Kristy Kroeker

29

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

> An interactive experience like that of the Stanford virtual reality program, however, can demonstrate the effects of acidification in an immediate and visceral manner.

The best placement for the sentence is

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

Do such programs change anyone's actions, though? A 2015 study suggests they can. At the start of the study, 30 researchers predicted that participants would use less hot water if they received personalized messages. The participants then went on to take virtual showers that varied in vividness. Later, when the participants were asked to wash their hands, those who had taken the vivid virtual shower used slightly less hot water than 31 taking the not-vivid virtual shower. While these 32 changes in attitudes may not be in and of themselves a substitute for pro-environmental policies, 33 even simple virtual reality experiences appear to inspire small environmentally friendly actions that collectively can have significant impact.

30

Which choice best sets up the discussion about the study that follows in the paragraph?

A) NO CHANGE
B) participants were shown and asked to touch nearly four pounds of coal.
C) participants read about a typical shower's environmental impact in terms of water and energy consumption.
D) researchers made sure to take photographs of each of the participants.

31

A) NO CHANGE
B) when participants took
C) those who had taken
D) DELETE the underlined portion.

32

A) NO CHANGE
B) changes in attitude's
C) changes' in attitudes'
D) changes in attitudes'

33

Which choice provides the most effective rebuttal to the claim introduced earlier in the sentence?

A) NO CHANGE
B) the United States Department of Energy lists reducing hot water usage as one way to diminish energy consumption.
C) the study's results mirror those of another study in which the virtual reality experience of cutting down redwood trees inspired participants to conserve paper.
D) other incentives, such as energy cost savings, may convince consumers to make decisions that positively impact the environment.

Questions 34-44 are based on the following passage.

The Juchitán Medusa

In the early 1920s, word began to spread about Juchitán de Zaragoza, a city in Oaxaca, Mexico, known as a cultural hub of the Indigenous Zapotec people. 34 Oaxaca, Mexico, is also home to the Indigenous Mixtecs. Revered for the bold and fashionable women who ran 35 its economy, Juchitán attracted artists from around the world who were inspired by how the Zapotecs lived. 36 Indeed, the city's most famous artwork wasn't created by a foreign artist; rather, it was the product of a partnership between Mexico City–based photographer Graciela Iturbide and the Zapotec women she met in Juchitán.

34

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

A) Kept, because it mentions another Indigenous group that lives in the area.
B) Kept, because it clarifies a claim made earlier in the passage.
C) Deleted, because it interrupts the discussion of Juchitán with loosely related information.
D) Deleted, because it doesn't include the other Indigenous peoples of Oaxaca.

35

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

36

A) NO CHANGE
B) However,
C) Furthermore,
D) Therefore,

In 1979, famed Mexican 37 artist and Juchitán local Francisco Toledo invited Iturbide to take photos for display in the city's cultural center. Unlike many artists at the time, Iturbide didn't want to simply admire the Zapotec culture from a distance; she set out to connect with the people of Juchitán before photographing them, insistent that she wanted them to play an active role in her work. Soon, the local women adopted her into the 38 community. They showed her around the city and inviting her to fiestas and on pilgrimages. They even suggested photos for her to take. "I discovered the Zapotec people through their eyes," Iturbide said.

37

A) NO CHANGE
B) artist, and Juchitán local Francisco Toledo
C) artist, and Juchitán local, Francisco Toledo,
D) artist and Juchitán local Francisco Toledo:

38

A) NO CHANGE
B) community; by showing
C) community, showing
D) community and showed

[1] It was during this cultural immersion that Iturbide photographed what became the city's most iconic image. [2] While taking photos at the busy local market, Iturbide spied a 39 merchant, Zobeida Díaz, balancing her wares atop her head. [3] Dressed in a flower-patterned blouse, Díaz wore a serene confidence as the eight live iguanas on her head faced every direction like 40 a flock of pigeons. [4] Iturbide captured the scene at a low 41 angel and on her usual black-and-white palette, accentuating Díaz's queenly pose. 42

39

A) NO CHANGE
B) merchant named Zobeida Díaz, and Díaz was
C) merchant known by the name of Zobeida Díaz
D) merchant, Zobeida Díaz, and saw her

40

Which choice best supports the description of Díaz in the paragraph?

A) NO CHANGE
B) cars stuck in traffic.
C) points on a crown.
D) a field of tulips.

41

A) NO CHANGE
B) angel and with
C) angle and at
D) angle and in

42

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

> Rather than the textiles, fish, and vegetables that many of the other Zapotec women offered, Díaz sold iguanas.

The best placement for the sentence is

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

When Iturbide presented her Juchitán photos to Toledo and he 43 showed and exhibited them at the cultural center, she was surprised to find that the photo of Díaz—called *Nuestra Señora de las Iguanas* (*Our Lady of the Iguanas*)—was a hit. Toledo created a postcard of the image, and people in town put up posters of it in their homes, dubbing it the "Juchitán Medusa," after the figure in Greek mythology who had snakes on her head instead of hair. As the photo spread beyond Juchitán and gained international fame, this mythological renaming spread as well, exemplifying the collaborative role the Zapotecs played in Iturbide's art. "I never think of my images as a project, I simply live the situations and photograph them," she says. "The camera is an excuse to share the life of the people." Thanks to the Juchitán Medusa, the whole world can now see the Zapotec people's life as Iturbide 44 did. From their perspective.

