

# Writing and Language Test

**35 MINUTES, 44 QUESTIONS**

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

**DIRECTIONS**

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

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

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

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

## New National Parks

Under the Antiquities Act of 1906, the Organic Act of 1916, and other federal laws, the US government has the power to take custody of land **1** when having historical significance or great natural beauty. The designation of a territory as a national park, national monument, or other **2** types of protected area can limit activities such as oil drilling and logging and provide funding for staff to work on preservation, maintenance, and visitor assistance. Federally protected lands are

**1**

- A) NO CHANGE
- B) for its having
- C) that has
- D) for it has

**2**

- A) NO CHANGE
- B) type of protected area
- C) type of protected areas
- D) protected area types

extremely popular, [3] with 270 million visitors each year to national parks alone, but in recent years critics have complained that these public lands are a burden on the federal budget that limits economic development. In fact, however, maintaining and expanding the land under public protection would be an economic benefit to many parts of the United States.

Some commentators claim that there [4] is an excess of too many pressing constraints on the federal budget to commit funds to federal land protection. But the 2014 budgets of the National Park Service, Fish and Wildlife Service, Forest Service, and Bureau of Land Management totaled significantly less than 1 percent of the national budget—hardly enough to make a considerable difference in overall government spending. Where protection does have a major economic impact is in local [5] communities visitors to protected lands need food, fuel, and lodging, and businesses that cater to these needs provide job opportunities in the surrounding communities.

3

- A) NO CHANGE
- B) being
- C) to have
- D) some

4

- A) NO CHANGE
- B) is too much of an excess of
- C) are, in abundance, too many
- D) are too many

5

- A) NO CHANGE
- B) communities; while visitors
- C) communities, visitors
- D) communities. Visitors

**6** In the western United States, federal control of

large areas of land has been a source of political controversy. According to a report from Headwaters Economics, a research group that studies land management in the West, rural counties with more than 30 percent of their land under federal protection **7** saw job growth of more than 300 percent from 1970 to 2010. Rural counties with no protected land saw smaller increases in employment than did counties with protected land. A look at the economic effects of Yellowstone National Park reveals the profound impact

6

Which choice provides the best introduction to the paragraph?

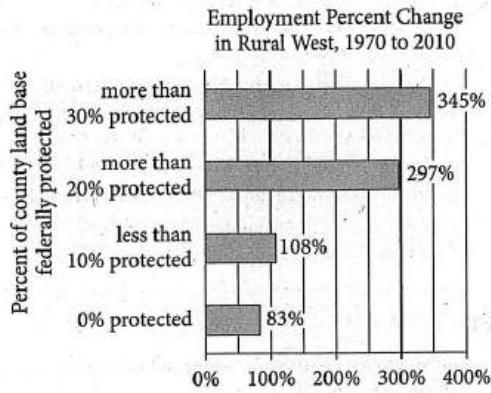
- A) NO CHANGE
- B) The influx of money from tourism is particularly important in areas such as the western United States, where most federally protected lands are located.
- C) The national park that has the most dramatic economic impact on the surrounding area is Yellowstone National Park, which is spread across parts of Wyoming, Montana, and Idaho.
- D) It is often a challenge to balance the interests of local industries with those of visitors to federally protected lands.

7

Which choice provides accurate and relevant information from the graph?

- A) NO CHANGE
- B) saw slightly less job growth than those with less than 10 percent of lands under federal protection
- C) had rates of job growth that were considerably higher than those of rural counties in the eastern United States
- D) saw job growth decline from nearly 350 percent to just under 300 percent

protected lands can have in a rural region. In 2013, Yellowstone had more than 3 million **8** tourists. They spent a total of nearly \$380 million in and around the park. **9**



Adapted from Headwaters Economics, "West Is Best: How Public Lands in the West Create a Competitive Economic Advantage." ©2012 by Headwaters Economics.

8

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

- A) tourists, the ones who spent
- B) tourists; spent was
- C) tourists, who spent
- D) tourists, but they spent

9

At this point, the writer wants to use information from the table below.

Economic Contribution of Tourists to the Region of Yellowstone National Park

	Park visitors	Park visitor spending	Jobs created
Total	3,188,030	\$381,763,000	5,300
From tourists	3,090,679	\$379,900,000	5,277
Percent from tourists	96.95%	99.51%	99.57%

Adapted from Catherine Cullinane Thomas, Christopher Huber, and Lynne Koontz, 2013 *National Park Visitor Spending Effects: Economic Contributions to Local Communities, States, and the Nation*. Published in 2014 by the National Park Service.

Which choice provides accurate and relevant evidence from the table to support the paragraph's claim?

- A) These tourists made up nearly 97 percent of all the visitors to the park in that year.
- B) This incoming money was enough to support more than 5,000 jobs in the Yellowstone region.
- C) Residents of the region tended to spend less money in and around the park than tourists did.
- D) As per-visitor spending in the park shows, visiting Yellowstone is a relatively economical vacation.

Many communities in the United States could gain significant tourist **10** revenue: if sites of natural beauty or historical significance—such as Idaho's Boulder-White Clouds and Utah's Cedar Mesa Plateau—were granted national park status. Given the economic benefits of protecting these and other proposed wilderness areas around the country, **11** additional laws are needed to ensure that the natural and historical legacy of the United States is preserved for future generations.

10

- A) NO CHANGE
- B) revenue, if sites of natural beauty,
- C) revenue if sites of natural beauty,
- D) revenue if sites of natural beauty

11

Which choice most logically concludes the passage?

- A) NO CHANGE
- B) national parks would provide more economic gains if they were managed more like businesses.
- C) it is time for the federal government to consider an additional investment in protected lands.
- D) protected lands should be extended to more urban parts of the country as well.

Questions 12–22 are based on the following passage.

### Going into Historical Detail

Many films depict a historical figure, event, or time period. Take, for example, Steven Spielberg's 2012 historical drama *Lincoln*, a film focused on the life of former president Abraham Lincoln, or Steve McQueen's 2013 film *12 Years a Slave*, based on an 1853 memoir by former American slave Solomon Northup. Both Spielberg and McQueen hired historical consultants to provide expert opinion on the costumes, props, and dialogue used in these films.

Some filmmakers expect historical consultants to commit to long-term **12** projects. Other filmmakers give historical consultants tasks that can be completed in a short period of time. In the 2003 historical film *Master and Commander*, a team of consultants was tasked with re-creating life aboard an 1805 warship. One of these consultants spent months training actors to operate cannons. Regardless of a project's scope, however, the task of a historical consultant is always the same: to enhance the accuracy of a film. Henry Louis Gates Jr., a prominent scholar of African American history, vetted the script of *12 Years a Slave* and **13** serves as the director of Harvard University's Hutchins Center for African and African American Research.

12

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

- A) projects, while others assign tasks
- B) projects, but some historical consultants have filmmakers give them tasks
- C) projects; meanwhile, other filmmakers give historical consultants other tasks
- D) projects; there are also tasks given by filmmakers

13

Which choice gives a second example that best supports the point the writer is making in this paragraph?

- A) NO CHANGE
- B) even wrote the film's concluding credits about the mystery surrounding Northup's disappearance in 1857.
- C) has also authored numerous books on African American literature and culture.
- D) played a large role in discovering and disseminating the earliest novels written by African Americans in the 1850s.

While historical integrity is important, [14] some directors spend too much time worrying about it. For instance, a historical consultant for *Master and Commander* [15] will say the director's desire to emphasize the camaraderie of the ship's officers meant

[16] dumping the period's formal social protocol. Duncan Henderson, the film's producer, acknowledged this tension between the competing demands of accuracy and [17] art: "The more real it is, the more the movie moves effortlessly forward because people are quickly taken into that world. [But] you don't want to give up the drama of the story just to be technically correct."

This deliberate decision to forgo accuracy for cinematic effect, [18] however, may be met with public criticism. When Tony Kushner, the screenwriter for *Lincoln*, portrayed two Connecticut congressmen as voting against the Thirteenth Amendment to the

14

Which choice most effectively sets up the example discussed in this paragraph?

- A) NO CHANGE
- B) many actors struggle with finding a balance between being historically accurate and conveying emotion.
- C) audiences often don't realize when there are errors in a historical film.
- D) other concerns may take precedence.

15

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

16

- A) NO CHANGE
- B) ditching
- C) scrapping
- D) disregarding

17

- A) NO CHANGE
- B) art—<sup>5</sup>The
- C) art; the
- D) art, the

18

- A) NO CHANGE
- B) therefore,
- C) likewise,
- D) particularly,

US Constitution, a current Connecticut congressman wrote a letter to the movie studio urging it to correct this error. Kushner responded by stating *Lincoln* upheld the expectations of a dramatic film because it illustrated the amendment's narrow vote, and Doris Kearns Goodwin, the film's historical **19** consultant, defending Kushner's script.

**20** Why, then, is historical accuracy important in films? Kate Williams, a British **21** historian—believes that “filmmakers have a great responsibility. How they present the past is how it gets remembered.” Historical consultants must **22** assure that filmmakers take this responsibility seriously. As films continue to engage with history, historical consultants will continue to preserve history’s intricacies.

**19**

- A) NO CHANGE
- B) consultant, who defended
- C) consultant, defended
- D) consultant to defend

**20**

Which choice provides the most effective transition from the previous paragraph?

- A) NO CHANGE
- B) What about directors who are less concerned about historical accuracy?
- C) Consequently, do movies that take place in the very recent past require historical consultants?
- D) What sources should filmmakers consult to ensure historical accuracy in their films?

**21**

- A) NO CHANGE
- B) historian
- C) historian,
- D) historian;

**22**

- A) NO CHANGE
- B) ensure that
- C) ensure for
- D) insure for

Questions 23-33 are based on the following passage.

#### Legal Nonrepresentation

"All my life," the sculptor Constantin Brancusi remarked, "I have been seeking to capture the essence of flight." [23] *Bird in Space* is a work of abstract art: it is not a readily recognizable representation of the bird in its title but rather a polished arc of bronze that calls to mind the animal's graceful airborne motion. With [24] it's end's tapering into points, much of the slender 53-inch curve [25] appear suspended in the air above its marble base. More than just a visually arresting sculpture, [26] then, *Bird in Space* was responsible for changing how the US government recognizes art.

23

The writer is considering adding the following sentence.

More than any of Brancusi's other works, the 1926 sculpture *Bird in Space* manages to achieve that aim.

Should the writer make this addition here?

- A) Yes, because it helps explain why the US government would eventually recognize *Bird in Space* as a work of art.
- B) Yes, because it provides an effective transition between the presentation of Brancusi's goal and the discussion of *Bird in Space*.
- C) No, because it presents information about *Bird in Space* that is repeated later in the paragraph.
- D) No, because it interrupts the explanation of the nature of abstract art.

24

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

25

- A) NO CHANGE
- B) is appearing
- C) has appeared
- D) appears

26

- A) NO CHANGE
- B) at any rate,
- C) though,
- D) therefore,

In the 1920s, abstract art like Brancusi's was a new phenomenon, a sharp contrast to more traditionally representational paintings and statues, so it is perhaps unsurprising that *Bird in Space* received a mixed reception. The general public struggled to find artistic value in the sculpture; indeed, many struggled to see it as a work of art at all. One newspaper likened it to "half an airplane propeller," while 27 also calling it "a tall, slender, highly polished object." Within the art world, however, *Bird in Space* was recognized as a beautiful and innovative work of modern sculpture. Such recognition led the art collector Edward Steichen to buy the piece and have it shipped to his New York City home from Brancusi's Paris studio.

The importation of the sculpture brought it to the attention of the US Customs Bureau. The agency's view reflected that of the general public: when *Bird in Space* came to the United States from France, the Customs Bureau classified it not as a work of art but as an industrial object. That classification carried with it substantial consequences. Works of 28 art, could be imported to the United States duty-free, but industrial materials were taxed at rates of up to 40 percent of 29 their purchase value. As a result, *Bird in Space* faced an import tax of \$229.35—more than a third of the \$600 Steichen paid for it.

27

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

- A) NO CHANGE
- B) another mocked it as an "expensive potato masher."
- C) Brancusi considered it "a symbol of flight liberating man from the narrow confines of lifeless matter."
- D) art critic Frank Crowninshield stated that it had "the suggestion of flight."

28

- A) NO CHANGE
- B) art—could
- C) art could
- D) art could,

29

- A) NO CHANGE
- B) its
- C) one's
- D) his

Brancusi, in turn, sued the US government, aiming to  
30 score recognition of his sculpture as art. The resultant 1927 court case, *Brancusi v. United States*, attempted to answer for the American public the question of whether abstract works like Brancusi's should be considered art. After hearing a lineup of

31 well-known, famous art critics testify to the aesthetic value and originality of nonrepresentational art like *Bird in Space*, 32 the court's ruling was in favor of Brancusi. The decision 33 meant that the public had finally come to recognize the artistic value of nonrepresentational art.

30

- A) NO CHANGE
- B) secure
- C) land
- D) gather up

31

- A) NO CHANGE
- B) well-known and famous
- C) famously well-known
- D) famous

32

- A) NO CHANGE
- B) the ruling of the court was in favor of Brancusi.
- C) the court ruled in favor of Brancusi.
- D) Brancusi was the favorable receiver of the court's ruling.

33

The writer wants a conclusion that reiterates the main idea expressed in the passage. Which choice best accomplishes this goal?

- A) NO CHANGE
- B) was a great victory for art collectors like Steichen; a major impediment to their ability to import artworks from Europe had been eliminated.
- C) would forever broaden the range of art acknowledged by the US government: from then on, customs law would recognize both abstract and traditional works within the category of art.
- D) concerning the value of abstract works such as *Bird in Space* would take many more years to be made in the court of public opinion, however.

Questions 34-44 are based on the following passage.

### Petrified Lightning

Scientists estimate that [34] two thousand is roughly the number of thunderstorms that rage over Earth at any given time and that lightning strikes the ground twenty times every second. Lightning bolts can be up to five times hotter than the surface of the [35] Sun. This is far hotter than the melting point of silica, the compound that is the primary constituent of sand and most types of rock. (Silica is also the essential ingredient used in making glass.) Under certain circumstances, when lightning strikes sand or rock, evidence of the strike is left behind in the form of a fulgurite, sometimes called petrified lightning.

34

- A) NO CHANGE
- B) approximately two thousand thunderstorms
- C) right around two thousand thunderstorms
- D) two thousand is approximately how many thunderstorms

35

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

- A) Sun; this temperature of the lightning bolts is
- B) Sun, and this temperature is
- C) Sun; however, this is
- D) Sun—

[1] First discovered in 1706, these formations are found in two varieties: sand fulgurites and the much less common rock fulgurites. [2] As it cools, the silica lining forms a glass-walled cavity that may look like [36] a plants' root system. [3] Sand that adhered to the molten silica as it solidified forms a casing around the fragile glassy structure. [4] Sand fulgurites form when the intense energy of a lightning bolt rapidly heats moist air trapped in sandy soil and the resulting explosive expansion creates a void lined with melted silica. [5] Rock fulgurites, found almost exclusively on the peaks of mountains, appear as a thin, glassy crust on [37] the surface of a rock or along fractures within them. [38]

Because glass is very resistant to weathering, fulgurites may last a very long [39] time; the oldest example is estimated to be 250 million years old—and give scientists a unique window into the past. The formation of a fulgurite occurs in only a fraction of a

36

- A) NO CHANGE
- B) a plant's root system.
- C) 'a plant's root systems'.
- D) plants root system's.

37

- A) NO CHANGE
- B) the rocky surface
- C) a rock's surface
- D) the surface of rocks

38

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

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

39

- A) NO CHANGE
- B) time. The
- C) time, the
- D) time—the

second, so air bubbles are often trapped in the cooling glass and can be analyzed to reveal the atmospheric composition at the time the fulgurite was created. [40]

There is also a practical reason for studying fulgurites. [41] When researchers dig them up very carefully, fulgurites can remain intact after they are extracted from the ground. Aboveground power lines are often struck by lightning, causing power outages, but the [42] affects of lightning on buried power lines were not investigated until the 1990s. Research at the University of Florida has shown that lightning can also disable

40

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

Gases trapped 15,000 years ago in fulgurites from the Sahara desert, for example, demonstrate that the region was once much wetter and prone to thunderstorms.

Should the writer make this addition here?

- A) Yes, because it provides an example of the paragraph's point about the uses of fulgurites in research.
- B) Yes, because it continues the passage's explanation of how fulgurites are formed.
- C) No, because it blurs the paragraph's focus by introducing a discussion of changing climates.
- D) No, because it undermines the paragraph's claim about how quickly fulgurites form.

41

Which choice best introduces the information that follows?

- A) NO CHANGE
- B) Lightning plays a major rôle in power distribution system failures in areas where thunderstorm activity is high.
- C) One project conducted in 1996 excavated the world's longest known fulgurite, which has three branches measuring eight, fourteen, and sixteen feet.
- D) Seasonal variations in storms mean that certain times of the year are best for collecting data on lightning.

42

- A) NO CHANGE
- B) affects from
- C) effects of
- D) effects by

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underground power systems because the strikes keep moving below ground. Examination of fulgurites around buried power systems **43** help scientists determine the most effective shielding materials for power lines. Florida averages about twenty-five to forty lightning strikes per square mile each **44** year, so the scientists hope their work can help mitigate the damage caused by so many strikes.

43

- A) NO CHANGE
- B) have helped
- C) are helping
- D) is helping

44

Which choice most effectively completes the paragraph?

- A) NO CHANGE
- B) year, and lightning strikes are dangerous to residents of the state as well as damaging to its infrastructure.
- C) year, but it is difficult to determine precisely how many of those strikes leave behind fulgurites.
- D) year.

## 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.

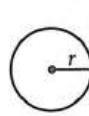
**DIRECTIONS**

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**

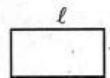
1. The use of a calculator is **not permitted**.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated,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

**REFERENCE**



$$A = \pi r^2$$

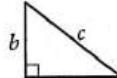
$$C = 2\pi r$$



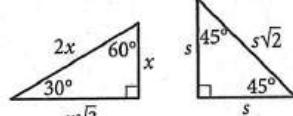
$$A = l w$$



$$A = \frac{1}{2} b h$$



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



Special Right Triangles



$$V = lwh$$



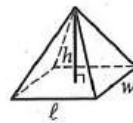
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3} lwh$$

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

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

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

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1

In the  $xy$ -plane, what is the  $y$ -intercept of the line with equation  $y = 4x - 1$ ?

- A) 4
- B)  $\frac{1}{4}$
- C)  $-\frac{1}{4}$
- D) -1

3

$$3(x + y) = 12$$

$$\frac{x}{2} = 3$$

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

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

2

$$f(x) = \frac{x+3}{2}$$

For the function  $f$  above, what is the value of  $f(7) - f(5)$ ?

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

4

$$D = 60 - \frac{3}{4}P$$

$$S = \frac{1}{4}P$$

In economics, the equilibrium price is defined as the price at which quantity demanded and quantity supplied are equal. If the quantity demanded,  $D$ , and quantity supplied,  $S$ , in terms of the price in dollars,  $P$ , are given by the equations above, what is the equilibrium price?

- A) \$0
- B) \$60
- C) \$80
- D) \$120

5

If  $(x - 2)^2 - 6(x - 2) + 9 = 0$ , what is the value of  $x$ ?

- A) 2
- B) 3
- C) 5
- D) 7

6

A chef plans to cook a maximum of 100 entrées for a dinner party; each entrée will include either chicken or fish. The cost of ingredients for each chicken entrée is \$7, and the cost of ingredients for each fish entrée is \$9. If no more than \$850 can be spent on ingredients for the entrées and the chef cooks  $c$  chicken entrées and  $f$  fish entrées, which of the following systems best represents the constraints on  $c$  and  $f$ ?