43

A) NO CHANGE
B) exhibited them
C) showed the presented photos
D) set them out for their exhibition

44

A) NO CHANGE
B) did; from
C) did from
D) did: from

STOP

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

Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

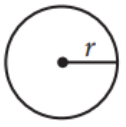
DIRECTIONS

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

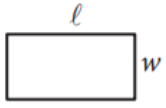
NOTES

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



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



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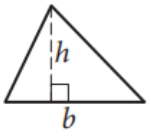

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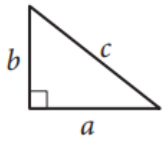

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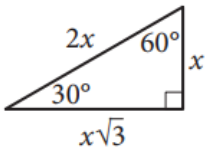
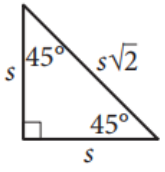
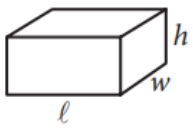
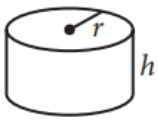




Special Right Triangles

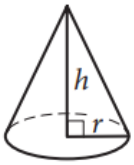


$V = \ell wh$

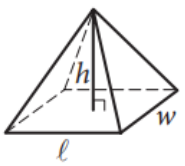


$V = \pi r^2 h$

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



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



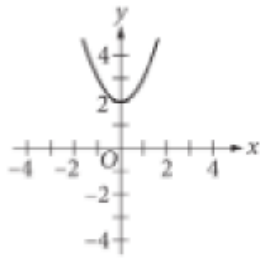
$V = \frac{1}{3}\ell wh$

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.

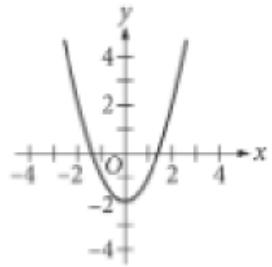
1

What is the graph of the equation $y = x^2 - 2$?

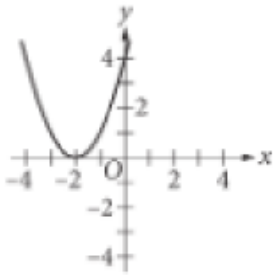
A)



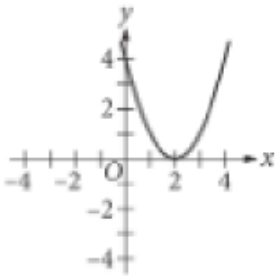
B)



C)



D)



2

$$T = NC$$

For a particular college program, the given equation relates the cost of tuition T, in dollars, to the number of credits taken, N, and the cost of each credit C, in dollars, where N and C are positive numbers. Which equation correctly expresses C in terms of N and T ?

A) $C = TN$

B) $C = T - N$

C) $C = \frac{N}{T}$

D) $C = \frac{T}{N}$

3

The linear function f is defined by $f(x) = 2(x - 1)$. What is the value of $f(4)$?

A) 1.5

B) 3

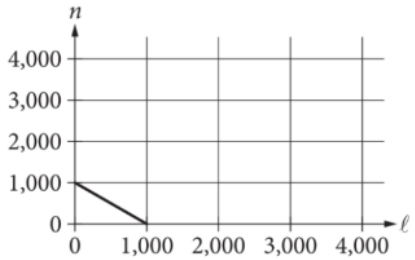
C) 6

D) 7

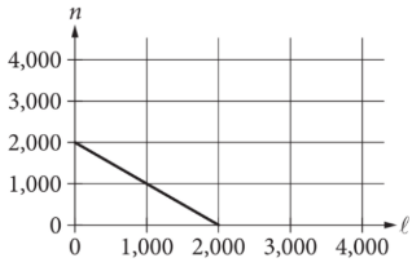
4

The equation $\ell + n = 2{,}000$ represents the possible combinations of the amounts of money, in dollars, that Lucia could invest in two bonds, where ℓ and n represent the amount of money, in dollars, that she could invest in Bond L and Bond N, respectively. Which of the following graphs represents the relationship between the possible combinations of the amounts of money, in dollars, that she could invest in Bond L and Bond N?

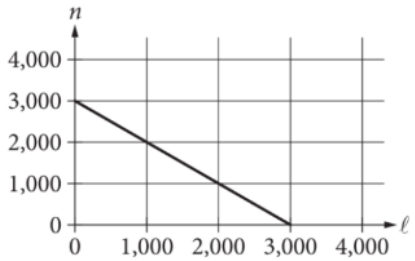
A)



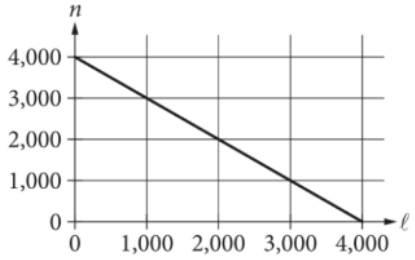
B)



C)



D)



5

In Pacific Northwest Native American cultures, people make totem poles to depict family legends and historical events. Jolon made a totem pole in x hours. He spent $\frac{1}{6}$ of the total time designing the pole, $\frac{1}{3}$ of the total time sketching the design on the pole, $\frac{1}{4}$ of the total time chiseling the design on the pole, and the remaining 24 hours of the total time sanding and painting the pole. Which of the following equations can be used to determine the total number of hours, x, he spent making the totem pole?