- A)  $c + f = 16$   
 $7c + 9f \leq 100$
- B)  $c + f \leq 100$   
 $7c + 9f > 850$
- C)  $c + f \leq 100$   
 $7c + 9f \leq 850$
- D)  $c + f = 100$   
 $7c + 9f < 850$

7

If  $x + y = 13$  and  $x - y = 2$ , what is the value of  $x^2 - y^2$ ?

- A) 4
- B) 26
- C) 121
- D) 165

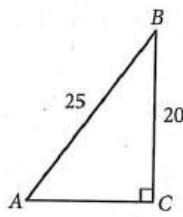
8

Every Saturday, Bob bakes loaves of bread to sell at the farmer's market. Each loaf costs him \$1 to make, and he sells the loaves for \$3 each. He also pays a vendor's fee of \$75 every Saturday to set up his booth. What is the least number of loaves of bread Bob needs to sell every Saturday to cover the cost of the vendor's fee?

- A) 38
- B) 37
- C) 25
- D) 19



9



In the right triangle above, the tangent of  $\angle A$  is  $\frac{4}{3}$ .

What is the sine of  $\angle B$ ?

- A)  $\frac{3}{5}$
- B)  $\frac{3}{4}$
- C)  $\frac{4}{5}$
- D)  $\frac{5}{3}$

10

$$wxy + xyz = wx + yz$$

In the equation above,  $w$ ,  $x$ , and  $z$  are each greater than 1. Which of the following is equivalent to  $y$ ?

- A)  $-x$
- B)  $-\frac{1}{x}$
- C)  $\frac{1}{xz - z}$
- D)  $\frac{wx}{wx + xz - z}$

11

The pressure exerted on an object under water increases by 1 atmosphere every 33 feet below the surface of the water. At sea level, the pressure is 1 atmosphere. Which equation gives the total pressure  $p$ , in atmospheres, exerted on an underwater object at a depth of  $f$  feet below sea level?

- A)  $p = \frac{f}{33}$
- B)  $p = 33f$
- C)  $p = 33f + 1$
- D)  $p = \frac{f}{33} + 1$



12

Which of the following equations has a graph in the  $xy$ -plane with no  $x$ -intercepts?

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

13

$$\begin{aligned}y &= 5x + 1 \\y &= x^2 + 3x + 2\end{aligned}$$

What is the  $y$ -coordinate of the point of intersection, in the  $xy$ -plane, of the graphs of the equations above?

- A) 1
- B) 2
- C)  $\frac{9}{4}$
- D) 6

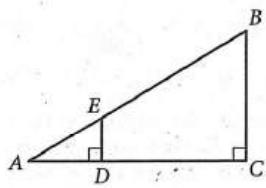
14

Which of the following expressions is equivalent

$$\text{to } (16x^2)^{\frac{1}{2}} \text{ ?}$$

- A)  $4|x|$
- B)  $8|x|$
- C)  $\sqrt{8x}$
- D)  $16x$

15



In the figure above,  $BC = 5$ , and the length of line segment  $AD$  is half the length of line segment  $CD$ . What is the length of line segment  $DE$ ?

- A)  $\frac{2}{5}$
- B)  $\frac{3}{5}$
- C)  $\frac{5}{3}$
- D)  $\frac{5}{2}$

May QAS 5/6/2017

**DIRECTIONS**

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

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

Write answer →  
in boxes.  
Grid in result.

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

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

Fraction line

Answer: 2.5

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

Decimal point

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

2	1	3
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7

.	6	6	6
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7

.	6	6	7
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7

Answer: 201 – either position is correct

2	0	1
0	0	0
1	1	1
2	2	2

2	0	1
0	0	0
1	1	1
2	2	2

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

16

In the equations  $a = x - 4$  and  $b = x + 4$ ,  $a$  and  $b$  are constants. When the product  $ab$  is written in the form  $x^2 - c$ , where  $c$  is a constant, what is the value of  $c$ ?

17

Isabella sells only rings and necklaces on her website. Rings sell for \$50 each, and necklaces sell for \$30 each. If Isabella sold 25 pieces of jewelry and her sales totaled \$1050, how many necklaces did Isabella sell?

18

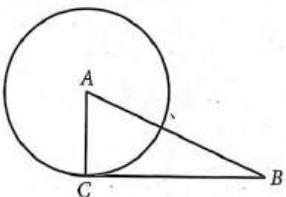
$$1.2(h+2) = 2h - 1.2$$

What value of  $h$  is the solution of the equation above?

19

If  $r > 0$  and  $\sqrt{\frac{9r}{2}} = \frac{1}{2}r$ , what is the value of  $r$ ?

20



Note: Figure not drawn to scale.

In the figure above, the circle has center  $A$ , and line segment  $CB$  is tangent to the circle at point  $C$ . If  $AB = 1.0$  and  $CB = 0.8$ , what is the length of the diameter of the circle?

# STOP

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

May QAS 5/6/2017

# Math Test – Calculator

## 55 MINUTES, 38 QUESTIONS

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

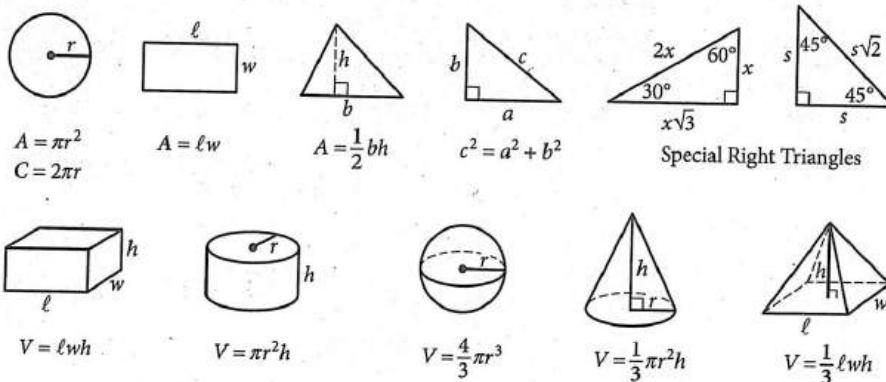
### DIRECTIONS

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

### NOTES

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

### REFERENCE



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

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

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

1

Ms. Anderson currently has 550 contacts on an online professional networking site. Her goal is to have at least 1,000 contacts. If she wants to meet this goal in 25 weeks, what is the minimum number of contacts per week, on average, she should add?

- A) 18
- B) 19
- C) 21
- D) 22

2

At her summer job, Paula earns the same amount of money for each hour she works. If she earns \$240 for working 20 hours, how much does she earn for 5 hours?

- A) \$12
- B) \$50
- C) \$60
- D) \$100

3

If  $3x = 24$ , what is the value of  $2x - 3$ ?

- A) 8
- B) 10
- C) 11
- D) 13

4

Yuna sold boxes of cookies and bags of candy. The ratio of the number of boxes of cookies she sold to the number of bags of candy she sold was 2 to 1. If Yuna sold 8 boxes of cookies, how many bags of candy did she sell?

- A) 4
- B) 8
- C) 10
- D) 16



5

For each repair job, an elevator technician charges  $r$  dollars per hour for each hour worked plus a flat fee of  $k$  dollars. If the technician charges \$210 for a 2-hour job, which of the following represents the relationship between  $r$  and  $k$ ?

- A)  $210 = k + 2r$
- B)  $210 = 2k + r$
- C)  $210 = 2r - k$
- D)  $210 = r - 2k$

6

A box in the shape of a right rectangular prism has a volume of 60 cubic inches. If the dimensions of the box are 3 inches by 5 inches by  $h$  inches, what is the value of  $h$ ?

- A) 3
- B) 4
- C) 5
- D) 6

7

A 15-foot wire and a 5-foot wire were each cut completely into 10-inch pieces. How many more 10-inch pieces resulted from the 15-foot wire than from the 5-foot wire? (12 inches = 1 foot)

- A) 6
- B) 9
- C) 12
- D) 18

8

Parabola  $D$  in the  $xy$ -plane has equation  $x - 2y^2 - 8y - 11 = 0$ . Which equation shows the  $x$ -intercept(s) of the parabola as constants or coefficients?

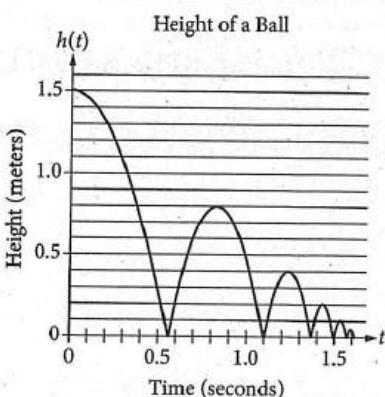
- A)  $x = 2y^2 + 8y + 11$
- B)  $x = 2(y + 2)^2 + 3$
- C)  $x - 3 = 2(y + 2)^2$
- D)  $y = -\sqrt{\frac{x-3}{2}} - 2$

9

The sum of two different numbers  $x$  and  $y$  is 70, and the difference when the smaller number is subtracted from the larger number is 30. What is the value of  $xy$ ?

- A) 100
- B) 210
- C) 1,000
- D) 2,100

10



A ball was dropped from a height of 1.5 meters and hit the ground several times. The graph above represents the height  $h$ , in meters, of the ball  $t$  seconds after it was dropped. Of the following, which best approximates the maximum height, in meters, of the ball between the second and third time it hit the ground?

- A) 0.2
- B) 0.4
- C) 0.8
- D) 1.5



11

Which of the following is an equation of the circle in the  $xy$ -plane that has center  $(0, 0)$  and radius 4?

- A)  $x^2 + y^2 = 4$
- B)  $x^2 + y^2 = 8$
- C)  $x^2 + y^2 = 16$
- D)  $x^2 + y^2 = 64$

12

Which of the following expressions is equivalent

to  $(16x^9y^3)^{\frac{1}{2}}$ , where  $x \geq 0$  and  $y \geq 0$ ?

- A)  $4x^3y^{\frac{3}{2}}$
- B)  $4x^{\frac{9}{2}}y^{\frac{3}{2}}$
- C)  $8x^3y^3$
- D)  $8x^{\frac{9}{2}}y^3$



13

At the beginning of a laboratory experiment, Miguel had 10 milliliters of a solution in a flask. The first step of the experiment consisted of Miguel pouring  $x$  milliliters of the solution into a beaker and  $y$  milliliters of the solution into a different beaker. There remained at least 4 milliliters of the solution in the flask after the first step. Which of the following inequalities can be used to correctly represent this situation?

- A)  $10 - x - y \geq 4$
- B)  $10 - x + y \geq 4$
- C)  $4 - x - y \geq 5$
- D)  $4 - x + y \geq 5$

14

To determine if cooking with olive oil reduces the risk of heartburn for men, researchers interviewed a random sample of 5,500 men who had no history of heartburn. Study participants were identified as either regular or occasional olive oil users. Five years later, researchers interviewed the men again. They found that the proportion of men who experienced frequent heartburn was significantly lower for men identified as regular olive oil users. Which of the following is the most appropriate conclusion of the study?

- A) Olive oil use causes a reduction in the risk of heartburn for men and women.
- B) Olive oil use causes a reduction in the risk of heartburn for men but not necessarily for women.
- C) There is an association between olive oil use and the risk of heartburn for men and women, but it is not necessarily a cause-and-effect relationship.
- D) There is an association between olive oil use and the risk of heartburn for men, but it is not necessarily a cause-and-effect relationship, and the association may not exist for women.



**Questions 15 and 16 refer to the following information.**

$$h = 3c$$

A wildlife biologist uses the formula above to estimate the height  $h$ , in centimeters, of an elephant from its foot to its shoulder, based on the circumference  $c$ , in centimeters, of the elephant's footprint.

15

If the wildlife biologist finds a circular elephant footprint that has a diameter of 30 centimeters (cm) while on a zoological study, which of the following is closest to the biologist's estimate of the elephant's height?

- A) 90.0 cm
- B) 94.2 cm
- C) 188.4 cm
- D) 282.6 cm

16

The circumference  $c$  of a mother elephant's circular footprint is 4 times the circumference of a baby elephant's circular footprint. What is the ratio of the height of the mother to the height of the baby?

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

17

If  $(x^{24})^a = (x^2)^4$ , and  $x > 1$ , what is the value of  $a$ ?

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

18

$$\begin{aligned}x^2 + y &= 7 \\x - y &= 5\end{aligned}$$

Which value is a  $y$ -coordinate of a solution to the system of equations above?

- A) -8
- B) -3
- C) -2
- D) 6

**Questions 19 and 20 refer to the following information.**

$$d = 2,565 - 500t$$

An airplane flies directly from a city in Pennsylvania to a city in Ecuador. The equation above estimates the distance  $d$ , in miles, from the city in Ecuador of the airplane  $t$  hours after taking off from the city in Pennsylvania.

19

Which of the following is the best interpretation of the number 2,565 in this context?

- A) The speed, in miles per hour, of the airplane
- B) The distance, in miles, the airplane travels in one hour
- C) The distance, in miles, the airplane travels between the two cities
- D) The time, in minutes, it takes the airplane to reach the city in Ecuador

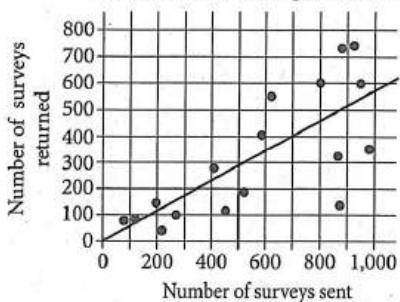
20

According to the equation, approximately how many hours will it take the airplane to travel between the two cities?

- A) 6.2
- B) 5.8
- C) 5.3
- D) 5.1

21

Surveys Sent to and Returned from 17 Neighborhoods



The scatterplot above shows the number of surveys sent to and returned from people in 17 different neighborhoods. A line of best fit for the data is also shown. For the neighborhood that had surveys sent to 800 people, which of the following is closest to the positive difference between the actual number of surveys returned and the number predicted by the line of best fit shown?

- A) 150
- B) 170
- C) 200
- D) 250



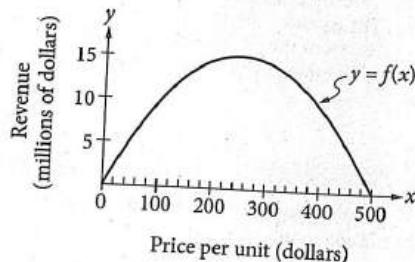
Questions 22 and 23 refer to the following information.

Annual Production (thousands of units)

	Factory W	Factory Z
Product P	21	32
Product Q	14	24

Projected Annual Revenue from Sales  
of Product P (millions of dollars)

$$f(x) = a(x - 250)^2 + k$$



A company makes and sells only two products, P and Q, and makes all products at factories W and Z. The table above shows the number of units of each product made at each factory during a year. The function  $f$  above represents the projected annual revenue from sales of product P as a function of the price per unit, where  $a$  and  $k$  are constants.

22

Based on the graph of  $f$ , which of the following is a factor of  $f(x)$ ?

- A)  $x - 15$
- B)  $x - 240$
- C)  $x - 250$
- D)  $x - 500$

23

Which of the following is closest to the percent of the total number of units of products P and Q combined that are made at factory Z annually?

- A) 38%
- B) 56%
- C) 62%
- D) 91%



24

For 5 consecutive even integers, the sum of the first and third integer is 20 less than 3 times the fourth integer. What is the fifth integer?

- A) 12
- B) 14
- C) 16
- D) 26

25

A polling agency wanted to test whether a ballot measure would pass with greater than 50% yes votes. The agency sampled 1,000 registered voters selected at random, and 50.6% of the voters favored the ballot measure. The margin of error associated with this poll was  $\pm 3\%$ . Based on the poll's results, which of the following statements must be true?

- A) The percentage of voters who will vote yes for the ballot measure is 50.6%.
- B) The ballot measure will pass with more yes votes than no votes, but the percentage of votes it will receive cannot be predicted.
- C) The ballot measure will pass with at least 53.6% of the vote.
- D) The poll's results do not provide sufficient evidence to conclude that the ballot measure will pass.

26

Treatment	Number of plants		
	Regressed	Thrived	Total
A	80	120	200
B	140	60	200

The table above shows the results of an experiment involving the effect of two treatments, A and B, on plants. Based on the results, what fraction of the plants that thrived received treatment A?

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

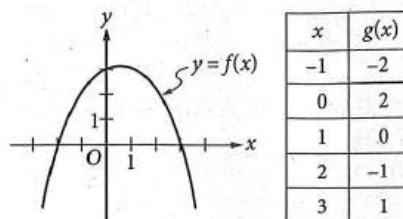


27

A sample of seawater is 3.5% salt by mass and contains 1,000 grams of salt. Which of the following is closest to the mass, in grams, of the sample of seawater?

- A) 28,600
- B) 27,600
- C) 965
- D) 35

28



$x$	$g(x)$
-1	-2
0	2
1	0
2	-1
3	1

The graph of the function  $f$  is shown in the  $xy$ -plane above, and selected values for the function  $g$  are shown in the table. For which of the following values of  $x$  is  $g(x) > f(x)$ ?

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

29

$$h(t) = -\frac{1}{175}t + 481$$

An archeologist estimates that, as a result of erosion, the height of the Great Pyramid of Giza has been decreasing at a constant rate since it was built. The function above is used by the archeologist to model the height  $h(t)$ , in feet, of the pyramid  $t$  years after it was built. According to the function, which of the following statements is true?

- A) Every 1,750 years the height of the pyramid decreases by 10 feet.
- B) Every 175 years the height of the pyramid decreases by 0.1 foot.
- C) Every 100 years the height of the pyramid decreases by 1.75 feet.
- D) Every year the height of the pyramid decreases by 175 feet.

30

A biologist grows a culture of bacteria as part of an experiment. At the start of the experiment, there are 75 bacteria in the culture. The biologist observes that the population of bacteria doubles every 18 minutes. Which of the following equations best models the number,  $n$ , of bacteria  $t$  hours after the start of the experiment?

- A)  $n = 75(2)^{\frac{t}{18}}$
- B)  $n = 75\left(1 + \frac{t}{18}\right)$
- C)  $n = 75(2)^{\frac{10t}{3}}$
- D)  $n = 75\left(1 + \frac{10}{3}t\right)$

**DIRECTIONS**

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

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

Write answer →  
in boxes.

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

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

Grid in result:

Answer: 2.5

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

← Decimal point

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

2	/	3
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7

.	6	6	6
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7

.	6	6	7
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7

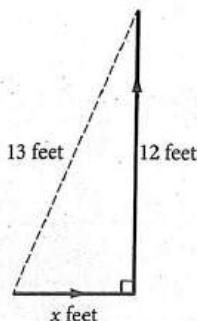
Answer: 201 – either position is correct

2	0	1
0	0	0
1	1	1
2	2	2

2	0	1
0	0	0
1	1	1
2	2	2

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

31



The solid lines in the figure above represent the route of a football player, and the dashed line represents the distance from his starting point to the point at which the player was stopped. What is the value of  $x$ ?

33

Median Ages of Populations of Selected Countries, 2012

Country	Median age of population (years)
Brazil	29.6
China	35.9
Germany	45.3
India	26.5
Indonesia	28.5
Nigeria	17.9
Philippines	23.1
Russia	38.8
United States	37.1

What is the range, in years, of the median ages of the populations for the countries in the table above?

32

Last year, Gary's tomato plants produced 24 kilograms of tomatoes. This year, Gary increased the number of tomato plants in his garden by 25%. If his plants produce tomatoes this year at the same rate per plant as last year, how many kilograms of tomatoes can Gary expect the plants to produce this year?



34

$$\begin{aligned}\frac{1}{2}x &= a \\ x + y &= 5a\end{aligned}$$

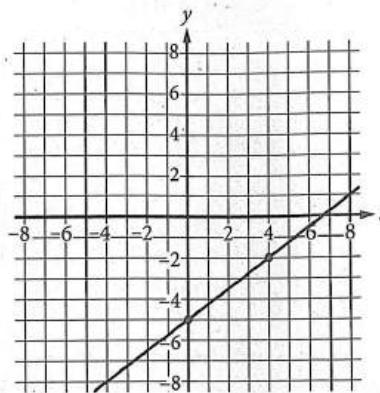
In the system of equations above,  $a$  is a constant such that  $0 < a < \frac{1}{3}$ . If  $(x, y)$  is a solution to the system of equations, what is one possible value of  $y$ ?

35

$$\frac{x^2 + 17x + 66}{x + 6}$$

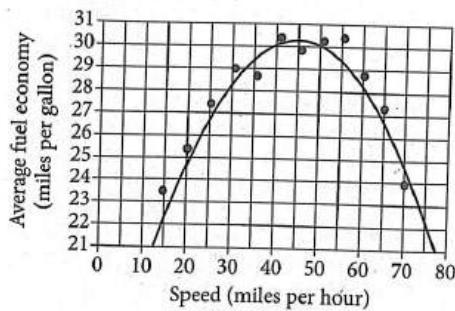
If the expression above is equivalent to an expression of the form  $x + a$ , where  $x \neq -6$ , what will be the value of  $a$ ?

36



A line is shown in the  $xy$ -plane above. A second line (not shown) is parallel to the line shown and passes through the points  $(1, 1)$  and  $(3, c)$ , where  $c$  is a constant. What is the value of  $c$ ?

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



The scatterplot above shows the average fuel economy for a certain class of car driven at 12 different speeds. The graph of a quadratic model for the data is also shown.

37

For what fraction of the 12 speeds does the model overestimate the average fuel economy?

38

The quadratic model predicts the average fuel economy to be 26 miles per gallon for how many different speeds?

**STOP**

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

## Writing and Language Test

35 MINUTES, 44 QUESTIONS

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

**DIRECTIONS**

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

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

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

Questions 1-11 are based on the following passage.

**Agriculture Grows Up**

[1] Current agricultural practices will not be able to meet the needs of the world's growing population, which is expected to rise to 9.6 billion by the year 2050. [2] The amounts of arable land, water, and fossil fuels necessary to feed so many people using conventional agricultural methods are simply too great. [3] Vertical farms maximize available space by stacking plant racks on top of each other inside skyscrapers and by growing crops year-round, regardless of weather conditions. [4] This method of farming increases crop production per square

meter, yielding much more food than does a traditional farming method employed on an equivalent area of land.

[5] One creative alternative is vertical farming: growing crops arranged vertically inside tall buildings rather than spread horizontally on land. [1]

Conventional agriculture uses 70 percent of the world's available drinking water for irrigation, while vertical farming techniques are much more efficient in [2] its use of water. Using drip irrigation to water the roots of plants directly rather than irrigating the soil around the plants, vertical farmers use less water than do [3] traditional places like farms. Other water-efficient methods available to vertical farmers are hydroponics (suspending plants in troughs of circulating nutrient-enriched water) and aeroponics (irrigating plants with only water vapor and nutrients). [4]

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

- A) where it is now.
- B) after sentence 1.
- C) after sentence 2.
- D) after sentence 3.

[2]

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

[3]

- A) NO CHANGE
- B) farms using traditional methods.
- C) traditional farmers.
- D) traditional farms.

[4]

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

Wheat, corn, and rice are problematic to grow in vertical farms because of the large amount of space these crops require relative to the amount of food they produce.

Should the writer make this addition here?

- A) Yes, because it presents a claim that is countered later in the passage.
- B) Yes, because it gives an example that supports the main point of the paragraph.
- C) No, because it distracts from the focus of the paragraph by adding irrelevant information.
- D) No, because it contradicts a point made earlier in the paragraph.

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Because their indoor facilities can be placed anywhere there is **5** sufficient light and energy, vertical farms can be located where they **6** had been most needed: in cities. Establishing farms in cities not only provides residents with fresh produce **7** but also reduces the fossil fuel consumed during shipping. Salad greens from the Chicago-based company FarmedHere, for example, are sold within a few miles of the vertical farm where they are harvested. By contrast, most lettuce consumed in Chicago must be transported over 1,000 miles by truck before it is eaten.

**5**

- A) NO CHANGE
- B) just about enough
- C) an unobjectionable amount of
- D) a plenitude of essential

**6**

- A) NO CHANGE
- B) were
- C) are
- D) are being

**7**

- A) NO CHANGE
- B) and also reduces
- C) as it also reduces
- D) while also reducing

Despite the advantages of vertical farming, it can be difficult to construct buildings that let in enough sunlight for crops to grow, and **8** the energy needed to supplement or replace sunlight with artificial light can be prohibitively expensive. However, preliminary experiments with low-cost LED lights have been promising, showing that farming with artificial light can be feasible on a **9** large and great scale. More experiments are necessary to demonstrate the viability of vertical farms, which Dickson **10** Despommier professor of public health and environmental health sciences at Columbia University, believes could make cities nearly self-sufficient food producers. Still, as demand for agricultural produce continues to increase, **11** vertical-farming advocates will likely encourage consumers to patronize local businesses, including vertical farms.

8 Which choice most effectively sets up the next sentence in the paragraph?

- A) NO CHANGE
- B) the air quality inside the buildings differs according to location.
- C) the architect would likely need some knowledge of vertical farming.
- D) cities that are already populous may not have room for more buildings.

9 Which choice best completes the sentence?

- A) NO CHANGE
- B) large
- C) large, extensive
- D) large and also extensive

10 Which choice best completes the sentence?

- A) NO CHANGE
- B) Despommier, professor of
- C) Despommier professor, of
- D) Despommier professor of

11 Which choice best completes the sentence?

The writer wants a conclusion that restates the main idea of the passage. Which choice best accomplishes this goal?

- A) NO CHANGE
- B) vertical-farming advocates seek additional ways to allow sunlight into city buildings so the plants can grow.
- C) researchers are continuing to investigate the feasibility of using low-cost LED lights in vertical farming.
- D) vertical farming and similar efforts to meet the world's nutritional needs can only become more important.

March QAS 3/10/18

Questions 12–22 are based on the following passage.

**A Singer Finds Her Voice**

In the spring of 1963, African Americans across the United States learned that the civil rights leader Martin Luther King Jr. had been arrested at a nonviolent demonstration protesting racial segregation in Alabama. As King worked on his historic “Letter from Birmingham Jail,” many African American musicians, **12** writers, and other artists looked for ways to use their skills to **13** increase the cause of civil rights. One such artist, celebrated singer Nina **14** Simone, became a strong public voice for the movement, **15** having studied classical music at the Juilliard School in New York City.

**12**

- A) NO CHANGE
- B) writers; and
- C) writers and,
- D) writers, and

**13**

- A) NO CHANGE
- B) enlarge
- C) advance
- D) elaborate

**14**

- A) NO CHANGE
- B) Simone—
- C) Simone,
- D) Simone

**15**

The writer wants to introduce one of the passage’s important ideas. Which choice best accomplishes this goal?

- A) NO CHANGE
- B) even though she hesitated at first to take a prominent role.
- C) although her early musical work was in jazz and cabaret.
- D) an unsurprising turn of events for such a talented singer.

Simone's friend, the dramatist Lorraine Hansberry, had recently brought national attention to racial inequality through her play *A Raisin in the Sun*. Hansberry was passionate about inspiring her fellow artists to be more outspoken in support of civil rights.

**16** However, she pointedly asked Simone **17** what she was doing for the movement while its most visible leader sat in a jail cell. Although Simone was an avid supporter, she said she did not see herself in a leadership role.

Simone's unease about playing a more vocal part in the movement **18** were based largely on her misgivings about mixing politics with popular music. She thought that a three-minute song was too brief to adequately convey a nuanced political message. **19** Moreover, it seemed to her that popular music, typically intended for light entertainment, did not provide the dignity the subject matter deserved. She feared that noble ideals would be cheapened if expressed to the tune of a pop song. Hansberry, however, urged her to reconsider.

16

- A) NO CHANGE
- B) Regardless,
- C) On the contrary,
- D) DELETE the underlined portion and capitalize the next word.

17

- A) NO CHANGE
- B) was she doing anything for the movement while its most visible leader sat in a jail cell.
- C) whether she was doing anything for the movement while its most visible leader sat in a jail cell?
- D) what she was doing for the movement while its most visible leader sat in a jail cell?

18

- A) NO CHANGE
- B) are
- C) have been
- D) was

19

- The writer is considering deleting the underlined sentence. Should the sentence be kept or deleted?
- A) Kept, because it elaborates on a key term that is used in the paragraph.
  - B) Kept, because it adds an additional detail that supports the main point of the paragraph.
  - C) Deleted, because it distracts from the paragraph's discussion by introducing irrelevant information.
  - D) Deleted, because it merely repeats information that is found earlier in the passage.

Only a few months after King's arrest, the backlash against civil rights activists intensified. News of violent acts carried out against civil rights demonstrators and even bystanders shocked the public. The **20** events dismayed Simone. In 1964 she wrote and performed her first protest song to express her anguish. Other such songs followed. Simone decided that Hansberry had been right—the stage and the airwaves could be used to promote the struggle for civil rights and **21** have denounced discrimination and violence.

In 1965, at the age of 34, Hansberry died. In 1970, Simone composed a political anthem and named it after a play based on Hansberry's work: "To Be Young, Gifted, and Black." The song was a heartfelt tribute to the artist and activist who had inspired Simone's own political development. **22**

20

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

- A) events so dismayed Simone that in 1964 she wrote and performed
- B) events dismayed Simone; in 1964 Simone wrote and performed
- C) events, to her dismay, caused her in 1964 to write and perform
- D) events, dismayed her, caused her in 1964 to write and perform

21

- A) NO CHANGE
- B) denounce
- C) denouncing
- D) will denounce

22

The writer wants a conclusion that emphasizes how Simone sought to motivate members of her audience to take political action of their own. Which choice best accomplishes this goal?

- A) For Simone, the meaning of the song was more important than the melody or the complexity of the lyrics—she just wanted to reach people with her message.
- B) In a fitting turn, Simone encouraged listeners to recognize their abilities and dedicate them to the cause of civil rights, just as Hansberry had done for her.
- C) Simone eventually left the United States, but she continued to produce music that made her a worldwide phenomenon.
- D) Simone was invited to New York City in 1971 to receive a commendation from the Congress of Racial Equality for her musical work.

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

#### The Inner Workings of Work

23 A specialist within the field of psychology, industrial/organizational (I/O) psychologists are hired by companies to apply psychological principles and research methods to the workplace. With the goal of improving workplace culture and organization, I/O psychologists study many elements of a company, such as hiring processes, training, and employee work habits, and help implement changes to improve them. Though hiring an I/O psychologist is an expense a company 24 maybe wary of taking on, it pays off: an investment in the expert guidance of an I/O psychologist can yield process improvements, increased job satisfaction among employees, and cost savings.

23

- A) NO CHANGE
- B) Specialists within the field
- C) Being a specialist within the field
- D) Those that are specialists within the fields

24

- A) NO CHANGE
- B) maybe weary
- C) may be wary
- D) may be weary

I/O psychologists strive to promote productivity and cooperation among employees. Eduardo Salas, an I/O psychologist at the Institute for Simulation and Training at the University of Central Florida, consults with organizations to study how employees interact with each other and respond to challenges. For example, he has worked with NASA to study team **25** dynamic's among astronauts and the variable's inherent in the isolated and **26** dicey environment of outer space. "It is usually context specific," Salas says of his team-training strategy. So, when working with NASA, his goal was to provide recommendations that would keep astronauts safe and productive.

25

- A) NO CHANGE
- B) dynamics among astronauts and the variables
- C) dynamic's among astronauts and the variables
- D) dynamics among astronauts and the variable's

26

- A) NO CHANGE
- B) dodgy
- C) chancy
- D) hazardous

27 Survey results can be an effective means of gauging the effectiveness of I/O psychologists. A company's success depends largely on worker morale; a 2010 Gallup study, found that productivity lost by unhappy, disengaged workers costs companies \$28,000 per person annually. 28 To minimize such losses, some I/O psychologists research ways to make employees feel valued and engaged. For example, they may design training courses to help employees learn new skills or advance to leadership positions.

27

Which choice provides the best introduction to the main idea of the paragraph?

- A) NO CHANGE
- B) Employee productivity can be affected by a variety of factors.
- C) I/O psychologists can also improve workplaces by focusing on employee satisfaction.
- D) In addition to making recommendations, I/O psychologists can suggest effective ways of implementing them.

28

- A) NO CHANGE
- B) morale—a 2010 Gallup study,
- C) morale, a 2010 Gallup study,
- D) morale: a 2010 Gallup study

29

Which choice provides the best transition from the previous sentence?

- A) NO CHANGE
- B) Despite that study,
- C) Although workers are often disengaged,
- D) Since productivity can vary,

A 2014 survey of the 500 fastest-growing private companies in the US found that more than half are looking for innovative ways to attract and retain high-performing employees. To meet these needs, companies are increasingly turning to the **30** intuitions provided by I/O psychology. The US Bureau of Labor Statistics reports that I/O psychology is still a relatively small field: **31** the total number of psychologists is expected to increase 12 percent from 2012 to 2022. However, I/O psychology is one of the fastest-growing fields in the country, expected to grow **32** to 178,900 employees between 2012 and 2022.

Employment Projections for Psychologists, 2012–2022

Occupational title	2012 employment	2022 projected employment	Percent increase, 2012–2022 (projected)
Clinical, counseling, and school psychologists	145,100	161,500	11%
Industrial/organizational psychologists	1,600	2,500	56%
Other psychologists	13,500	14,900	10%
Total psychologists	160,200	178,900	12%

Adapted from US Department of Labor, Bureau of Labor Statistics, Employment Projections, 2014.

30

- A) NO CHANGE
- B) insights
- C) perceptiveness
- D) discernment

31

Which choice best illustrates the claim made earlier in the sentence with information from the table?

- A) NO CHANGE
- B) there will be almost 1,000 more jobs in I/O psychology by 2022.
- C) there were only about 1,600 I/O psychologists in 2012.
- D) the total number of psychologists in 2022 is projected to be 178,900.

32

Which choice provides accurate information from the table to support the point made in the sentence?

- A) NO CHANGE
- B) 11 percent
- C) 56 percent
- D) from 13,500 to 14,900 employees

Though companies must spend money to hire I/O

33 psychologists, but doing so is a worthwhile  
investment. Businesses can hire I/O psychologists  
full-time or contract with them on a short-term basis to  
solve specific problems. More than just benefiting a  
company's bottom line, I/O psychologists can help  
people feel valued and engaged at work, and that results  
in jobs well done.

- 33 psychologists, but doing so is a worthwhile
- A) NO CHANGE
  - B) psychologists; while
  - C) psychologists; however,
  - D) psychologists,

Questions 34–44 are based on the following passage and supplementary material.

#### The Road to Recovery

The Endangered Species Act (ESA) requires the US government to identify and protect plant and animal species that are in danger of extinction. While the ESA helps to preserve species classified as endangered,

**34** conservationists have identified hundreds of at-risk species that do not appear on the government's endangered species list. A species that may require protection under the ESA must first be vetted via a complicated and time-consuming process. Since the ESA's implementation in 1973, 10 percent of all species that were candidates for inclusion on the list have disappeared. If the ESA is to fulfill its task of preserving biological diversity, it must reform its procedures to

**35** ensure and guarantee that the list accurately reflects the number of at-risk species in existence.

34

- A) NO CHANGE
- B) conservationists' have identified hundreds
- C) conservationist's have identified hundreds'
- D) conservationists have identified hundreds'

35

- A) NO CHANGE
- B) guarantee by ensuring
- C) ensure the certainty
- D) ensure

The ESA considers a species endangered if it is “in danger of extinction throughout all or a significant portion of its range.” Many critics of the act argue that this ambiguous terminology hinders species from being classified as endangered. **36** Some critics also worry that the ESA could have negative economic impacts, so scientists and government officials must define it for themselves, and they often **37** reach for different conclusions. A more objective approach would be to define the term “endangered” as the probability of a species becoming extinct within a set number of years. While scientists may debate the methods used to calculate this probability of extinction, **38** therefore, the set number of years would need to be defined, conservationists could identify at-risk species using this standard of measurement.

36

Which choice best introduces the topic of this sentence?

- A) NO CHANGE
- B) Although there is disagreement about the terms that should be used,
- C) Critics do not always have suggestions about how the ESA might be improved;
- D) Because the act does not explain the meaning of “a significant portion,”

37

- A) NO CHANGE
- B) reach
- C) reach toward
- D) have an outreach of

38

- A) NO CHANGE
- B) and
- C) even so,
- D) DELETE the underlined portion.

The ESA's criteria would also benefit from

39 tighter restrictions. The act uses only two categories to classify at-risk 40 species. These two categories are "endangered"—likely to go extinct—and "threatened"—likely to become endangered in the near future. By contrast, the International Union for Conservation of Nature (IUCN), a private environmental 41 group acknowledges a broader range of species vulnerability by using three categories for at-risk species in the wild: critically endangered, endangered, and vulnerable. A

39

Which choice best introduces the discussion in the rest of the paragraph?

- A) NO CHANGE
- B) clearer definitions of key terms.
- C) stronger oversight.
- D) being more inclusive.

40

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

- A) species:
- B) species; respectively, the two are
- C) species, these being
- D) species: they are

41

- A) NO CHANGE
- B) group;
- C) group—
- D) group,

comparison of animals classified by the ESA and the IUCN [42] reveal that the [43] IUCN lists a total of 642 at-risk species.

**Noninclusion of IUCN At-Risk Species by the US Endangered Species Act**

	Total IUCN-listed species	Total unrecognized by ESA	Percent unrecognized by ESA
Amphibians	55	44	80.0%
Birds	62	25	40.3%
Mammals	36	18	50.0%
Gastropods	195	176	90.3%
Insects	105	100	95.2%
Crustaceans	189	168	88.9%
Total	642	531	82.7%

Adapted from J. Berton C. Harris et al., "Conserving Imperiled Species: A Comparison of the IUCN Red List and US Endangered Species Act." ©2011 by Wiley Periodicals, Inc.

The US government could improve the scope of its conservation efforts by recognizing more degrees of risk and using the IUCN's categories as a model for ESA reform. A new classification system could also [44] be financially advantageous; the US government would be able to begin protection efforts earlier, which might prevent the need for drastic—and costly—interventions when a species is nearly extinct.

[42] IUCN lists a total of 642 at-risk species.

- A) NO CHANGE
- B) revealing
- C) reveals
- D) have revealed

[43] IUCN lists a total of 642 at-risk species.

Which information from the table provides the strongest evidence in support of the passage's main argument?

- A) NO CHANGE
- B) ESA fails to recognize 82.7 percent of the species listed as at-risk by the IUCN.
- C) ESA fails to recognize 80.0 percent of the amphibian species listed by the IUCN as at-risk.
- D) IUCN includes six classes of animals in its classifications of at-risk animal populations.

[44] IUCN lists a total of 642 at-risk species.

Which choice best introduces the argument made in the final sentence of the paragraph?