A) $x = \frac{1}{13}x + 24$

B) $x = \frac{3}{13}x + 24$

C) $x = \frac{2}{3}x + 24$

D) $x = \frac{3}{4}x + 24$

6

Which expression is equivalent to $\sqrt[4]{a^9}$?

A) $a^{\frac{9}{4}}$

B) $a^{\frac{4}{9}}$

C) a^{13}

D) a^{36}

7

A circle in the *xy*-plane has its center at $(3, 5)$ and has a radius of 6. What is an equation of the circle?

A) $(x-3)^2+(y-5)^2=6$

B) $(x+3)^2+(y+5)^2=6$

C) $(x-3)^2+(y-5)^2=36$

D) $(x+3)^2+(y+5)^2=36$

8

One of the two linear equations in a system is $3x+4y=8$. The system has exactly one solution. Which of the following could be the other equation in the system?

A) $\frac{3}{2}x+2y=4$

B) $3x+4y=4$

C) $4x+3y=8$

D) $6x+8y=16$

9

$$x^2-3x-1=0$$

What is one of the solutions of the given equation?

A) $\frac{-3+\sqrt{13}}{2}$

B) $\frac{-3+\sqrt{5}}{2}$

C) $\frac{3+\sqrt{5}}{2}$

D) $\frac{3+\sqrt{13}}{2}$

10

The function $f(x)=2x+2(2x+1)$ gives the perimeter, in meters, of a rectangle that has a width of x meters. Which of the following is the best interpretation of $2x+1$ in this context?

A) The length, in meters, of the rectangle

B) The width, in meters, of the rectangle

C) Half the perimeter, in meters, of the rectangle

D) Twice the length, in meters, of the rectangle

11

Line k has a slope of $-\frac{4}{5}$ and an x-intercept of $\left(\frac{r}{2}, 0\right)$, where r is a constant. What is the y-coordinate of the y-intercept of line k in terms of r ?

A) $-\frac{2r}{5}$

B) $\frac{2r}{5}$

C) $-\frac{5r}{8}$

D) $\frac{5r}{8}$

12

A sphere and a right circular cylinder both have radius r. The height of the cylinder is 18. For what value of r will the volume of the sphere be twice the volume of the cylinder?

A) 6.75

B) 13.5

C) 27

D) 54

13

$$-2|x-5| = -4x$$

What are all possible solutions to the given equation?

A) -5

B) $\frac{5}{3}$

C) -5 and $\frac{5}{3}$

D) 5 and $-\frac{5}{3}$

14

$$f(x) = \left(\frac{3}{4}\right)^x + 5$$

If the function f is graphed in the xy-plane, where $y = f(x)$, what is the y-intercept of the graph?

A) $\left(\frac{3}{4}, 5\right)$

B) $\left(\frac{3}{4}, 0\right)$

C) $(0, 5)$

D) $(0, 6)$

15

$$f(x) = (2x+3)(2x-5)$$

What is the minimum value of the given function?

A) -16

B) $-\frac{3}{2}$

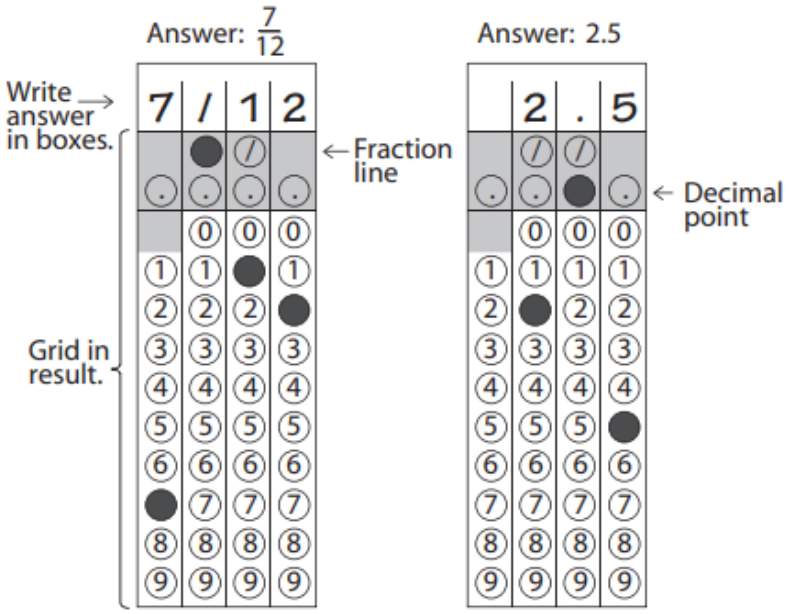
C) $\frac{1}{2}$

D) 2

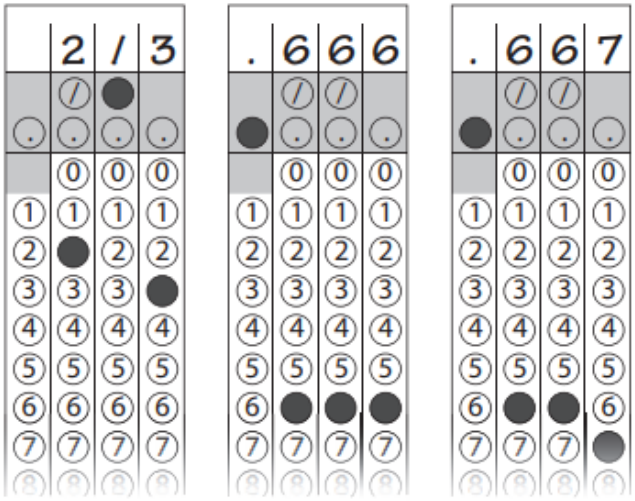
DIRECTIONS

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

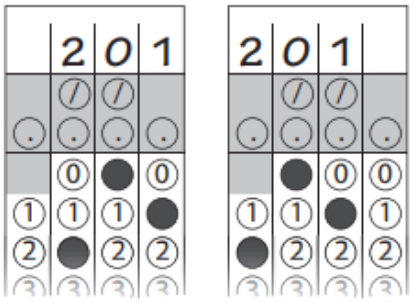
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.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



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.

16

What value of x satisfies the equation $\frac{1}{8}x + \frac{1}{4} = \frac{1}{2}$?

17

The expression $\frac{4x^{11}}{12x^5}$ is equivalent to $\frac{1}{3}x^b$, where b is a constant and $x > 0$. What is the value of b?

18

In right triangle ABC, angle C is a right angle and $\sin A = 0.70$. What is the value of $\cos B$?

19

The function f is defined by $f(r) = (r-1)(r+2)^2$.

If $f(h-5) = 0$, where h is a constant, what is one possible value of h?

20

$$-8x - 24 = 10y$$

$$15y = 6 - 18x$$

The solution to the given system of equations is (x, y). 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.

Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

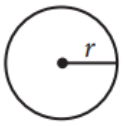
DIRECTIONS

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

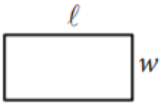
NOTES

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.

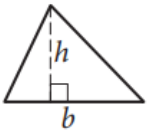
REFERENCE



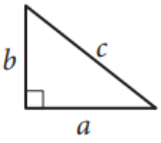
$A = \pi r^2$
$C = 2\pi r$



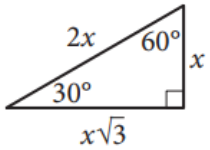
$A = \ell w$

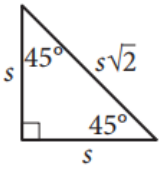


$A = \frac{1}{2}bh$

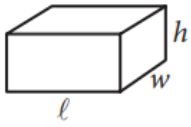


$c^2 = a^2 + b^2$

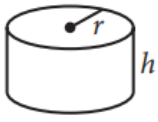




Special Right Triangles

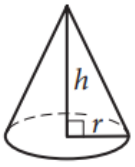


$V = \ell wh$

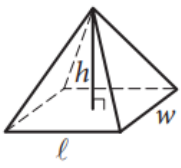


$V = \pi r^2 h$

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



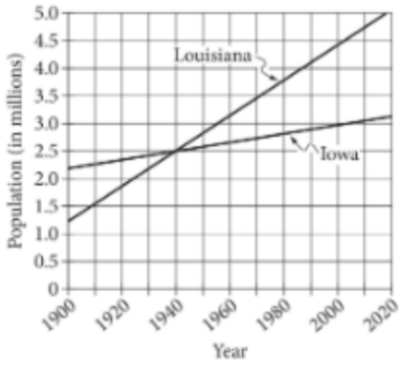
$V = \frac{1}{3}\pi r^2 h$



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

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

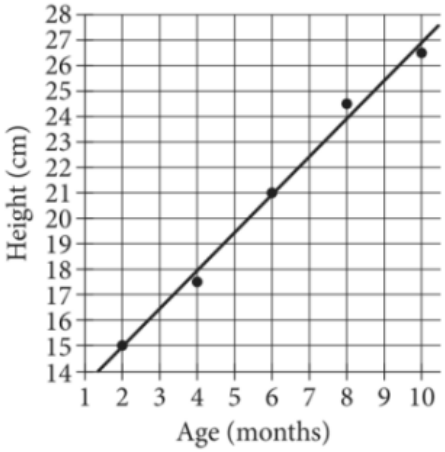


The lines shown model the populations of Iowa and Louisiana from 1900 to 2020. In what year does the graph indicate that Iowa and Louisiana had the same population?

A) 1900
B) 1940
C) 1990
D) 2000

2

A researcher measured the height of a poodle's shoulders from the ground, in centimeters (cm), as it aged over 10 months. The scatterplot shows this relationship. A line of best fit for the data is also shown.



What is the height of the poodle's shoulders, in cm, predicted by the line of best fit when the poodle is 5 months old?

A) 18.7
B) 19.4
C) 20.7
D) 21.8

3

Each face of a fair number cube is labeled with a number from 1 through 6, with a different number appearing on each face. If the number cube is rolled one time, what is the probability that the number 2 will be shown on the top face?

A) $\frac{1}{6}$

B) $\frac{2}{6}$

C) $\frac{4}{6}$

D) $\frac{5}{6}$

4

A car's fuel efficiency is 30 miles per gallon of gasoline. During a trip, the car uses 5 gallons of gasoline. Based on the car's fuel efficiency, how many miles did the car travel during the trip?