- A) NO CHANGE
- B) please conservationists more than any other strategy;
- C) be subject to further revision;
- D) constitute a model for other nations grappling with environmental perils;

**STOP**

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

**Do not turn to any other section.**

March QAS 3/10/18



# 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**

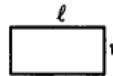
1. The use of a calculator is not permitted.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated,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

**REFERENCE**



$$A = \pi r^2$$

$$C = 2\pi r$$



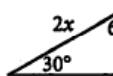
$$A = lw$$



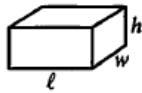
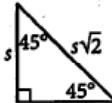
$$A = \frac{1}{2}bh$$



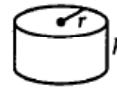
$$c^2 = a^2 + b^2$$



Special Right Triangles



$$V = lwh$$



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



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



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

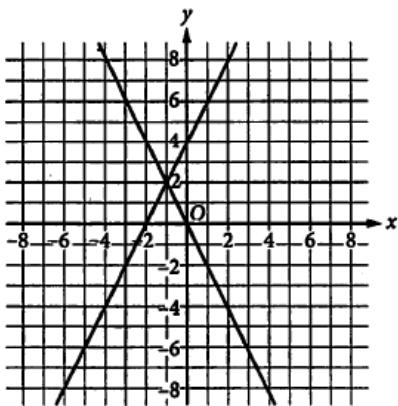


$$V = \frac{1}{3}lwh$$

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

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

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



The lines in the  $xy$ -plane above are the graphs of two linear equations. What is the solution  $(x, y)$  to the system formed by the equations?

- A)  $(-2, 4)$
- B)  $(-1, 2)$
- C)  $(0, 0)$
- D)  $(0, 4)$

2

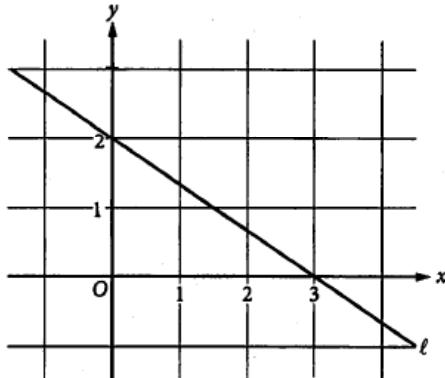
A checkers enthusiast is customizing a checkers set by painting a design on each of the 24 checkers in the set. It takes the enthusiast 35 minutes to paint the design on each checker. If  $c$  of the checkers are already painted, which of the following represents the number of additional minutes needed to finish painting the set of checkers?

- A)  $24(35 - c)$
- B)  $24(c - 35)$
- C)  $35(24 - c)$
- D)  $35(c - 24)$

3

What is the sum of  $(3x^5 + 4x^2 + 8)$  and  $(12x^3 - 2x^2 + 6)$ ?

- A)  $15x^8 + 2x^2 + 14$
- B)  $3x^5 + 12x^3 + 2x^2 + 14$
- C)  $3x^5 + 12x^3 + 6x^2 + 14$
- D)  $3x^5 + 12x^3 + 4x^2 - 2x + 14$



Line  $\ell$  is shown in the  $xy$ -plane above. Line  $m$  (not shown) is parallel to line  $\ell$  and passes through the point  $(0, 3)$ . Which of the following is an equation of line  $m$ ?

- A)  $y = -\frac{2}{3}x + 3$
- B)  $y = -\frac{3}{2}x + 3$
- C)  $y = \frac{2}{3}x + 3$
- D)  $y = \frac{3}{2}x + 3$

5

What are the slope and the  $y$ -intercept of the graph in the  $xy$ -plane of the equation  $5x + 4y + 3 = 0$ ?

- A) The slope is  $-\frac{5}{4}$ , and the  $y$ -intercept is  $(0, -\frac{3}{4})$ .
- B) The slope is  $-\frac{5}{4}$ , and the  $y$ -intercept is  $(0, \frac{3}{4})$ .
- C) The slope is  $\frac{5}{4}$ , and the  $y$ -intercept is  $(0, -\frac{3}{4})$ .
- D) The slope is  $\frac{5}{4}$ , and the  $y$ -intercept is  $(0, \frac{3}{4})$ .

6

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

What value of  $x$  satisfies the equation above?

- A)  $\frac{4}{3}$
- B) 4
- C) 5
- D)  $\frac{20}{3}$



7

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

What is the solution set to the equation above?

- A)  $\left\{\frac{1}{2}, -2\right\}$
- B)  $\left\{-\frac{1}{2}, 2\right\}$
- C)  $\left\{\frac{1}{2}, -2, 2\right\}$
- D)  $\left\{-\frac{1}{2}, -2, 2\right\}$

8

$$(3 + 4i) - (2 + 3i)$$

In the complex number system, which of the following is equivalent to the expression above?  
(Note:  $i = \sqrt{-1}$ )

- A) 0
- B)  $1 + i$
- C)  $-1 - i$
- D)  $-5 - 7i$

9

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

What is the solution to the equation shown?

- A) -5
- B) -2
- C) 0
- D) 1

10

$$P(x) = x^2 - 11x + k$$

In the function above,  $k$  is a constant. If 2 is a zero of the function, what is the value of  $k$ ?

- A) -18
- B) -2
- C) 3
- D) 18



11

$$\frac{2}{3x^2} - \frac{1}{6x^2}$$

Which of the following expressions is equivalent to the expression above for  $x > 0$ ?

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

12

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

What is the solution set of the equation above?

- A) {1}
- B) {0, 3}
- C) {1, 2}
- D) {1, 3}

13

$$P(t) = 60(3)^{\frac{t}{2}}$$

The number of microscopic organisms in a petri dish grows exponentially with time. The function  $P$  above models the number of organisms after growing for  $t$  days in the petri dish. Based on the function, which of the following statements is true?

- A) The predicted number of organisms in the dish triples every two days.
- B) The predicted number of organisms in the dish doubles every three days.
- C) The predicted number of organisms in the dish triples every day.
- D) The predicted number of organisms in the dish doubles every day.



14

In the  $xy$ -plane, the graph of the equation  $y = 9x - 8$  intersects the graph of the equation  $y = x^2$  at two points. What is the sum of the  $x$ -coordinates of the two points?

- A) -9
- B) -7
- C) 7
- D) 9

15

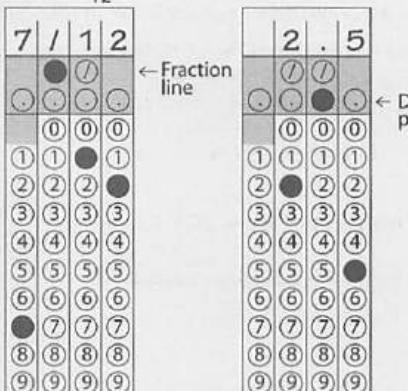
Which of the following expressions is equivalent to  $(-4x^3)^{\frac{2}{3}}$ ?

- A)  $-2x^3 \cdot \sqrt[3]{2}$
- B)  $-x^3 \cdot \sqrt[3]{16}$
- C)  $2x^2 \cdot \sqrt[3]{2}$
- D)  $2x^2 \cdot \sqrt[3]{16}$

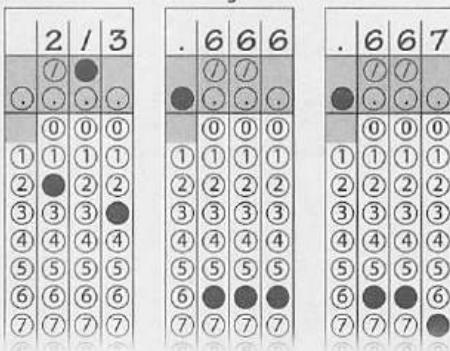
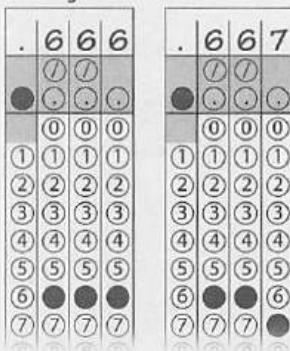
**DIRECTIONS**

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

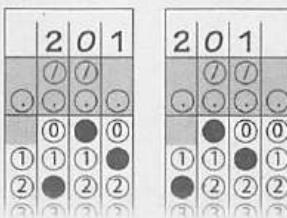
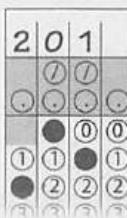
- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.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

Answer: $\frac{7}{12}$	Answer: 2.5
Write answer in boxes.	← Decimal point
Grid in result. 	

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

. 2   3	. 6 6 6	. 6 6   7
Grid in result.	Grid in result.	Grid in result.
		

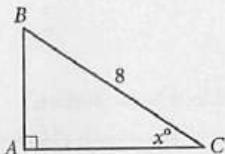
Answer: 201 – either position is correct

2   0   1	2   0   1
Grid in result.	Grid in result.
	

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



16



Note: Figure not drawn to scale.

- In right triangle  $ABC$  above,  $BC = 8$ . If the cosine of  $x^\circ$  is  $\frac{\sqrt{3}}{2}$ , what is the length of  $\overline{AB}$ ?

17

$$\frac{1}{x} + \frac{1}{x-1} = 0$$

What value of  $x$  satisfies the equation above?

18

- For a function  $f$ ,  $f(-1) = 12$  and  $f(1) = 16$ . If the graph of  $y = f(x)$  is a line in the  $xy$ -plane, what is the slope of the line?

19

- An angle measure of 540 degrees was written in radians as  $x\pi$ . What is the value of  $x$ ?

20

- Tamika is ordering desktop computers for her company. The desktop computers cost \$375 each, and tax is an additional 6% of the total cost of the computers. If she can spend no more than \$40,000 on the desktop computers, including tax, what is the maximum number of computers that Tamika can purchase?

## STOP

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

March QAS 3/10/18



# 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**

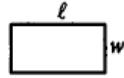
1. The use of a calculator is permitted.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the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

**REFERENCE**



$$A = \pi r^2$$

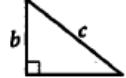
$$C = 2\pi r$$



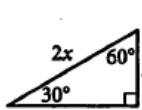
$$A = \ell w$$



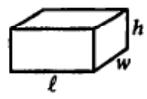
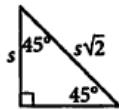
$$A = \frac{1}{2}bh$$



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



Special Right Triangles



$$V = \ell wh$$



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



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



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



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

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

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

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



$$(3x + 2)(2x + 3)$$

Which of the following is equivalent to the expression above?

- A)  $3x^2 + 10x + 5$
- B)  $5x^2 + 13x + 5$
- C)  $6x^2 + 13x + 6$
- D)  $6x^2 + 15x + 9$

$$f(x) = 2x - 11$$

The function  $f$  is defined above. What is the value of  $f(-2)$ ?

- A) -15
- B) -7
- C) 15
- D) 30

Number of Flight Arrivals at  
Centerville Airport in a Month

	On time	Delayed	Total
Airline A	2,029	861	2,890
Airline B	1,150	700	1,850
Total	3,179	1,561	4,740

Based on the table above, what fraction of the flights for Airline A were delayed?

- A)  $\frac{700}{1,850}$
- B)  $\frac{861}{1,561}$
- C)  $\frac{861}{2,890}$
- D)  $\frac{2,029}{2,890}$

A political scientist wants to predict how the residents of New Jersey will react to a new bill proposed in the state senate. Which of the following study designs is most likely to provide reliable results for the political scientist?

- A) Mailing a questionnaire to each of 200 randomly selected residents of New Jersey
- B) Surveying a group of 300 randomly selected New Jersey residents
- C) Interviewing a group of students randomly selected from a large public university in New Jersey
- D) Surveying a group of 1,500 randomly selected US residents



5

If the ratio of  $0.5 : x$  is equivalent to  $1.5 : 2.25$ , what is the value of  $x$ ?

- A) 0.75
- B) 1.6875
- C) 3
- D) 3.25

6

$$8ax - 4 = 24$$

Based on the equation above, what is the value of  $2ax - 1$ ?

- A) 3
- B) 6
- C) 8
- D) 12

$$P = 2,000x$$
$$P = 500(2^x)$$

A website administrator is considering using one of the two models above to predict the total number of purchases,  $P$ , made  $x$  weeks after the website's advertising campaign begins. How many more purchases are predicted by the exponential model than by the linear model 5 weeks after the advertising campaign begins?

- A) 6,000
- B) 8,000
- C) 10,000
- D) 16,000



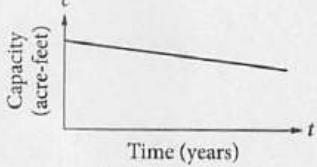
Questions 8–10 refer to the following information.

The Conowingo Reservoir had an original storage capacity of 300,000 acre-feet at the end of 1928, the year in which it was built. Starting in 1929, sediment carried downstream by the Susquehanna River collected in the reservoir and began reducing the reservoir's storage capacity at the approximate rate of 1,700 acre-feet per year.

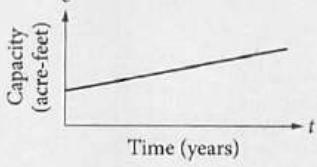
8

Which of the following could be a graph of the reservoir's capacity  $c$ , in acre-feet, as a function of time  $t$ , in years, after 1928?

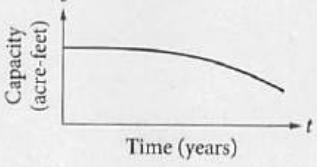
A)



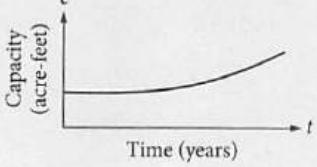
B)



C)



D)



9

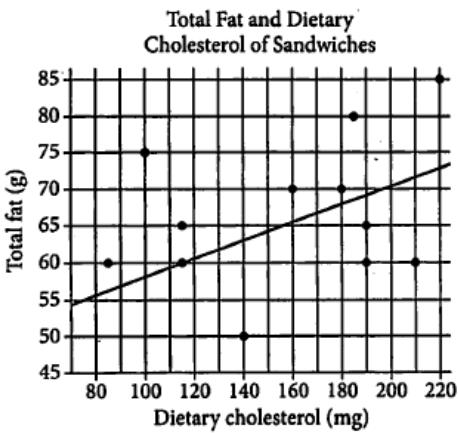
What was the approximate storage capacity, in acre-feet, of the reservoir at the end of 1993?

- A) 300,000
- B) 189,500
- C) 175,000
- D) 159,500

10

If the reservoir's capacity  $t$  years after 1928 was between 290,000 and 292,000 acre-feet, which of the following must be true?

- A)  $t < 2$
- B)  $2 < t < 4$
- C)  $4 < t < 6$
- D)  $6 < t < 8$



The scatterplot above shows the relationship between the amount of dietary cholesterol, in milligrams (mg), and the amount of total fat, in grams (g), in the 12 sandwiches offered by a certain restaurant. The line of best fit predicts the amount of total fat a sandwich has based on the amount of dietary cholesterol in the sandwich. How many grams of total fat are in the sandwich for which this prediction is the most accurate?

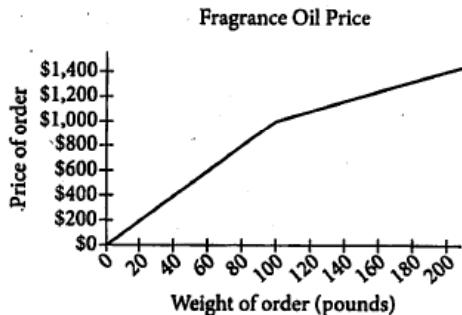
- A) 140
- B) 115
- C) 85
- D) 60

12

Which of the following is a solution to the equation

$$\sqrt{14 - x} + 2 = x$$

- I. -2
  - II. 1
  - III. 5
- A) I only  
B) II only  
C) III only  
D) I and III

13. *What is the value of  $x$ ?*

The graph above shows the price that a chemical company charges for an order of fragrance oil, depending on the weight of the order. Based on the graph, which of the following statements must be true?

- A) The company charges more per pound for orders greater than 100 pounds than for orders less than 100 pounds.
- B) The company charges less per pound for orders greater than 100 pounds than for orders less than 100 pounds.
- C) The company charges less per pound for orders greater than 1,000 pounds than for orders less than 1,000 pounds.
- D) The company charges the same price per pound, regardless of order size.

14. *What is the value of  $x$ ?*

If  $2x + 3 = x - 4$ , what is the value of  $x + 8$ ?

- A) -7
- B) -1
- C) 1
- D) 7

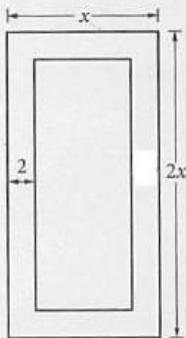
15. *What is the mean score of the remaining players?*

A group of 10 students played a certain game. Every player received a score equal to an integer from 1 to 10, inclusive. For the 10 players, the mean score was 4. If more than half of the players received a score greater than 5, which of the following is true about the mean score of the remaining players?

- A) It must be less than 4.
- B) It must be equal to 4.
- C) It must be between 4 and 5.
- D) It must be greater than 5.



16



The figure above represents a rectangular painting with a frame that is 2 inches wide. The expression  $2x^2 - (x - 4)(2x - 4)$  represents the area of the frame, in square inches, of the inner rectangle  $(x - 4)(2x - 4)$  in the expression represent?

- A) The width of the painting, in inches
- B) The height of the frame, in inches
- C) The area, in square inches, of the inner rectangle
- D) The combined area, in square inches, of the frame and painting

17

$$f(x) = x(x + 5)$$

The function  $f$  is defined above. If the function  $g$  is defined by  $g(x) = f(x) + 5$ , what is the value of  $g(3)$ ?

- A) 8
- B) 15
- C) 24
- D) 29

March QAS 3/10/18

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18

A sample of 600 ninth graders was selected at random and asked how much time they spend on homework each day. Of the ninth graders selected, 220 spend less than 2 hours on homework each day. If the conclusion was drawn that “approximately 1.35 million ninth graders spend less than 2 hours on homework each day,” which of the following is closest to the population, in millions, of ninth graders?

- A) 0.495
- B) 1.35
- C) 3.68
- D) 5.84

19

$$\begin{aligned}y &= -2 \\y + 11 &= x^2\end{aligned}$$

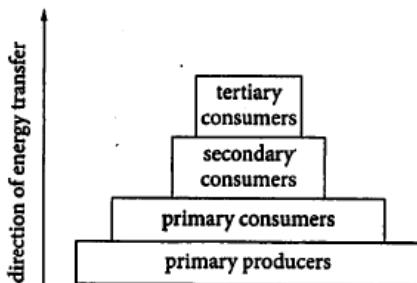
If  $(x_1, y_1)$  and  $(x_2, y_2)$  are solutions to the system of equations above, what are the values of  $x_1$  and  $x_2$ ?

- A)  $-\sqrt{13}$  and  $\sqrt{13}$
- B)  $-\sqrt{11}$  and  $\sqrt{11}$
- C) -2 and 2
- D) -3 and 3



20

The energy pyramid below shows four trophic levels in an ecosystem and the direction of energy transfer between those levels.



On average, 10% of the net energy of one trophic level is transferred to the next trophic level in an ecosystem. Based on the energy pyramid, if primary producers have 5,000 joules (J) of energy, approximately how much of this energy, in calories, is transferred to the secondary consumers in this ecosystem? (1 calorie = 4.18 J)

- A) 11.96
- B) 20.90
- C) 119.6
- D) 209.0

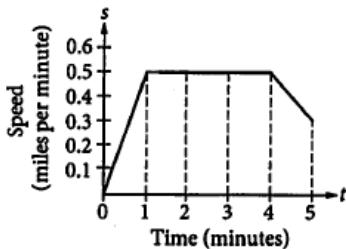
21

$$\sqrt[a]{x^b}$$

Which of the following is equivalent to the expression above for all  $x > 0$ , where  $a$  and  $b$  are positive integers?

- A)  $x^{ab}$
- B)  $x^{\frac{a}{b}}$
- C)  $x^{\frac{b}{a}}$
- D)  $x^{a-b}$

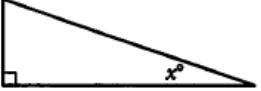
22



The graph above models the speed,  $s$ , of an automobile during the first 5 minutes of travel time,  $t$ . What was the total distance traveled from  $t = 1$  to  $t = 4$ ?

- A) 0.5 mile
- B) 1.5 miles
- C) 2.0 miles
- D) 2.5 miles



23. 

Note: Figure not drawn to scale.

In the figure above,  $\sin(90^\circ - x^\circ) = \frac{12}{13}$ . What is the value of  $\sin x^\circ$ ?

- A)  $\frac{12}{13}$
- B)  $\frac{5}{13}$
- C)  $\frac{5}{12}$
- D)  $\frac{13}{12}$

24. 

$$s = 9.8t$$

The equation above can be used to approximate the speed  $s$ , in meters per second (m/s), of an object  $t$  seconds after being dropped into a free fall. Which of the following is the best interpretation of the number 9.8 in this context?

- A) The speed, in m/s, of the object when it hits the ground
- B) The increase in speed, in m/s, of the object for each second after it is dropped
- C) The speed, in m/s, of the object  $t$  seconds after it is dropped
- D) The initial speed, in m/s, of the object when it is dropped

25. 

A magazine article on video game habits in the United States reported that in 2012 gamers spent an average of 5.6 hours per week playing games. The article also reported the average for 2013 to be 6.3 hours per week. Based on the article, how did the average number of hours that gamers spent playing games per week change from 2012 to 2013?

- A) It decreased by 12.5%.
- B) It increased by 7.0%.
- C) It increased by 11.1%.
- D) It increased by 12.5%.



26

$$\begin{aligned}5x + y &= a \\-3x - 2y &= 5\end{aligned}$$

In the system of equations above,  $a$  is a constant. What is the  $y$ -value of the solution to the system in terms of  $a$ ?

- A)  $\frac{-3a - 25}{7}$
- B)  $\frac{a - 1}{7}$
- C)  $\frac{2a + 5}{7}$
- D)  $\frac{10a + 5}{7}$

27

$$y = x^2 - 6x - 16$$

The graph of the equation above in the  $xy$ -plane is a parabola. Which of the following equivalent forms of the equation includes the  $x$ - and  $y$ -coordinates of the vertex as constants?

- A)  $y = (x - 3)^2 - 25$
- B)  $y = x(x - 6) - 16$
- C)  $y = x^2 - 2(3x + 8)$
- D)  $y + 16 = x(x - 6)$

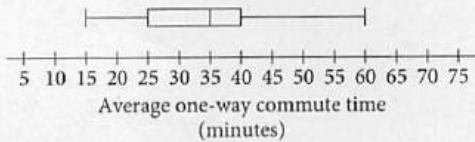


28

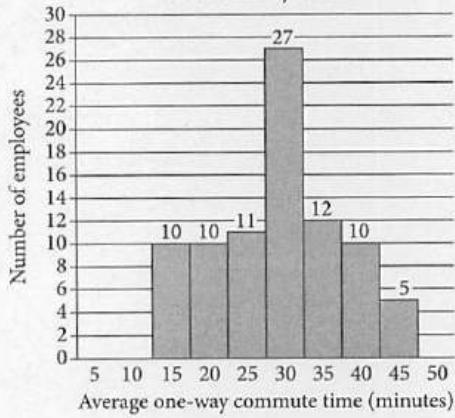
**Questions 28 and 29 refer to the following information.**

For a particular office building with 1,420 employees, Tia and Amir each conducted a survey about the average one-way commute times, in minutes, between the employees' home and office. Both Tia and Amir selected employees at random, mailed out surveys, and collected data from the returned surveys. For both surveys, respondents were asked to report their average commute times to the nearest 5 minutes. Tia collected data from 150 employees, and Amir collected data from 85 employees. The results from Tia's and Amir's returned surveys are summarized below.

Tia's Survey Results



Amir's Survey Results



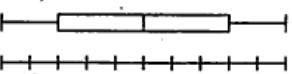
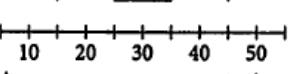
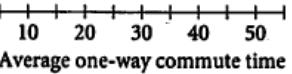
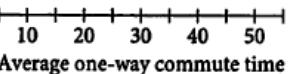
If  $T$  is the median commute time of the employees who responded to Tia's survey and  $A$  is the median commute time of the employees who responded to Amir's survey, what is the value of  $T - A$ ?

- A) 10
- B) 8
- C) 5
- D) 0

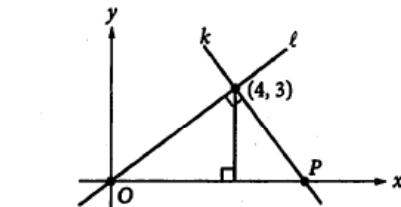


29

Which of the following box plots could represent Amir's survey data?

- A) 
- B) 
- C) 
- D) 

30



In the  $xy$ -plane above, lines  $k$  and  $\ell$  are perpendicular. What is the  $x$ -coordinate of point  $P$ ?

- A) 5.25  
B) 5.75  
C) 6  
D) 6.25

**DIRECTIONS**

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

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

Write →  
answer  
in boxes.  
Grid in  
result.

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

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

← Fraction  
line

Answer: 2.5

2	.	5
0	1	2
4	5	6
8	9	0

← Decimal  
point

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

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

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

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

Answer: 201 – either position is correct

2	0	1
0	1	2
4	5	6
8	9	0

2	0	1
0	1	2
4	5	6
8	9	0

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



31

A museum built a scale model of an *Apatosaurus* dinosaur skeleton, where 1 centimeter in the model is equivalent to 16 centimeters of the actual skeleton. If the length of the femur bone of the actual skeleton is 184 centimeters, what is the length, to the nearest tenth of a centimeter, of the femur bone in the model?

32

How many cups, each with a capacity of 8 fluid ounces, can be filled with water from a cooler that contains 10 gallons of water? (1 gallon = 128 fluid ounces)

33

In triangle  $ABC$ , angle  $A$  measures  $48^\circ$ , angle  $B$  measures  $88^\circ$ , and angle  $C$  measures  $44^\circ$ .

Triangle  $ABC$  is similar to triangle  $LMN$ , such that  $\frac{LM}{AB} = \frac{MN}{BC} = \frac{LN}{AC} = 3$ . What is the measure, in degrees, of angle  $L$ ?

34

$$\begin{aligned}\frac{1}{2}y &= \frac{19}{12} - \frac{1}{3}x \\ 5y &= 3x\end{aligned}$$

In the  $xy$ -plane, the lines that correspond to the system of equations above intersect at the point  $(a, b)$ . What is the value of  $\frac{a}{b}$ ?



35

$$z = \frac{5}{2}z - \frac{21}{8}$$

What value of  $z$  satisfies the equation above?

36

A circle in the  $xy$ -plane has a diameter with endpoints  $(-1, -3)$  and  $(7, 3)$ . If the point  $(0, b)$  lies on the circle and  $b > 0$ , what is the value of  $b$ ?

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

Race Summary

Split number	Race segment (meters)	Split time (seconds)	Total race time at end of split (seconds)
1	0–500	109	109
2	500–1000	112	221
3	1000–1500	111	332
4	1500–2000	108	440

A rowing team entered a 2000-meter race. The team's coach is analyzing the race based on the team's split times, as shown in the table above. A split time is the time it takes to complete a 500-meter segment of the race.

37

During the fourth split of the race, the team rowed at a rate of 28 strokes per minute. To the nearest whole number, how many strokes did it take the team to complete the final 500 meters of the race?

38

By the end of the season, the coach wants the team to reduce its mean split time by 10% as compared to this race. At the end of the season, what should the team's mean split time be, in seconds?

**STOP**

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

# Writing and Language Test

35 MINUTES, 44 QUESTIONS

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

## DIRECTIONS

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

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

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

Questions 1-11 are based on the following passage.

### Benjamin Banneker: Marking Time

Benjamin Banneker gained local fame for making a working clock in 1753, a time when few people owned clocks, let alone understood [1] they're mechanics. A twenty-two-year-old free black man living in Maryland, Banneker learned how to make the clock by examining the insides of a watch a merchant friend had lent him. His sharp skills in measuring the passage of time would eventually lead Banneker to the job of determining the official borders of the new United States capital.

1

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

Studious from an early age, Banneker completed his formal education only up through algebra, at which point his father pulled him out of school to help on the family farm. A former teacher, however, encouraged Banneker to pursue his education independently and lent him the books to do so. Banneker also studied the night **2** sky, he charted how the migration of the stars relates to the passage of time.

**3** When the wealthy Ellicott family built a flour mill not far from his farm, Banneker befriended George **4** Ellicott. Ellicott's knowledge about science and astronomy impressed him. They met regularly at the flour mill and **5** Banneker's home, where they met to discuss debates in astronomy. From Ellicott, Banneker borrowed books by authors such as James Ferguson, a leading astronomer of the time.

2

- A) NO CHANGE
- B) sky. Charting
- C) sky, charting
- D) sky, he also charted

3

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

- A) In the 1770s, Banneker made a fortuitous friendship.
- B) The 1770s were filled with social and political upheaval.
- C) Banneker's life was significantly influenced by several people.
- D) Banneker continued his studies in science and math.

4

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

- A) Ellicott of whom
- B) Ellicott, from whom his
- C) Ellicott, while Ellicott's
- D) Ellicott, whose

5

- A) NO CHANGE
- B) at Banneker's home, meeting
- C) Banneker's home
- D) Banneker's home, meeting

[1] In that same decade, the United States became a fledgling nation with no permanent capital. [2] Federal legislators met in eight different northern cities before they decided that, as part of a broader compromise, a capital should be built farther south. [3] His cousin George likely recommended Banneker for the job. [4] In 1791 President Washington issued a directive: the capital would be situated on the Potomac River and encompass a ten-mile square that included the booming ports of Georgetown, then a part of Maryland, and Alexandria, Virginia. [5] Leading the team to determine the capital's boundaries **6** were Major Andrew Ellicott, a well-known land surveyor who needed a capable assistant. [6] Land surveying, the art of measuring horizontal and vertical distances between objects, demands a strong command of trigonometry and astronomy, **7** particularly to the ability to chart mathematically the course of celestial bodies in relation to the curvature of the rotating Earth—skills Banneker possessed. **8**

6

- A) NO CHANGE
- B) will be
- C) have been
- D) was

7

- A) NO CHANGE
- B) particular about
- C) particularly
- D) in particularly

8

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

- A) where it is now.
- B) after sentence 4.
- C) after sentence 5.
- D) after sentence 6.

Banneker and the rest of Major Ellicott's crew set up camp on Jones Point in early March 1791. A peninsula extending into the Potomac River, the point offered an expansive view of the territory. **9** Additionally, a National Park Service plaque at Jones Point

**10** commemorates the men's contributions in shaping the capital. On a clear day, looking north across the water, visitors can see the domed Capitol Building rising toward the sky. **11**

9

- A) NO CHANGE
- B) Not surprisingly,
- C) After some time,
- D) Today,

10

- A) NO CHANGE
- B) memorizes
- C) magnifies
- D) fossilizes

11

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

Visitors to Jones Point can also enjoy activities such as fishing and kayaking.

Should the writer make this addition here?

- A) Yes, because it contributes to the description of Jones Point as it is in the present.
- B) Yes, because it encourages readers to visit a place of historical importance.
- C) No, because it strays from the paragraph's focus on Banneker's publications.
- D) No, because it tacks on irrelevant information at the end of the passage.

Questions 12–22 are based on the following passage.

### Energy Storage Under Pressure

Renewable energy **12** sources pose a challenge for the businesses and utilities that use them: the need to store surplus energy to use later, during times **13** of peak demand. For example, wind fluctuates and generally produces more energy during the night, when demand is lower. Conversely, solar power generates most of its electricity during the day and provides little power at night. A method of storage called Compressed Air Energy Storage (CAES) **14** is one method that may be one of the best solutions to this problem.

**12**

The writer is considering revising the underlined portion to the following.

sources, such as hydropower, wind power, and solar power,

Should the writer make this revision here?

- A) Yes, because it sets up how the information in the passage will be structured.
- B) Yes, because it offers examples that clarify a key term in the passage.
- C) No, because it groups together examples that are too different to be of use to the passage.
- D) No, because it conflicts with information presented later in the sentence.

**13**

- A) NO CHANGE
- B) for peak
- C) of peeked
- D) for peaked

**14**

- A) NO CHANGE
- B) is a particular means of storage that
- C) constitutes a form of storage that
- D) DELETE the underlined portion.

[1] Power plants with CAES systems use surplus energy produced during off-peak hours to pump air into large underground cavities, such as naturally occurring or human-made salt or rock caverns. [2] The expanding air drives a turbine, generating electricity. [3] The walls of these spaces have been specially fortified to handle the high pressure and density of pressurized air. [4] As air is pumped into the inflexible cavern, the pressure increases to 1,100 pounds per square inch. [5] When energy is needed later, the power plant releases pressurized air from the cavity, causing the air to expand. **15**

**15**

To make this paragraph most logical, sentence 2 should be placed

- A) where it is now.
- B) after sentence 3.
- C) after sentence 4.
- D) after sentence 5.

Currently, only two power plants use **16** CAES; one in McIntosh, Alabama, and another in Huntorf, Germany. The McIntosh power plant can produce up to 110 megawatts of electrical **17** power, the German plant can produce 321 megawatts. **18** Combined, that's enough energy to service approximately 431,000 homes. There are a few other CAES projects in progress across the United States, including pilot projects in Ohio, California, and New Jersey.

**16**

- A) NO CHANGE
- B) CAES. One
- C) CAES: one
- D) CAES, one:

**17**

- A) NO CHANGE
- B) power, as well as
- C) power, and
- D) power; while

**18**

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

- A) Kept, because it shows the impact of the two CAES plants currently in use.
- B) Kept, because it provides a transition to another point about how to provide electricity to homes.
- C) Deleted, because it ignores differences in the levels of energy usage of individual homes.
- D) Deleted, because it interrupts the paragraph's description of the McIntosh facility.

There are a number of reasons that so few CAES units have been built, despite the fact that CAES is one of only a few reliable ways to store energy from renewable energy sources. First, huge underground cavities are possible only in certain types of land. Second, even where these formations exist, reinforcing them and building the infrastructure for **19** CAES, can cost upwards of \$100 million. Finally, traditional methods of CAES **20** requires heat to compress the air, which can lower the energy efficiency of the process.

Though the system is initially expensive and involves an expenditure of energy, CAES has proven to be reliable and economically viable in the long term. Furthermore, researchers have developed methods of CAES that reach much better efficiency levels by **21** apprehending the heat required to compress the air and reusing it to heat the decompressing air. These methods can be used in CAES units built in the future. Given the growing shift to renewable energy, **22** the only stumbling blocks to additional innovations may be national energy policies that make potential investors hesitate.

19

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

20

- A) NO CHANGE
- B) had required
- C) does require
- D) require

21

- A) NO CHANGE
- B) capturing
- C) arresting
- D) seizing

22

The writer wants a conclusion that restates the main idea of the passage. Which choice most effectively accomplishes this goal?

- A) NO CHANGE
- B) CAES is a promising solution to one of alternative energy's biggest challenges.
- C) it is dismaying that CAES technology is not yet as efficient as it could be.
- D) residential applications of CAES technology—in addition to large operations—are likely to become feasible soon.

Questions 23–33 are based on the following passage.

#### A Man of Many Words

In 1747 the author Samuel **23** Johnson announced an ambitious plan for a new English-language dictionary. He did so with the encouragement of a group of London booksellers. Johnson's goal was to produce an authoritative guide to the language "by which its purity may be preserved." The completed *Dictionary of the English Language* finally appeared in **24** 1755, its release was every bit the publishing event that the writer and his backers had imagined. Along **25** one's laborious journey from planning to publication, however, Johnson's *Dictionary* had become a book with more humble ambitions—one that no longer aspired to preserve the purity of the language. Johnson had come to realize that, like all languages, the English language was a living, changing thing that could not be preserved, only described.

23

Which choice best combines the sentences at the underlined portion?

- A) Johnson announced an ambitious plan for a new English-language dictionary and was encouraged by a group of London booksellers.
- B) Johnson, announcing an ambitious plan for a new English-language dictionary, was encouraged by a group of London booksellers.
- C) Johnson announced an ambitious plan for a new English-language dictionary; he was encouraged in this by a group of London booksellers.
- D) Johnson, encouraged by a group of London booksellers, announced an ambitious plan for a new English-language dictionary.

24

- A) NO CHANGE
- B) 1755, and
- C) 1755, as
- D) 1755 with

25

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

Johnson had begun his work in 1746, furnishing his house with several large tables and massive heaps of books. To provide examples of proper word use for his *Dictionary*, Johnson looked to those he considered the **26** hotshot experts on the English language: the leading English writers of the past and present. Johnson read through the works of hundreds of **27** writers, his marking the passages he viewed as exemplary. He then handed the books off to six scribes he had hired to copy out his chosen excerpts.

**28** Johnson was extremely selective in the passages he used to illustrate his words. No earlier English lexicographer, or dictionary writer, had attempted to define words as precisely as Johnson did. However, Johnson's careful analysis of his sources revealed subtle but inexorable changes in the ways words were used by different writers at different times. When the *Dictionary* was published in 1755, Johnson's preface

**29** acknowledged this inherent mutability of language, noting that no lexicographer "shall imagine that his dictionary can embalm his language, and secure it from corruption and decay."

**26**

- A) NO CHANGE
- B) foremost
- C) big-name
- D) primo

**27**

- A) NO CHANGE
- B) writers,
- C) writers, and
- D) writers by

**28**

Which choice best introduces the topic of this paragraph?

- A) NO CHANGE
- B) It is unknown precisely how much work Johnson's scribes did beyond copying down passages.
- C) Johnson was not the first writer to create a dictionary of the English language.
- D) Next, Johnson undertook the more difficult task of composing definitions.

**29**

Which choice best sets up the quotation from Johnson later in the sentence?

- A) NO CHANGE
- B) bemoaned the low status of dictionary writers,
- C) explained how the writer determined which words to include,
- D) stated that the quotations were carefully chosen for their style or subject matter,

This recognition did not mean that Johnson had no opinions about how words should be used. On the contrary, Johnson **30** used the *Dictionary* to promote words he favored and to protest words he disliked. **31** In the definition for “pictorial,” a term coined by Sir Thomas Browne, Johnson described the word as one “not adopted by other writers, but elegant and useful.” **32** By the same token, the word “writative,” which Johnson had found in the letters of Alexander Pope, was not even granted a definition; Johnson simply wrote “A word of Pope’s coining: not to be imitated.” Johnson understood that he could not preserve his language—but he **33** could—at the very least, try to shape its future use. In that more modest goal he appears to have succeeded: Johnson’s work stood as the definitive English dictionary for well over a century, influencing generations of English writers and readers.

**30**

- A) NO CHANGE
- B) had used
- C) will use
- D) uses

**31**

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

When it was finished, Johnson’s *Dictionary* contained 42,773 words, which made it neither the longest nor the shortest dictionary of the eighteenth century.

Should the writer make this addition here?