A) 5
B) 6
C) 35
D) 150

5

A line in the xy-plane passes through the point $(0, 5)$ and has a slope of 7. What is an equation of this line?

A) $y = 5x - 7$

B) $y = 5x + 7$

C) $y = 7x - 5$

D) $y = 7x + 5$

6

$$y < x$$

$$x > 7$$

What point (x, y) is a solution to the given system of inequalities in the xy-plane?

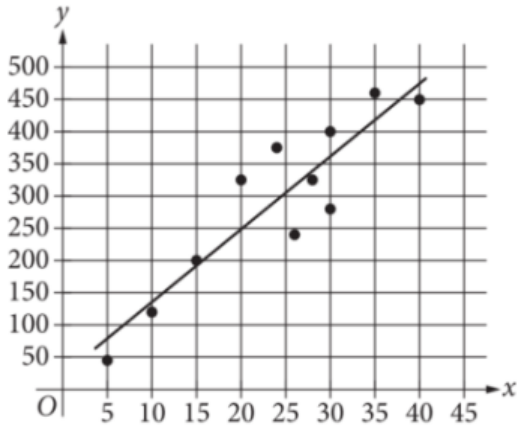
A) $(0, 1)$

B) $(3, 2)$

C) $(6, 7)$

D) $(9, 8)$

7



In the given scatterplot, a line of best fit for the data is shown. At $x = 20$, approximately how much greater is the actual y-value than the y-value predicted by the line of best fit?

A) 3

B) 20

C) 75

D) 250

8

The average price of regular gasoline, per gallon, in the United States in 2001 was \$1.42. Each year from 2001 to 2008, the average price increased by approximately 12% of the previous year's average price. Which equation best models this situation, where y is the average price, in dollars, of regular gasoline, per gallon, and x is the number of years since 2001?

A) $y = 1.12^x$

B) $y = 1.42^x$

C) $y = 1.12(1.42)^x$

D) $y = 1.42(1.12)^x$

9

$$5x + 3y = 7$$

$$2x + y = 2$$

The solution to the given system of equations is (x, y). What is the value of $7x + 4y$?

A) 2

B) 7

C) 9

D) 23

10

In a certain election, the ratio of electoral votes received in Maine by Candidate X to those received by Candidate Y was 3 to 1. The state of Maine had 4 electoral votes in this election. How many electoral votes did Candidate Y receive in Maine?

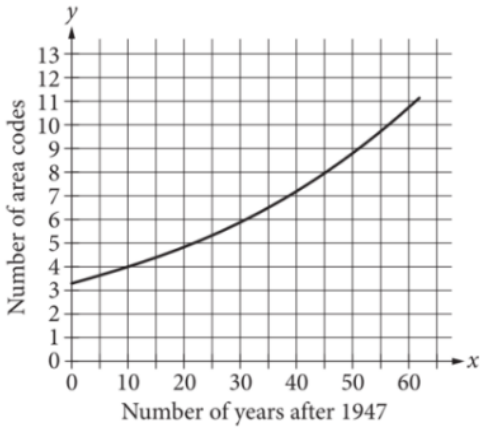
A) 1

B) 2

C) 3

D) 4

11



The graph shown models the number of area codes assigned to phone numbers in Illinois from 1947 through 2009, where x represents the number of years after 1947. Which equation represents this relationship?

A) $y = 1.02(3.26)^{-x}$

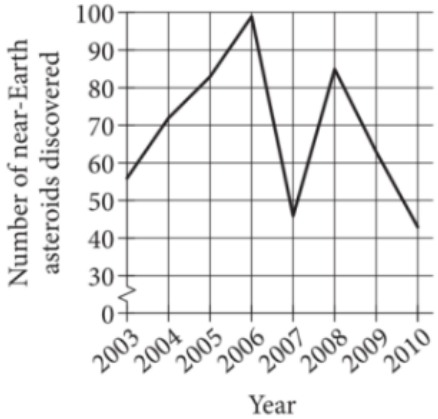
B) $y = 3.26(1.02)^{-x}$

C) $y = 1.02(3.26)^{x}$

D) $y = 3.26(1.02)^{x}$

12

The line graph shows the number of near-Earth asteroids discovered by the Spacewatch survey from 2003 to 2010.



During which period was the increase in the number of near-Earth asteroids discovered the greatest?

A) From 2003 to 2004

B) From 2004 to 2005

C) From 2005 to 2006

D) From 2007 to 2008

13

There are infinitely many solutions to which of the following equations?

I. $4(x + 1) + 2 = 4x + 6$

II. $4(x + 1) + 1 = 4x + 7$

A) I only

B) II only

C) I and II

D) Neither I nor II

14

A sample of 50 employees from the finance department at Company XYZ was selected at random. The 50 employees completed a survey about a website's ease of use, and 72% of them thought the website was easy to use. Which of the following is the largest population to which the results of this survey can be generalized?

A) All employees in a finance department in the United States

B) All employees in Company XYZ

C) All employees in the finance department in Company XYZ

D) All employees in the sample

15

$$r = \frac{10}{3}s$$

The given equation shows a proportional relationship between the variables r and s. Which expression is equivalent to $6r$?

A) $20s$

B) $60s$

C) $\frac{5}{9}s$

D) $\frac{16}{3}s$

16

Data set P: 12, 18, 19, 19, 19, 19, 19, 21, 21, 22, 22

Data set P contains the lengths, in inches, of 11 objects. The length 12 inches is removed from data set P to create data set N, which contains the lengths, in inches, of 10 objects. Which statement best compares the mean q and the median r of data set P with the mean s and the median t of data set N?

A) $q < s; r > t$

B) $q = s; r > t$

C) $q < s; r = t$

D) $q = s; r = t$

17

$$6 = \frac{2}{3}(x - 7)$$

Which equation has the same solution as the given equation?

A) $9 = x - 14$

B) $9 = \frac{2}{3}x - 7$

C) $9 = x - 7$

D) $9 = x - \frac{14}{3}$

18

Distance (miles)	Average time (minutes)
0.16	4
0.48	12
0.72	18

The table shows the average time t, in minutes, it takes Oliver to walk a certain distance d, in miles. Which equation could represent this linear relationship?

A) $t = 40d$

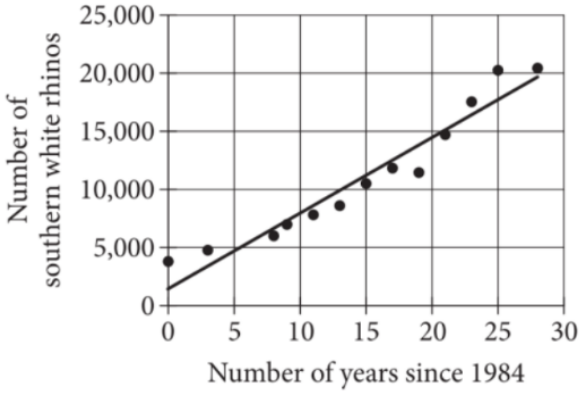
B) $t = 25d$

C) $t = \frac{1}{25}d$

D) $t = \frac{1}{40}d$

Questions 19 and 20 refer to the following information.

The number of southern white rhinos was 3,800 in 1984. Due to conservation methods over time, the number of southern white rhinos increased to 20,405 by 2012. The scatterplot shows the relationship between time, in number of years since 1984, and the number of southern white rhinos. A line of best fit for the data is also shown.



19

What is the best approximation for the ratio of southern white rhinos in 1984 to southern white rhinos in 2012?

A) 1 to 3

B) 1 to 5

C) 1 to 20

D) 1 to 28

20

Which value is closest to the slope of the line of best fit shown?

A) –2,500

B) –650

C) 650

D) 2,500

21

$$\sqrt{x^2} = 5$$

What are all possible solutions to the given equation?

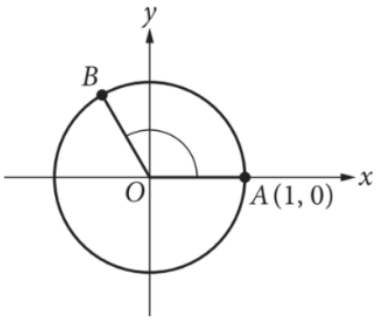
A) –25 and 25

B) –5 and 5

C) –25 only

D) 5 only

22



In the figure shown, points A and B lie on the circle with radius 1 centered at the origin, O. If the cosine of $\angle AOB$ is $-\frac{1}{2}$, what is the measure, in radians, of $\angle AOB$?

A) $\frac{5\pi}{12}$

B) $\frac{7\pi}{12}$

C) $\frac{2\pi}{3}$

D) $\frac{5\pi}{6}$

Questions 23 and 24 refer to the following information.

Oocytes are a type of cell that can be modeled as a sphere. The table shows the surface area, in square micrometers (μm^2), and volume, in cubic micrometers (μm^3), based on the average radius for oocytes at the same stage of development in four types of mammals. (The surface area of a sphere with a radius of r is $4\pi r^2$, and the volume of a sphere with a radius of r is equal to $\frac{4}{3}\pi r^3$.)

Mammal	Surface area (μm^2)	Volume (μm^3)
Mouse	498.76	1,047.4
Hamster	1,720.2	6,708.8
Pig	2,660.3	12,903
Human	4,071.5	24,429

23

The volume of a mouse oocyte is approximately what percent of the volume of a human oocyte?

A) 4.29%

B) 8.16%

C) 12.25%

D) 23.32%

24

Based on the information in the table, what is the average radius, in micrometers, of a hamster oocyte?

A) 68.4

B) 20.7

C) 14.2

D) 11.7

25

Under certain conditions, the equation $9.8T^2 = 4\pi^2 L$ models the time T, in seconds, it takes for a pendulum to complete one cycle, where L is the length, in meters, of the pendulum. Solving the equation for T yields $T = 2\pi\sqrt{\frac{L}{9.8}}$. Which of the following is the best interpretation of $T = 2\pi\sqrt{\frac{12}{9.8}}$ in this context?

A) The time, in seconds, it takes a pendulum of $2\pi\sqrt{\frac{12}{9.8}}$ length meters to complete one cycle

B) The time, in seconds, it takes a pendulum of length 9.8 meters to complete one cycle

C) The time, in seconds, it takes a pendulum of length 12 meters to complete one cycle

D) The time, in seconds, it takes a pendulum of length $\frac{12}{9.8}$ meters to complete one cycle

26

$$(x-5)^2 + 1 = 0$$

How many distinct real solutions does the given equation have?