- A) Yes, because it provides relevant contextual information about eighteenth-century dictionaries.
- B) Yes, because it puts in perspective just how many words Johnson had influence over.
- C) No, because it interrupts the discussion of how Johnson used his *Dictionary* to affect the English language.
- D) No, because it merely repeats information about Johnson’s *Dictionary* that appears earlier in the passage.

**32**

- A) NO CHANGE
- B) On the other hand,
- C) For example,
- D) Nevertheless,

**33**

- A) NO CHANGE
- B) could, at the very least—
- C) could, at the very least,
- D) could; at the very least,

Questions 34–44 are based on the following passage and supplementary material.

### Retailers Profit from Paying Well

Many retailers rely on discount prices to attract customers, and these companies' executives and managers often assume that they must maintain low employee costs to preserve these discounts. However, in recent years, several retailers have challenged this **34** conventional wisdom, offering better-than-average wages and **35** benefits, and they have done so, while keeping costs down and performing well financially.

The cost of better compensation for employees is lower than many employers may realize. A 2012 study by Demos, a public policy research and advocacy organization, noted that if retail workers' annual earnings were increased so that on average the lowest-paid workers received a 27 percent raise, the additional cost to employers would amount to only 0.5 percent of total retail sales. **36** Stores could increase their prices to make up for this expenditure. The additional cost to consumers if they did so would average 30 cents per shopping trip—hardly enough to keep most customers away.

34

- A) NO CHANGE
- B) habitual
- C) routine
- D) accustomed

35

- A) NO CHANGE
- B) benefits—and they have done so
- C) benefits: and they have done so,
- D) benefits and they have done so,

36

- Which choice most effectively combines the sentences at the underlined portion?
- A) If stores increased their prices to make up for this expenditure, the additional cost to consumers
  - B) Increasing their prices to make up for this expenditure, stores could make an additional cost to consumers that
  - C) The additional cost to consumers to make up for this expenditure would be increased store prices so that they
  - D) If the additional cost to consumers made up for this expenditure by increasing store prices, it

Yet this modest price increase would probably be unnecessary because increasing pay at retail businesses increases sales performance. When Professor Zeynep Ton at the Massachusetts Institute of Technology compared two chains of warehouse club **37** stores—one with better-than-average pay and benefits and another with lower employee wages, she found that the average number of sales per employee at the higher-wage club store was double **38** the employees at the lower-wage club store. According to Ton's study, well-paid workers were friendlier and more helpful to customers, and they were more knowledgeable about the company's products. As a result of their experiences with these employees, customers were more likely to make purchases.

**37**

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

**38**

- A) NO CHANGE
- B) the ones
- C) the number
- D) DELETE the underlined portion.

By contrast, many employees at retail stores that pay average or below-average wages quit each year, a phenomenon known as employee turnover, forcing these businesses to rely on inexperienced workers and to devote resources to finding, hiring, and training new workers. **39** When examined, the same pair of club stores that Ton studied, Professor Wayne F. Cascio of the University of Colorado found that **40** full-time employees at the lower-paying club store make an average of \$17 per hour, which costs the firm an estimated \$5,274 per full-time employee. He found that the turnover rate at the higher-paying club store, however, was lower—**41** the firm's 67,600 full-time employees made an average of \$17 per hour.

Comparison of Two Warehouse Club Store Chains

	Total full-time employees	Estimated average hourly wage	Annual full-time employee turnover rate	Annual estimated cost of turnover per full-time employee
Company A	110,200	\$10	44%	\$5,274
Company B	67,600	\$17	17%	\$3,628

Source: Data from Wayne F. Cascio, "The High Cost of Low Wages." ©2006 by Harvard Business School Publishing.

39

- A) NO CHANGE
- B) An examination of
- C) When they examined
- D) Examining

40

- Which choice provides accurate information from the table to support the writer's argument?
- A) NO CHANGE
  - B) 44 percent of full-time employees at the lower-paying club store leave their jobs each year,
  - C) 110,200 full-time employees at the lower-paying club store leave their jobs each year,
  - D) full-time employees at the lower-paying club store make an average of \$5,274 each year,

41

- The writer wants to include relevant information from the table to illustrate the point made in the first part of the sentence. Which choice best accomplishes this goal?
- A) NO CHANGE
  - B) and its staff, at 67,600 full-time employees, was significantly smaller.
  - C) 17 percent, at a lesser cost of \$3,628 per full-time employee.
  - D) and it paid its full-time employees \$17 per hour compared with its competitor's \$10 per hour.

The club store chains that Ton and Cascio studied **42** are both successful. Grocery stores, convenience stores, and numerous other businesses have been able to thrive in their respective industries while paying significantly higher employee wages than their rivals. The success of these businesses **43** highlight that paying workers well **44** can be a profitable strategy for retailers.

**42**

Which choice best introduces the information that follows?

- A) NO CHANGE
- B) have large workforces.
- C) are not unique.
- D) are managed differently.

**43**

- A) NO CHANGE
- B) have highlighted
- C) would highlight
- D) highlights

**44**

Which choice provides the most logical conclusion to the passage?

- A) NO CHANGE
- B) may be surprisingly difficult to implement.
- C) is one of several ways to boost employee morale.
- D) is still the subject of much debate among employers.

**STOP**

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

Do not turn to any other section.



# Math Test – No Calculator

**25 MINUTES, 20 QUESTIONS**

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

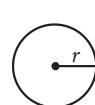
## DIRECTIONS

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

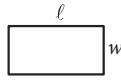
## NOTES

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

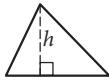
## REFERENCE



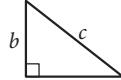
$$\begin{aligned} A &= \pi r^2 \\ C &= 2\pi r \end{aligned}$$



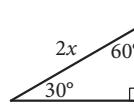
$$A = \ell w$$



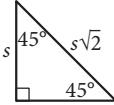
$$A = \frac{1}{2}bh$$



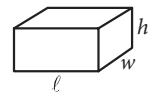
$$c^2 = a^2 + b^2$$



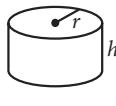
$$\begin{array}{l} 2x \\ 30^\circ \\ x\sqrt{3} \end{array}$$



Special Right Triangles



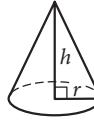
$$V = \ell wh$$



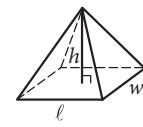
$$V = \pi r^2 h$$



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



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



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

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

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

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

April QAS 4/10/18



1

$$\begin{aligned}x + y &= 21 \\x - 2y &= -3\end{aligned}$$

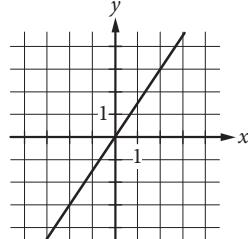
According to the system of equations above, what is the value of  $x$ ?

- A) 6
- B) 8
- C) 13
- D) 15

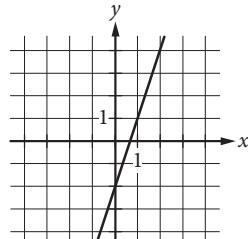
2

Which of the following is the graph of the equation  $y = 3x - 2$  in the  $xy$ -plane?

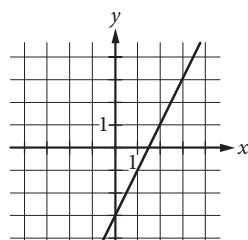
A)



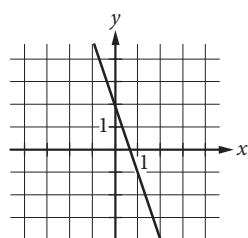
B)



C)



D)





3

Which of the following expressions is equivalent to  $x^2 + 10x + 21$ ?

- A)  $(x + 1)(x + 9) + 12$
- B)  $(x + 1)(x + 9) + 12x$
- C)  $(x + 3)(x + 7) + 5$
- D)  $(x + 3)(x + 7) + 5x$

5

In the  $xy$ -plane, line  $\ell$  passes through the points  $(0, 1)$  and  $(1, 4)$ . Which of the following is an equation of line  $\ell$ ?

- A)  $y = \frac{1}{3}x + 1$
- B)  $y = \frac{1}{3}x - 1$
- C)  $y = 3x + 1$
- D)  $y = 3x - 1$

4

$$y \geq -2x + 11$$

$$y > 3x - 9$$

In the  $xy$ -plane, point  $A$  is contained in the graph of the solution set of the system of inequalities above. Which of the following could be the coordinates of point  $A$ ?

- A)  $(2, 1)$
- B)  $(4, 1)$
- C)  $(4, 5)$
- D)  $(6, 6)$

6

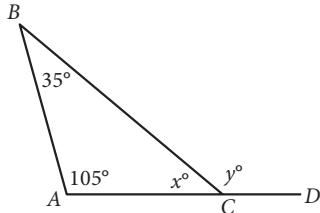
$$\sqrt{x + 28} - 2\sqrt{x + 1} = 0$$

What value of  $x$  satisfies the equation above?

- A) 8
- B) 9
- C) 26
- D) 27



7



In triangle  $ABC$  above, side  $\overline{AC}$  is extended to point  $D$ . What is the value of  $y - x$ ?

- A) 40
- B) 75
- C) 100
- D) 140

9

$$Q = \sqrt{\frac{2dK}{h}}$$

The formula above is used to estimate the ideal quantity,  $Q$ , of items a store manager needs to order given the demand quantity,  $d$ ; the setup cost per order,  $K$ ; and the storage cost per item,  $h$ . Which of the following correctly expresses the storage cost per item in terms of the other variables?

- A)  $h = \sqrt{\frac{2dK}{Q}}$
- B)  $h = \frac{\sqrt{2dK}}{Q}$
- C)  $h = \frac{2dK}{Q^2}$
- D)  $h = \frac{Q^2}{2dK}$

8

In the  $xy$ -plane, the point  $(2, 6)$  lies on the graph of

$y = \frac{k}{x}$ , where  $k$  is a constant. Which of the following points must also lie on the graph?

- A)  $(1, 3)$
- B)  $(1, 4)$
- C)  $(3, 3)$
- D)  $(3, 4)$

10

$$8x - 2x(c + 1) = x$$

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

- A)  $\frac{3}{2}$
- B)  $\frac{5}{2}$
- C)  $\frac{7}{2}$
- D)  $\frac{9}{2}$



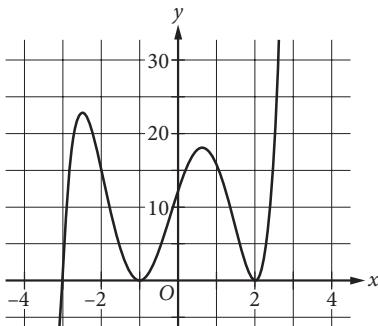
11

$$2,000 - 61k = 48$$

In 1962, the population of a bird species was 2,000. The population  $k$  years after 1962 was 48, and  $k$  satisfies the equation above. Which of the following is the best interpretation of the number 61 in this context?

- A) The population  $k$  years after 1962
- B) The value of  $k$  when the population was 48
- C) The difference between the population in 1962 and the population  $k$  years after 1962
- D) The average decrease in the population per year from 1962 to  $k$  years after 1962

12



The graph of the function  $f$  is shown in the  $xy$ -plane above, where  $y = f(x)$ . Which of the following functions could define  $f$ ?

- A)  $f(x) = (x - 3)(x - 1)^2(x + 2)^2$
- B)  $f(x) = (x - 3)^2(x - 1)(x + 2)$
- C)  $f(x) = (x + 3)(x + 1)^2(x - 2)^2$
- D)  $f(x) = (x + 3)^2(x + 1)(x - 2)$

13

$$(x + 2)^2 + (y - 3)^2 = 40$$

$$y = -2x + 4$$

Which of the following could be the  $x$ -coordinate of a solution to the system of equations above?

- A)  $\sqrt{7}$
- B)  $\frac{\sqrt{35}}{2}$
- C)  $\frac{6 + 2\sqrt{34}}{5}$
- D)  $\frac{4 + \sqrt{191}}{5}$



14

$$P = 215(1.005)^{\frac{t}{3}}$$

The equation above can be used to model the population, in thousands, of a certain city  $t$  years after 2000. According to the model, the population is predicted to increase by 0.5% every  $n$  months. What is the value of  $n$ ?

- A) 3
- B) 4
- C) 12
- D) 36

15

Which of the following is an equivalent form of the expression  $(2x - 2)^2 - (2x - 2)$ ?

- A)  $2x^2 - 6x + 6$
- B)  $4x^2 - 10x + 2$
- C)  $(2x - 2)(2x - 2)$
- D)  $(2x - 3)(2x - 2)$

**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  $\frac{7}{2}$ . (If  is entered into the grid, it will be interpreted as  $\frac{31}{2}$ , not  $3\frac{1}{2}$ .)
6. **Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

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

Write answer → in boxes.

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

Grid in result.

← Fraction line

Answer: 2.5

← Decimal point

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

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

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

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

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

Answer: 201 – either position is correct

2	0	1
0	0	0
1	1	1
2	2	2

2	0	1
0	0	0
1	1	1
2	2	2

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



16

$$2s + t = 11$$

In the equation above, what is the value of  $s$  when  $t = -1$ ?

17

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

What is one possible solution to the equation above?

18

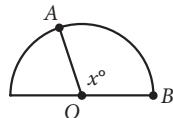
In the complex number system, what is the value of the expression  $16i^4 - 8i^2 + 4$ ? (Note:  $i = \sqrt{-1}$ )

19

$x$	$f(x)$
8	12
12	17

The table above shows two pairs of values for the linear function  $f$ . The function can be written in the form  $f(x) = ax + b$ , where  $a$  and  $b$  are constants. What is the value of  $a + b$ ?

20



Segments  $\overline{OA}$  and  $\overline{OB}$  are radii of the semicircle above. Arc  $\widehat{AB}$  has length  $3\pi$  and  $OA = 5$ . 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.

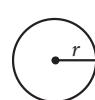
**DIRECTIONS**

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.

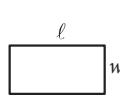
**NOTES**

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.
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.

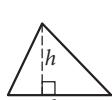
**REFERENCE**



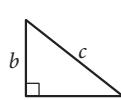
$$\begin{aligned} A &= \pi r^2 \\ C &= 2\pi r \end{aligned}$$



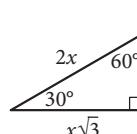
$$A = \ell w$$



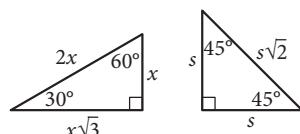
$$A = \frac{1}{2}bh$$



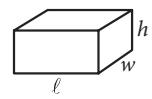
$$c^2 = a^2 + b^2$$



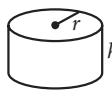
$$\begin{array}{l} 2x \\ 30^\circ \\ x\sqrt{3} \end{array}$$



Special Right Triangles



$$V = \ell wh$$



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



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



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



$$V = \frac{1}{3}A h$$

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

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

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

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1

If  $6 \cdot 2k = 36$ , what is the value of  $4k - 2$ ?

- A) 12
- B) 10
- C) 6
- D) 1

3

A physician prescribes a treatment in which a patient takes 2 teaspoons of a medication every 6 hours for 5 days. According to the prescription, how many teaspoons of the medication should the patient take in a 24-hour period?

- A) 4
- B) 6
- C) 8
- D) 40

2

The number of people who rode a certain bus each day of a week is shown in the table below.

Day	Number of riders
Monday	612
Tuesday	798
Wednesday	655
Thursday	773
Friday	808
Saturday	480
Sunday	229

Which of the following is true based on these data?

- A) The bus had the most riders on Tuesday.
- B) Each day from Tuesday through Sunday, the number of riders on the bus was greater than the previous day.
- C) Each day from Tuesday through Sunday, the number of riders on the bus was less than the previous day.
- D) The two days with the fewest number of riders were Saturday and Sunday.



4

One hundred park-district members will be selected to participate in a survey about selecting a new park-district coordinator. Which of the following methods of choosing the 100 members would result in a random sample of members of the park district?

- A) Obtain a numbered list of all park-district members. Use a random number generator to select 100 members from the list. Give the survey to those 100 members.
- B) Obtain a list of all park-district members sorted alphabetically. Give the survey to the first 100 members on the list.
- C) Tell all park-district members that volunteers are needed to take the survey. Give the survey to the first 100 members who volunteer.
- D) Obtain a list of all park-district members who are attending an upcoming event. Give the survey to the first 100 members on the list.

5

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

Which of the following expressions is equivalent to the expression above?

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

6

If  $x + 3 = 2x - 2$ , what is the value of  $x - 4$ ?

- A) 9
- B) 5
- C) 4
- D) 1



7

The functions  $f$  and  $g$  are defined by  $f(x) = 4x$  and  $g(x) = x^2$ . For what value of  $x$  does  $f(x) - g(x) = 4$ ?

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

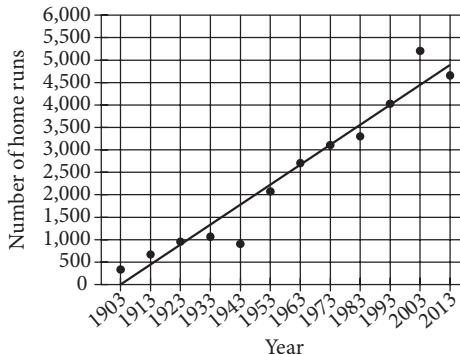
8

The function  $g$  is defined as  $g(x) = \frac{2x}{3} + 3$ . What is the value of  $g(-30)$ ?

- A)  $-27$
- B)  $-23$
- C)  $-17$
- D)  $-7$

9

Total Home Runs for Selected Years, 1903–2013

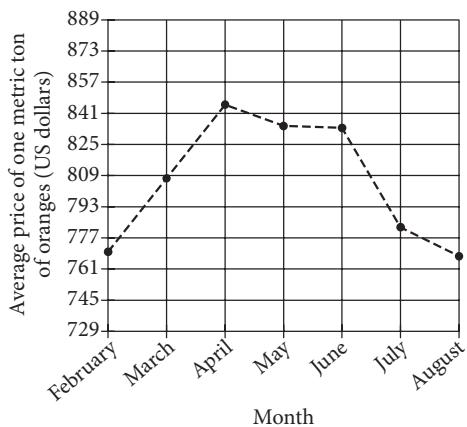


The scatterplot above shows the total number of home runs hit in major league baseball, in ten-year intervals, for selected years. The line of best fit for the data is also shown. Which of the following is closest to the difference between the actual number of home runs and the number predicted by the line of best fit in 2003?

- A) 250
- B) 500
- C) 750
- D) 850



**Questions 10-12 refer to the following information.**



The line graph above shows the average price of one metric ton of oranges, in dollars, for each of seven months in 2014.

10

Between which two consecutive months shown did the average price of one metric ton of oranges decrease the most?

- A) March to April
- B) May to June
- C) June to July
- D) July to August

11

Which of the following is closest to the median price, in dollars, of the seven recorded prices of one metric ton of oranges?

- A) 834
- B) 808
- C) 783
- D) 768

12

In 2014, the average price of one metric ton of oranges decreased by 2.36% from January (not shown) to February. Which of the following is closest to the price of one metric ton of oranges in January 2014?

- A) 700
- B) 770
- C) 790
- D) 830



13

	Roof type			
	Asphalt shingle	Slate	Cedar shake	Total
Single story	9	4	2	15
Two story	20	10	3	33
Total	29	14	5	48

The table above shows the distribution of single-story and two-story houses in a neighborhood classified according to roof type. If one of the houses is selected at random, what is the probability that it will be a single-story house with a slate roof?