A) Zero

B) Exactly one

C) Exactly two

D) Infinitely many

27

The Sun's mass is 1.989×10^{30} kilograms, and 0.04% of its total mass is sulfur. If the total mass of sulfur in the Sun is $s \times 10^{30}$ kilograms, what is the value of s ?

A) 0.0007956

B) 0.007956

C) 0.07956

D) 0.7956

28

x	$f(x)$
–2	–5
4	4
12	16

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) 7

B) 8

C) 9

D) 10

29

For the linear equation $y = mx + b$, where m and b are positive constants, which of the following tables gives three values of x and their corresponding values of y ?

A)

x	y
-2	$-2m$
1	m
$-\frac{b}{m}$	0

B)

x	y
-2	$-2m + b$
1	$m + b$
$-\frac{b}{m}$	0

C)

x	y
-2	$-2m + b$
1	$m + b$
b	0

D)

x	y
-2	$-2m$
1	m
b	0

30

A fitness membership costs \$45 per month. All new members receive a discount of \$20 off the cost of their first month of membership. Which function c gives the total cost $c(t)$, in dollars, that a new member pays after t months of membership?

A) $c(t) = 20 + 45t$

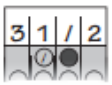
B) $c(t) = 25 + 45t$

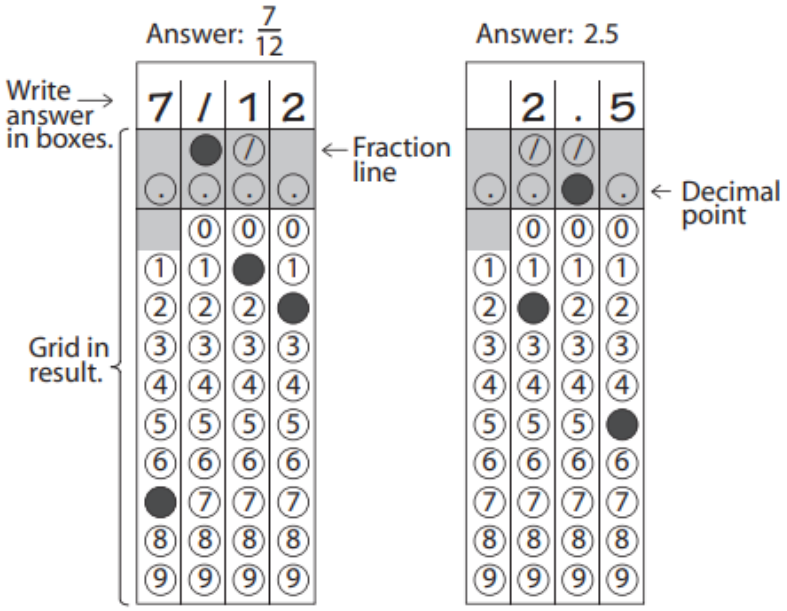
C) $c(t) = 20 + 45(t - 1)$

D) $c(t) = 25 + 45(t - 1)$

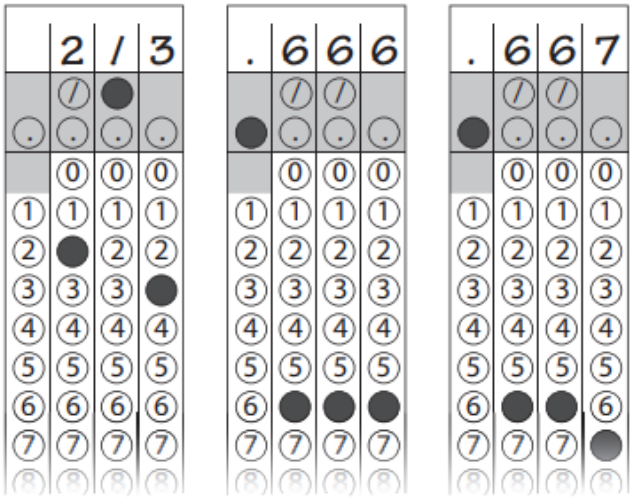
DIRECTIONS

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

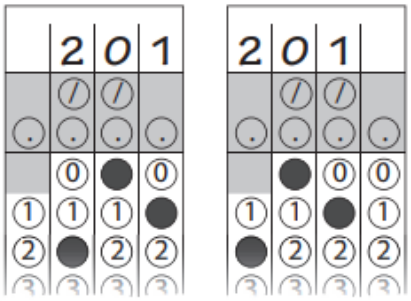
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.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

31

A list of 10 data values is shown below.

4, 6, 7, 2, 8, 9, 6, 3, 3, 3

What is the mean of the data?

32

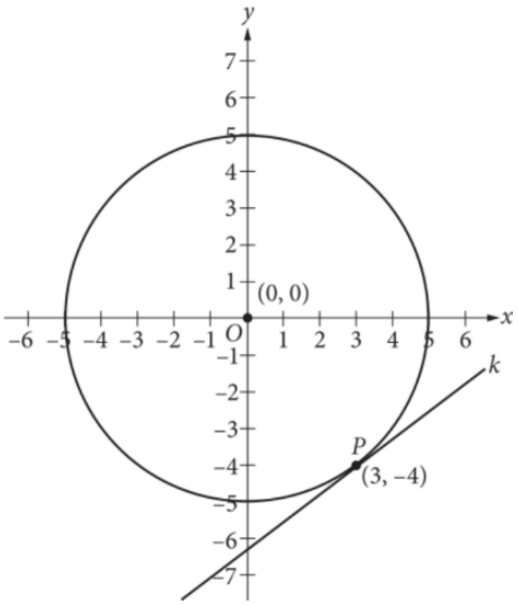
The dot plot represents a data set.

What is the median of the 19 values in the data set?

33

A bag contains only red, blue, and yellow marbles. If a marble is selected at random from this bag, the probability of selecting a yellow marble is 2 times the probability of selecting a blue marble, and the probability of selecting a yellow marble is 6 times the probability of selecting a red marble. What is the probability of selecting a blue marble? (Express your answer as a decimal or fraction, not as a percent.)

34



Line k is tangent to the circle with center O at point P as shown. What is the slope of line k ?

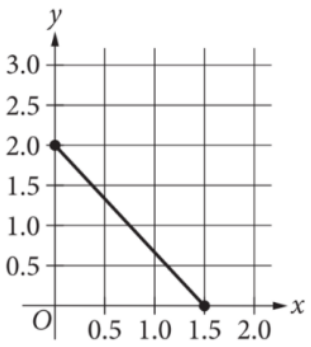
35

$$f(x) = x + 3$$

$$g(x) = 4x^2 - rx + 36$$

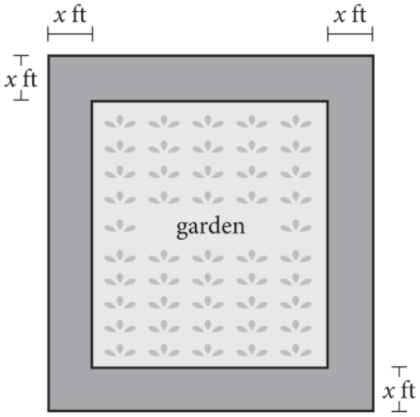
For the given functions f and g, r is a constant. If $f(x) \cdot g(x) = 4x^3 + 108$, what is the value of r ?

36



Line m is shown in the xy-plane, and the point with coordinates $(0.25, r)$ is on line m. What is the value of r ?

37



Note: Figure not drawn to scale.

The rectangular garden shown has a width of 50 feet and a length of 45 feet and is surrounded by a paved path with a uniform width of x feet. If the combined area of the garden and the paved path is 2646 square feet, what is the value of x ?

38

The population of a city in 2000 was 2.6 times its population in 1999. The population of this city increased by p% from 1999 to 2000. What is the value of p ?

STOP

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

April 2023 QAS Reading Key:

Question #	Correct Answer
1	A
2	D
3	D
4	C
5	B
6	A
7	D
8	B
9	C
10	C
11	A
12	D
13	B
14	B
15	C
16	D
17	C
18	D
19	A
20	B
21	A
22	A
23	B
24	C
25	B
26	A
27	D
28	D
29	A
30	D
31	C
32	C
33	D
34	A
35	B
36	C
37	B
38	B
39	A
40	D
41	C
42	D
43	B
44	A
45	B
46	B
47	C
48	D
49	C
50	D
51	A
52	A

Raw Score (# correct)	Scaled Score [bracketed = inferred score, not reported on Reddit]
52	400
51	400
50	390
49	380
48	370
47	370
46	[360]
45	360
44	350
43	350
42	340
41	340
40	330
No more #correct/score reported	

April 12, 2023 QAS: Writing & Language
Answer Key

1. C
2. A
3. D
4. D
5. D
6. B
7. B
8. C
9. D
10. A
11. B
12. D
13. B
14. D
15. A
16. D
17. B
18. C
19. B
20. C
21. A
22. B
23. B
24. D
25. C
26. A
27. C
28. B
29. B
30. C
31. C
32. A
33. A
34. C
35. A
36. B
37. A
38. C
39. A
40. C
41. D
42. C
43. B
44. D

April 2023 QAS

Math—No Calculator:

Question #	Correct Answer
1	B
2	D
3	C
4	B
5	D
6	A
7	C
8	C
9	D
10	A
11	B
12	C
13	B
14	D
15	A
16	2
17	6
18	7/10,.7
19	3,6
20	7

Math—Calculator

Question #	Correct Answer
1	B
2	B
3	A
4	D
5	D
6	D
7	C
8	D
9	C
10	A
11	D
12	D
13	A
14	C
15	A
16	C
17	C
18	B
19	B
20	C
21	B
22	C
23	A
24	D
25	C
26	A
27	A
28	A
29	B
30	D
31	51/10,5.1
32	42
33	3/10,.3
34	3/4,.75
35	12
36	5/3,1.66,1.67
37	2
38	160

Scaled Score (based on Reddit reporting)
Brackets indicate an unverified, inferred score (actual may vary by ±10).

Raw Score (# of correct answers)	Math Section Score
58	800
57	800
56	790
55	780
54	770
53	750
52	740
51	730
50	720
49	[710]
48	[700]
47	690
46	670
No more #correct/score reported	