- A)  $\frac{4}{48}$
- B)  $\frac{4}{15}$
- C)  $\frac{4}{14}$
- D)  $\frac{14}{48}$

14

$$\begin{aligned}2x - y &= -4 \\2x + y &= 4\end{aligned}$$

For the solution of the system of equations above, what is the value of  $x$ ?

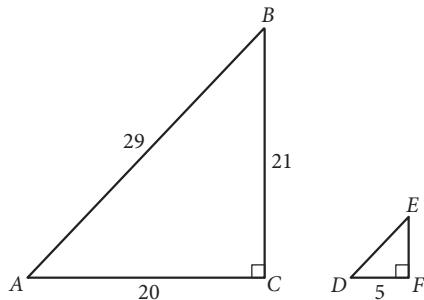
- A) -4
- B) -2
- C) 0
- D) 2

15

The load capacity of a certain washing machine is 12 pounds. What is the approximate load capacity of the same washing machine, in kilograms? (1 kilogram = 2.2046 pounds)

- A) 2.2
- B) 5.4
- C) 9.8
- D) 26.5

16



Triangles  $ABC$  and  $DEF$  above are similar. How much longer than segment  $EF$  is segment  $DE$ ?

- A) 1
- B) 2
- C) 4
- D) 8



17

Data set A	25,550	40,430	49,150	62,590	73,670	118,780	126,040
Data set B	22,860	55,020	173,730	300,580	358,920	456,170	603,300

Which of the following is true about the standard deviations of the two data sets in the table above?

- A) The standard deviation of data set B is larger than the standard deviation of data set A.
- B) The standard deviation of data set A is larger than the standard deviation of data set B.
- C) The standard deviation of data set A is equal to the standard deviation of data set B.
- D) There is not enough information available to compare the standard deviations of the two data sets.

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18

The velocity  $v$ , in meters per second, of a falling object on Earth after  $t$  seconds, ignoring the effect of air resistance, is modeled by the equation  $v = 9.8t$ . There is a different linear relationship between time and velocity on Mars, as shown in the table below.

Time (seconds)	Velocity on Mars (meters per second)
0	0
4	14.8
8	29.6

If an object dropped toward the surface of Earth has a velocity of 58.8 meters per second after  $t$  seconds, what would be the velocity of the same object dropped toward the surface of Mars after  $t$  seconds, ignoring the effect of air resistance?

- A) 15.9 meters per second
- B) 22.2 meters per second
- C) 36.2 meters per second
- D) 88.8 meters per second

19

In the  $xy$ -plane, the graph of line  $\ell$  has slope 3. Line  $k$  is parallel to line  $\ell$  and contains the point  $(3, 10)$ . Which of the following is an equation of line  $k$ ?

- A)  $y = -\frac{1}{3}x + 11$
- B)  $y = \frac{1}{3}x + 9$
- C)  $y = 3x + 7$
- D)  $y = 3x + 1$

20

A certain colony of bacteria began with one cell, and the population doubled every 20 minutes. What was the population of the colony after 2 hours?

- A) 6
- B) 12
- C) 32
- D) 64



21

The circumference of Earth is estimated to be 40,030 kilometers at the equator. Which of the following best approximates the diameter, in miles, of Earth's equator? (1 kilometer  $\approx$  0.62137 miles)

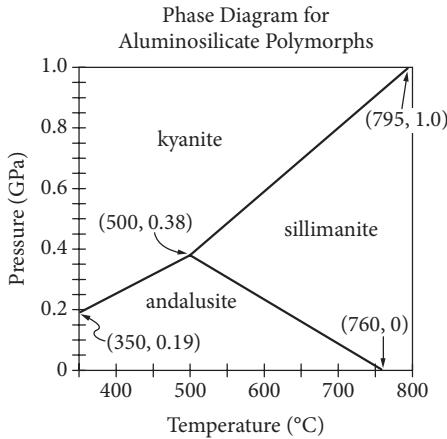
- A) 3,205 miles
- B) 5,541 miles
- C) 7,917 miles
- D) 13,004 miles

22

The budget for a school band was \$8,000 in 2010. The budget decreased by 15% from 2010 to 2011 and then increased by 22% from 2011 to 2012. Which of the following expressions represents the budget, in dollars, for the school band in 2012?

- A)  $(1.15)(1.22)(8,000)$
- B)  $(0.85)(1.22)(8,000)$
- C)  $(1.15)(0.78)(8,000)$
- D)  $(0.85)(0.78)(8,000)$

**Questions 23 and 24 refer to the following information.**



During mineral formation, the same chemical compound can become different minerals depending on the temperature and pressure at the time of formation.

A phase diagram is a graph that shows the conditions that are needed to form each mineral. The graph above is a portion of the phase diagram for aluminosilicates, with the temperature  $T$ , in degrees Celsius ( $^{\circ}\text{C}$ ), on the horizontal axis, and the pressure  $P$ , in gigapascals (GPa), on the vertical axis.



23

$$P = -0.00146T + 1.11$$

An equation of the boundary line between the andalusite and sillimanite regions is approximated by the equation above. What is the meaning of the  $T$ -intercept of this line?

- A) It is the maximum temperature at which sillimanite can form.
- B) It is the temperature at which both andalusite and sillimanite can form when there is no pressure applied.
- C) It is the increase in the number of degrees Celsius needed to remain on the boundary between andalusite and sillimanite if the pressure is reduced by 1 GPa.
- D) It is the decrease in the number of gigapascals of pressure needed to remain on the boundary between andalusite and sillimanite if the temperature is increased by 1°C.

24

Which of the following systems of inequalities best describes the region where sillimanite can form?

- A)  $P \geq 0.0021T - 0.67$   
 $P \geq 0.0013T - 0.25$
- B)  $P \leq 0.0021T - 0.67$   
 $P \geq -0.0015T + 1.13$
- C)  $P \leq 0.0013T - 0.25$   
 $P \geq -0.0015T + 1.13$
- D)  $P \leq 0.0013T - 0.25$   
 $P \leq -0.0015T + 1.13$

25

$$y = 2x + 4$$

$$y = (x - 3)(x + 2)$$

The system of equations above is graphed in the  $xy$ -plane. At which of the following points do the graphs of the equations intersect?

- A)  $(-3, -2)$
- B)  $(-3, 2)$
- C)  $(5, -2)$
- D)  $(5, 14)$

26

The gas mileage  $M(s)$ , in miles per gallon, of a car traveling  $s$  miles per hour is modeled by the function below, where  $20 \leq s \leq 75$ .

$$M(s) = -\frac{1}{24}s^2 + 4s - 50$$

According to the model, at what speed, in miles per hour, does the car obtain its greatest gas mileage?

- A) 46
- B) 48
- C) 50
- D) 75



27

$x$	$h(x)$
-1	1
2	7
4	11

The table above shows selected values for the function  $h$ . In the  $xy$ -plane, the graph of  $y = h(x)$  is a line. What is the value of  $h(8)$ ?

- A) 15
- B) 19
- C) 21
- D) 22

28

The front row of an auditorium has 10 seats. There are 50 rows in total. If each row has 2 more seats than the row before it, which expression gives the total number of seats in the last row?

- A)  $10 + 2(50 - 1)$
- B)  $10 + 2(50)$
- C)  $50(10 + 2)$
- D)  $10 + 2^{50}$

29

An ecologist selected a random sample of 30 prairie dogs from a colony and found that the mean mass of the prairie dogs in the sample was 0.94 kilograms (kg) with an associated margin of error of 0.12 kg. Which of the following is the best interpretation of the ecologist's findings?

- A) All prairie dogs in the sample have a mass between 0.82 kg and 1.06 kg.
- B) Most prairie dogs in the colony have a mass between 0.82 kg and 1.06 kg.
- C) Any mass between 0.82 kg and 1.06 kg is a plausible value for the mean mass of the prairie dogs in the sample.
- D) Any mass between 0.82 kg and 1.06 kg is a plausible value for the mean mass of the prairie dogs in the colony.

30

A poster has an area of 432 square inches. The length  $x$ , in inches, of the poster is 6 inches longer than the width of the poster. Which of the following equations can be solved to determine the length, in inches, of the poster?

- A)  $x^2 - 6 = 432$
- B)  $x^2 - 6x = 432$
- C)  $x^2 + 6 = 432$
- D)  $x^2 + 6x = 432$

**DIRECTIONS**

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

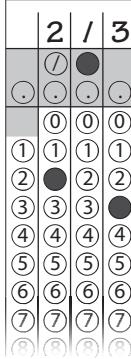
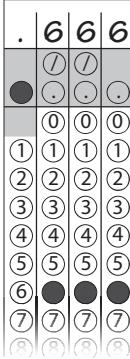
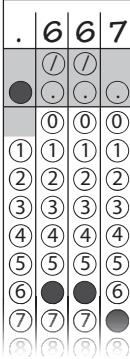
- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.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

Write →  
answer  
in boxes.

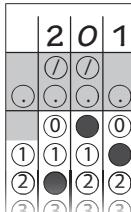
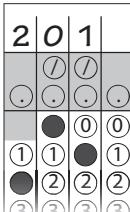
Grid in result.

Answer: $\frac{7}{12}$	Answer: 2.5																																																																													
<table border="1" style="width: 100px; height: 100px;"> <tr><td>7</td><td>/</td><td>1</td><td>2</td></tr> <tr><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td><td>1</td><td>1</td></tr> <tr><td>2</td><td>2</td><td>2</td><td>2</td></tr> <tr><td>3</td><td>3</td><td>3</td><td>3</td></tr> <tr><td>4</td><td>4</td><td>4</td><td>4</td></tr> <tr><td>5</td><td>5</td><td>5</td><td>5</td></tr> <tr><td>6</td><td>6</td><td>6</td><td>6</td></tr> <tr><td>7</td><td>7</td><td>7</td><td>7</td></tr> <tr><td>8</td><td>8</td><td>8</td><td>8</td></tr> <tr><td>9</td><td>9</td><td>9</td><td>9</td></tr> </table>	7	/	1	2	0	0	0	0	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7	8	8	8	8	9	9	9	9	<table border="1" style="width: 100px; height: 100px;"> <tr><td>2</td><td>.</td><td>5</td></tr> <tr><td>0</td><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td><td>1</td></tr> <tr><td>2</td><td>2</td><td>2</td></tr> <tr><td>3</td><td>3</td><td>3</td></tr> <tr><td>4</td><td>4</td><td>4</td></tr> <tr><td>5</td><td>5</td><td>5</td></tr> <tr><td>6</td><td>6</td><td>6</td></tr> <tr><td>7</td><td>7</td><td>7</td></tr> <tr><td>8</td><td>8</td><td>8</td></tr> <tr><td>9</td><td>9</td><td>9</td></tr> </table>	2	.	5	0	0	0	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	8	8	8	9	9	9
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← Fraction line	← Decimal point																																																																													

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

		
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Answer: 201 – either position is correct

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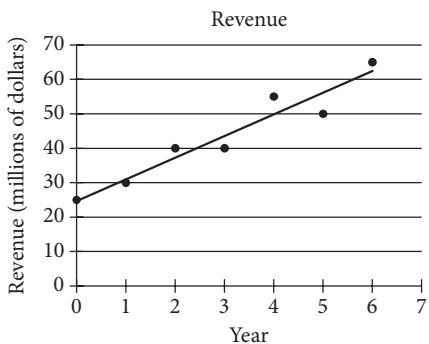
**NOTE:** You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



31

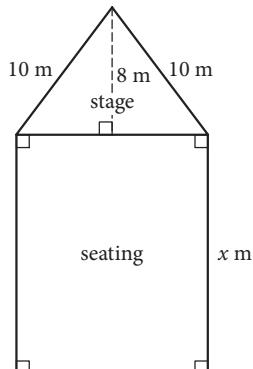
If  $|2x + 3| = 5$  and  $|3y - 3| = 6$ , what is one possible value of  $|xy|$ ?

32



The scatterplot above shows the revenue, in millions of dollars, that a company earned over several years and a line of best fit for the data. In Year 4, the difference between the actual revenue and the predicted revenue is  $n$  million dollars, where  $n$  is a positive integer. What is the value of  $n$ ? Round your answer to the nearest whole number. (Disregard the \$ sign when gridding your answer.)

33



The figure above is the floor plan drawn by an architect for a small concert hall. The stage has depth 8 meters (m) and two walls each of length 10 m. If the seating portion of the hall has an area of 180 square meters, what is the value of  $x$ ?



34

Jacob bought two types of pens: blue pens that cost \$0.60 each and red pens that each cost  $d$  times as much as a blue pen. If the cost of 3 blue pens and 6 red pens was \$10.80, what is the value of  $d$ ?

36

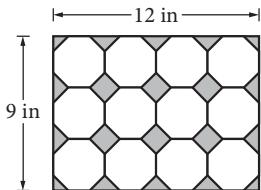
An arc of a circle measures 2.4 radians. To the nearest degree, what is the measure, in degrees, of this arc? (Disregard the degree sign when gridding your answer.)

35

George took a nonstop flight from Dallas to Los Angeles, a total flight distance of 1,233 miles. The plane flew at a speed of 460 miles per hour for the first 75 minutes of the flight and at a speed of 439 miles per hour for the remainder of the flight. To the nearest minute, for how many minutes did the plane fly at a speed of 439 miles per hour?



Questions 37 and 38 refer to the following information.



Carrie, a packaging engineer, is designing a container to hold 12 drinking glasses shaped as regular octagonal prisms. Her initial sketch of the top view of the base of the container is shown above.

37

If the length and width of the container base in the initial sketch were doubled, at most how many more glasses could the new container hold?

38

Carrie redesigned the container because the initial sketch did not account for cushioning material between the glasses. The area of the base of the newly designed container is 25% greater than the area of the base in the initial sketch. What is the area, in square inches, of the base of the newly designed container?

**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 QAS 4/10/18

## Writing and Language Test

35 MINUTES, 44 QUESTIONS

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

**DIRECTIONS**

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

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

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

Questions 1-11 are based on the following passage.

**Parks and Re-creation**

In US cities, open space is difficult to come by. In New York, **1** likewise, nearly half of the districts have less than 1.5 acres of parkland per 1,000 residents. For this reason, cities must creatively use what is available, including repurposing landfills. Transforming landfills into parks has its pitfalls, **2** however, it is well worth the effort for communities to invest in these spaces.

**1**

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

**2**

- A) NO CHANGE
- B) but
- C) nonetheless
- D) however

3 There is no official count of the number of parks built on landfills nationwide, but it could be as many as 1,000. Land formerly used for garbage is usually inexpensive to buy. It is also 4 prolific; the Environmental Protection Agency estimates that the United States has at least 10,000 closed municipal landfills. By restoring the landscape, these parks also hold

3 Which choice best introduces the main idea of the paragraph?

- A) NO CHANGE
- B) For many environmental and logistical reasons, not all landfills can be repurposed as parks.
- C) Reclaiming landfills for park space offers multiple advantages to urban areas.
- D) Americans generated 251 million tons of trash in 2012, only 34.5 percent of which was recycled.

- 4
- A) NO CHANGE
  - B) abundant:
  - C) magnanimous:
  - D) excessive:

tremendous benefits for the environment; because they transform a blemish into an attractive asset, they have the added benefit of raising property values. A recent paper published by the Trust for Public Land notes that parks are a boon to communities in terms of both health and social development. Exercise, **5** play, and exposure to green space have all been linked to improved health.

**6** The report also notes that community spaces, such as gardens and sports fields, are linked to reduced crime and a stronger bond among neighborhood residents.

5

- A) NO CHANGE
- B) play, and,
- C) play, as well as
- D) play; and

6

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

Interest in urban parks declined around the mid-twentieth century but has been revived during the past few decades.

Should the writer make this addition here?

- A) Yes, because it provides a detail that supports the main claim of the paragraph.
- B) Yes, because it effectively sets up the sentence that follows in the paragraph.
- C) No, because it includes information that contradicts the main idea of the paragraph.
- D) No, because it distracts from the focus of the paragraph by introducing irrelevant information.

One example of a successful landfill **7** park, is Freshkills, a space on the coast of Staten Island, New York, that was once a 2,200-acre dump. The park offers many recreational opportunities largely unavailable in the **8** city; these occur on layers of plastic, soil, and grass atop the garbage. Coastline restoration introduces water-absorbing plants, protecting residential areas from flood damage. **9** Its design also features a solar station that will produce enough energy **10** to power more than 2,000 homes.

The process of converting landfills into parks presents some challenges, but they are surmountable. When buried waste decomposes, it releases flammable gases such as methane, causing a potential health hazard. Also, while landfills are inexpensive to purchase, maintenance costs can be high. However, technological advances allow park designers to address both concerns. Turning the **11** disgusting problem into an advantage, Freshkills uses a gas-collection system that converts methane into enough energy to heat 22,000 homes, a process that will generate \$12 million in revenue to offset the cost of park construction. Clearly, the advantages of converting landfills into parks dramatically outweigh the drawbacks. With such innovations in place, there is little reason for communities not to create a park from what would otherwise be a wasteland.

- 7
- A) NO CHANGE
  - B) park is
  - C) park is,
  - D) park is:

- 8
- Which version of the underlined portion provides the most relevant examples for the sentence?
- A) NO CHANGE
  - B) city, such as horseback riding, nature trails, and kayaking.
  - C) city; the park's wetlands include coastal grassland and marshes.
  - D) city, among such plants as switchgrass, purple coneflowers, and bugbane.

- 9
- A) NO CHANGE
  - B) It's
  - C) Their
  - D) The park's

- 10
- A) NO CHANGE
  - B) so that it powers
  - C) for powering of
  - D) powering

- 11
- A) NO CHANGE
  - B) noxious
  - C) gross
  - D) foul

May QAS 5/5/18

Questions 12–22 are based on the following passage.

**A Swan Song for Sherlock Holmes**

When Arthur Conan Doyle introduced the brilliant and eccentric London detective Sherlock Holmes in the 1887 novel *A Study in Scarlet*, relatively few readers took notice. Beginning in 1891, though, a steady stream of short stories published in the London magazine *The Strand* caused Holmes's fan base to grow exponentially, and by 1893, the character was an international sensation. With Holmes at the height of his popularity, readers who purchased *The Strand*'s December 1893 issue were taken aback by the shocking conclusion of the latest installment: **I2** Holmes, having plunged from a waterfall in Switzerland while fighting his enemy Moriarty, was dead.

12

- A) NO CHANGE
- B) Holmes, having plunged,
- C) Holmes; having plunged
- D) Holmes having plunged

**13** Having introduced Moriarty in the same story, Conan Doyle in fact had long desired to end the series.

**14** “I am weary of his name,” the author declared; devising the intricate plots of the stories took a great deal of time and effort, and Conan Doyle wanted to dedicate **15** one’s energies elsewhere. Believing the Holmes stories to be lowbrow work, **16** instead, a focus on writing historical epics was what he wanted. Lucrative publishing contracts had made it difficult to walk away from the series, but by 1893 the author had made up his mind. “If I had not killed him, he would certainly have killed me,” Conan Doyle remarked ominously.

**15**

Which choice provides the best transition from the previous paragraph?

- A) NO CHANGE
- B) Having given Holmes the ability to adopt a variety of costumes and disguises,
- C) Not knowing that his works would later be adapted for stage and screen,
- D) Though Holmes’s death seemed sudden to readers,

**14**

Which choice provides a quotation from Conan Doyle that best sets up the information that follows in the paragraph?

- A) NO CHANGE
- B) “It was still the Sherlock Holmes stories for which the public clamored,” the author complained;
- C) “He takes my mind from better things,” the author lamented of Holmes;
- D) “I was amazed at the concern expressed by the public,” the surprised author declared;

**15**

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

**16**

A) NO CHANGE  
B) focusing on writing historical epics was what he wanted to do instead.  
C) writing historical epics was what he wanted to focus on instead.  
D) he wanted to focus on writing historical epics instead.

17 Young readers were especially saddened at the loss of their hero. Making headlines around the world, the death of such a beloved character spurred a public outcry. The author received an abundance of angry letters petitioning for Holmes's return, and 18 they were not enough to make him change his mind. It is even said that Londoners donned 19 black armbands in solidarity. Such armbands are a traditional symbol of mourning. Conan Doyle's decision was a serious blow not only to the public but also to the magazine—*Strand* editors panicked as 20,000 people canceled 20 its subscriptions.

17 Which choice best introduces the topic of this paragraph?

- A) NO CHANGE
- B) The periodicals of the time played an important role in expressing the public's feelings.
- C) It had been only eighteen months since *The Strand* published its first Holmes story, but the magazine's success was already dependent on the detective.
- D) While Conan Doyle was more than ready to part with the character, legions of fans were not.

18 Which choice provides an additional example that is most similar to the one already in the sentence?

- A) NO CHANGE
- B) "Keep Holmes Alive" clubs formed.
- C) those writing to him came from all parts of society.
- D) he turned his attention to other forms of writing.

19 Which choice best combines the sentences at the underlined portion?

- A) such black armbands in solidarity, a traditional symbol of mourning.
- B) black armbands, these being a traditional symbol of mourning, in solidarity.
- C) black armbands, a traditional symbol of mourning, in solidarity.
- D) traditionally symbolic black armbands in mourning and solidarity.

20 Which choice best completes the sentence?

- A) NO CHANGE
- B) its
- C) there
- D) their

After nearly eight years, however, Conan Doyle **21** caved. *The Hound of the Baskervilles*, a novel set before Holmes's death, was serialized in *The Strand* from August 1901 to April 1902. Soon after, exorbitant sums offered by the magazine convinced Conan Doyle to reverse Holmes's death sentence and continue the series indefinitely. In "The Adventure of the Empty House," he wrote that Holmes had actually faked his death and spent several years traveling. "The explanation may be thin, / But . . . we don't care a pin," proclaimed P. G. Wodehouse in a comic poem hailing the detective's return. Readers were thrilled to have Holmes back. Though Conan Doyle would always harbor ambivalence about the **22** series, but it is the large body of Holmes stories and countless adaptations for stage and screen that have been responsible for the author's lasting legacy.

21 Which choice best maintains the tone of the passage?

- A) NO CHANGE
- B) sold out.
- C) loosened up.
- D) relented.

22 Which choice maintains the tone of the passage?

- A) NO CHANGE
- B) series;
- C) series,
- D) series, while

Questions 23–33 are based on the following passage.

#### Ancient Acoustics

Built in southern Greece in the fourth century BCE and rediscovered in the late nineteenth century CE, the outdoor amphitheater of Epidaurus is renowned for allowing performers' voices to carry even to the last of its fifty-five rows. The source of this acoustic quality, **23** therefore, has long been misunderstood. It **24** is not until 2007 that a study by Nico Declercq and Cindy Dekeyser of the Georgia Institute of **25** Technology demonstrated that the theater's seating arrangement is the source of its excellent acoustics.

23

- A) NO CHANGE
- B) however,
- C) instead,
- D) consequently,

24

- A) NO CHANGE
- B) had not been
- C) would not have been
- D) was not

25

- A) NO CHANGE
- B) Technology—
- C) Technology. It
- D) Technology, which

Before Declercq and Dekeyser's study, many explanations had been proposed for the sound quality at the Epidaurus theater. Observers speculated that the direction in which the wind blows, the rhythm of performances in ancient Greece, or the amplifying properties of actors' masks allowed sound from the stage to reach the entire audience. But while these factors may have had some effect, **26** the Greek soprano Maria Callas performed at the theater in 1960, and actors have performed there without special enunciation or augmentation. Since actors remained audible under all of these **27** conditions and circumstances, the mystery of the theater's acoustics endured.

26

Which choice most effectively addresses the theories presented in the previous sentence?

- A) NO CHANGE
- B) the theater provides a fitting venue for the annual Epidaurus Festival, which features stagings of ancient Greek classics,
- C) audience members continue to enjoy the beautiful view of a lush landscape beyond the stage,
- D) modern plays have been staged at Epidaurus on windless days,

27

- A) NO CHANGE
- B) conditions and in these situations,
- C) conditions and were able to be heard,
- D) conditions,

28 In considering the primary source of the theater's sonic properties, Declercq and Dekeyser suspected that the key might be the way sound waves reflect or break apart when they encounter ridged surfaces. Applying mathematical models derived in part from Declercq's earlier research, which had examined the ways sound waves reflect off a step pyramid at Chichén Itzá in Mexico, they found that the tiered rows of limestone benches in the Epidaurus theater affect sound waves in an unusual way. 29 The waves encounter the theater's seats. As this happens, sounds with frequencies lower than 500 hertz are significantly damped while higher-frequency sounds are reflected with little diminution.

28

Which choice most effectively introduces the information in the paragraph?

- A) NO CHANGE
- B) Sensing that the ancient Greeks and Romans had admired the theater's design,
- C) Even though evidence suggests that the Greek builders of the theater did not understand the acoustic principles that account for the quality of sound in the theater,
- D) Curious about the effects of background noise on the sound quality of an ancient outdoor venue such as the Epidaurus theater,

29

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

- A) After an encounter between the waves and the theater's seats,
- B) When the waves encounter the theater's seats,
- C) The waves happen to encounter the theater's seats, and
- D) The waves encounter the theater's seats—thus,

[1] This filtering effect explains why performers are so easy to hear in the theater. [2] Low-frequency sounds such as wind, rustling trees, and other noises coming from the area around the theater are reduced when they bounce off the seats, whereas the high-frequency sounds coming from the actors remain relatively unchanged. [3] Performers' voices also contain low tones, and these too are muted by the theater's seats. [4] But this sound reduction doesn't impair actors' audibility because of a neurological phenomenon called "virtual pitch." [5] This capacity helps people hear human voices more clearly than **30** hearing less important sounds. [6] When exposed to speech that lacks **31** their typical lower tones, the human brain automatically reconstructs the missing frequencies. [7] At Epidaurus, the combination of virtual pitch and the sound-dampening effect of the seats **32** allow performers' voices to be heard fully and clearly from any seat. **33**

- 30
- A) NO CHANGE
  - B) less
  - C) having heard less
  - D) those of less

- 31
- A) NO CHANGE
  - B) it's
  - C) its
  - D) they're

- 32
- A) NO CHANGE
  - B) have been allowing
  - C) are allowing
  - D) allows

- 33
- To make this paragraph most logical, sentence 7 should be placed
- A) where it is now.
  - B) before sentence 1.
  - C) after sentence 1.
  - D) after sentence 2.

Questions 34–44 are based on the following passage and supplementary material.

#### A Ray of Sunshine for the US Economy

The solar-power industry in the United States has seen dramatic growth during recent years as energy consumers have sought to become more self-sufficient, diminish their environmental [34] impact. And lowering their energy bills. As a result of increased demand for solar energy, the solar-power industry now offers one of the fastest-growing career paths in the country. From 2010 to 2014, the overall number of solar jobs in the US economy [35] held steady, with the addition of approximately 80,000 jobs in manufacturing, sales and distribution, installation, and more.

34

- A) NO CHANGE
- B) impact, plus they can lower their
- C) impact—with lower
- D) impact, and lower their

35

Which choice most effectively interprets data from the table to set up the information provided in the rest of the sentence?

- A) NO CHANGE
- B) increased at a rate of 72 percent,
- C) skyrocketed by nearly 86 percent,
- D) fluctuated between 30 and 121 percent,

Comprising just over half of solar jobs in 2014, installation is the largest single sector of the solar-power industry. Job opportunities in installation have soared: from 2010 to 2014, the number of solar-installation jobs increased 121 percent, **36** to 20,185 jobs in 2014, more than the number of manufacturing jobs. These jobs are open to people at a variety of experience levels. While many solar installers have taken courses at technical schools or community colleges, the only requirement beyond a high school diploma is usually an apprenticeship or other on-the-job training. **37** With California leading the country in solar jobs, jobs in this sector of the solar industry are quite profitable. In 2013, solar installers' wages averaged \$23.63 per hour, comparable to **38** those of skilled electricians and plumbers.

Solar Jobs by Sector, 2010–2014

Sector	2010	2012	2014	Growth rate, 2010–2014
Installation	43,934	57,177	97,031	121%
Manufacturing	24,916	29,742	32,490	30%
Sales and distribution	11,744	16,005	20,185	72%
Project development	N/A	7,988	15,112	N/A
Other	12,908	8,105	8,989	N/A
Total	93,502	119,016	173,807	85.9%

Changes in the number of jobs in "Other" over the years are not necessarily a reflection of actual increases or decreases in employment but may instead be due to changes in the types of jobs included in this category.

Adapted from The Solar Foundation, National Solar Jobs Census 2014. ©2015 by The Solar Foundation.

36

Which choice most effectively uses data from the table to support the point made in the first part of the sentence?

- A) NO CHANGE
- B) from 43,934 jobs in 2010 to 97,031 jobs in 2014.
- C) less than the growth rate for jobs in manufacturing.
- D) from 11,744 jobs in 2010 to 15,112 jobs in 2014.

37

Which choice best introduces the material that follows in the paragraph?

- A) NO CHANGE
- B) In addition to being abundant and accessible,
- C) Though they are less plentiful in some areas,
- D) Also requiring some knowledge of maintenance,

38

- A) NO CHANGE
- B) a skilled electrician or plumber.
- C) wages earned by a skilled electrician and plumbers.
- D) skilled electricians and plumbers.

May QAS 5/5/18

CONTINUE ➔

The rapid proliferation of well-paying jobs in solar installation **39** are largely attributable **40** to the falling price of solar energy. Technological innovation has made components less expensive, while tax subsidies and other governmental incentive programs have offset some of the costs of installation for businesses and individuals. Also, the efficiency of solar-installation companies has increased as the industry has matured, reducing costs still further. All of these factors have driven down the cost of equipment and installation for solar-power systems, which fell by more than 50 percent between 2010 and 2013. Solar power is now competitive with other energy sources in many **41** markets. This leads corporations, utility companies, and private homeowners to use it. Indeed, the primary reason most consumers cite for installing new solar-power systems is not to benefit the environment but to save money.

39

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

40

- A) NO CHANGE
- B) to,
- C) to
- D) to—

41

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

- A) markets, a development that has led
- B) markets, an aspect of solar power that has led
- C) markets; such competition has led
- D) markets, with this competition leading

42 Because some power companies don't provide information about saving money over helping the environment, technological and economic developments in the solar-power industry ensure they are doing both. Consumers are not the only ones for whom solar power is a win-win scenario, 43 though as a result of their own efforts, industry employees can meet demand for an environmentally friendly service while 44 also making a good living for themselves.

42

Which choice provides the best transition from the previous paragraph?

- A) NO CHANGE
- B) Even though consumers of solar-power systems may prioritize
- C) While it remains unclear whether people in urban areas prefer
- D) Since just installing solar panels doesn't immediately guarantee that people will prioritize

43

- A) NO CHANGE
- B) though, as a result,
- C) though: as a result
- D) though—as a result,

44

- A) NO CHANGE
- B) they also, meanwhile, make a good living for themselves.
- C) simultaneously making a good living for themselves at the same time.
- D) making a good living for themselves is something they can do at the same time.

## STOP

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

May QAS 5/5/18



# Math Test – No Calculator

**25 MINUTES, 20 QUESTIONS**

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

**DIRECTIONS**

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

**NOTES**

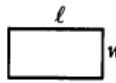
- The use of a calculator is not permitted.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated, the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

**REFERENCE**



$$A = \pi r^2$$

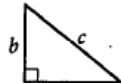
$$C = 2\pi r$$



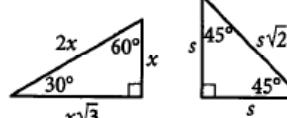
$$A = lw$$



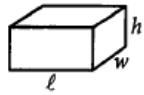
$$A = \frac{1}{2}bh$$



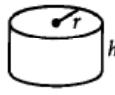
$$c^2 = a^2 + b^2$$



Special Right Triangles



$$V = lwh$$



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



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



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



$$V = \frac{1}{3}lwh$$

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

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

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



1 Lardarius spent a total of \$200 to lease snowboard equipment at Winter Mountain during his vacation. Each day of his vacation, he purchased a lift ticket for \$44. If Lardarius purchased  $t$  lift tickets, how much money, in dollars, did Lardarius spend during his vacation at Winter Mountain on snowboard equipment and lift tickets?

- A)  $44t$
- B)  $200 + 11t$
- C)  $200 + 44t$
- D)  $200 + 176t$

2

Which of the following expressions is equivalent to  $3q^2 + r^3 + 5r - 8q + 2(q^2 + r)$ ?

- A)  $7r^3 - 3q^4$
- B)  $r^3 + 5q^2 - qr$
- C)  $r^3 + 5q^2 - 8q + 6r$
- D)  $r^3 + 5q^2 - 8q + 7r$

3

Which of the following equations represents the line in the  $xy$ -plane that passes through  $(0, 3)$  and has a slope of  $-3$ ?

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

4

$$2(x + b) = ax + c$$

In the equation above,  $a$ ,  $b$ , and  $c$  are constants. If the equation has infinitely many solutions, which of the following must be equal to  $c$ ?

- A)  $a$
- B)  $b$
- C)  $2a$
- D)  $2b$

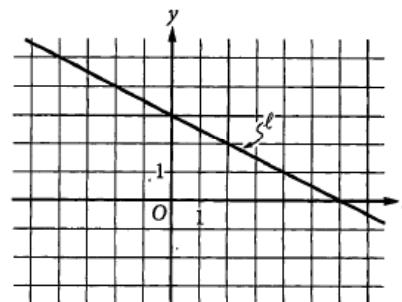


5

Which of the following is equivalent to  $(2x + 4)^2 - 4x^2$ ?

- A)  $16(x + 1)$
- B)  $8(x + 2)$
- C)  $4(4x + 1)$
- D)  $2(8x + 1)$

6



Line  $\ell$  is shown in the  $xy$ -plane above. Which of the following is an equation of line  $\ell$ ?

- A)  $x + 2y = 6$
- B)  $2x - y = 6$
- C)  $6x + 3y = 0$
- D)  $6x - 3y = 0$

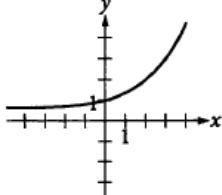


7

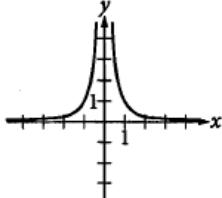
$x$	$f(x)$
1	$a$
2	$b$
3	$c$

For the function  $f$ , the table above shows some values of  $x$  and their corresponding values of  $f(x)$  in terms of the constants  $a$ ,  $b$ , and  $c$ . If  $a < b < c$ , which of the following could NOT be the graph of  $y = f(x)$  in the  $xy$ -plane?

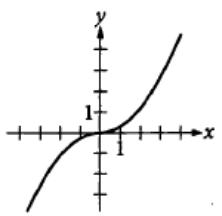
A)



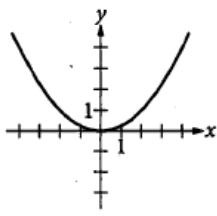
B)



C)



D)



8

If  $3x - 6y = 9z$ , which of the following expressions is equivalent to  $x^2 - 4xy + 4y^2$ ?

- A)  $9z$
- B)  $3z^2$
- C)  $9z^2$
- D)  $81z^2$



10

$$f(n) = 5.77(0.98^n)$$

The function above can be used to estimate the number of farms,  $f(n)$ , in millions, in the United States for  $0 \leq n \leq 72$ , where  $n$  is the number of years after 1940. Which of the following is the best interpretation of the number 5.77 in this context?

- A) The estimated number of farms, in millions, in 1940
- B) The estimated number of farms, in millions,  $n$  years after 1940
- C) The estimated decrease in the number of farms, in millions, each year after 1940
- D) The estimated percent by which the number of farms decreased from each year to the next after 1940

11

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

The system of equations above is graphed in the  $xy$ -plane. The graphs of the equations intersect at a point  $(x, y)$  where  $x > 0$  and  $y > 0$ . What is the  $y$ -coordinate of this point of intersection?

- A) 1
- B) 3
- C) 5
- D) 9

12

Which of the following is a solution to the equation

$$4x^2 + 4x - 3 = 0$$

- A) -1.5
- B) -0.5
- C) 1
- D) 3

13

The equation  $p = 14.7 + 0.439d$  approximates the pressure  $p$ , in pounds per square inch, exerted on a diver at a depth of  $d$  feet (ft) below the surface of the water. What is the increase in depth that is necessary to increase the pressure by 1 pound per square inch?

- A)  $\frac{1}{0.439}$  ft
- B)  $\frac{1}{14.7}$  ft
- C) 0.439 ft
- D) 14.7 ft



14

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

- A) 16
- B) 4
- C) 1
- D)  $\frac{1}{4}$

15

In the  $xy$ -plane, the points  $(2, 4)$  and  $(-2, -4)$  are the endpoints of a diameter of a circle. Which of the following is an equation of the circle?

- A)  $(x - 2)^2 + (y + 4)^2 = 80$
- B)  $(x - 2)^2 + (y + 4)^2 = 20$
- C)  $x^2 + y^2 = 80$
- D)  $x^2 + y^2 = 20$

**DIRECTIONS**

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

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

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

Write →  
answer  
in boxes.

7	/	1	2
---	---	---	---

← Fraction line

Grid in result.

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

Answer: 2.5

← Decimal point

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

2	/	3
---	---	---

.	6	6	6
---	---	---	---

.	6	6	7
---	---	---	---

Answer: 201 – either position is correct

2	0	1
---	---	---

2	0	1
---	---	---

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



16

In the  $xy$ -plane, line  $k$  passes through the point  $(3, 1)$  and is parallel to the line with equation  $y = \frac{5}{2}x - \frac{7}{2}$ . What is the slope of line  $k$ ?

19

The two acute angles of a right triangle have degree measures of  $x$  and  $y$ . If  $\sin x = \frac{5}{13}$ , what is the value of  $\cos y$ ?

17

$$\begin{aligned}2x + 3y &= 4 \\y &= 2x\end{aligned}$$

If the ordered pair  $(x, y)$  satisfies the system of equations above, what is the value of  $x$ ?

20

$$(15 - 4i)(6 - 3i) = a + bi$$

In the equation above,  $a$  and  $b$  are real numbers and  $i = \sqrt{-1}$ . What is the value of  $a$ ?

18

$$\frac{1}{x-8} = -\frac{1}{x-9}$$

What value of  $x$  satisfies the equation above?

## STOP

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

**Do not turn to any other section.**

May QAS 5/5/18



# Math Test – Calculator

**55 MINUTES, 38 QUESTIONS**

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

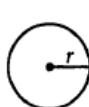
**DIRECTIONS**

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**

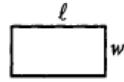
1. The use of a calculator is permitted.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the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

**REFERENCE**



$$A = \pi r^2$$

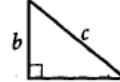
$$C = 2\pi r$$



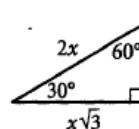
$$A = \ell w$$



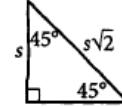
$$A = \frac{1}{2}bh$$



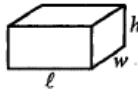
$$c^2 = a^2 + b^2$$



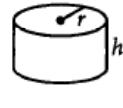
Special Right Triangles



$s$



$$V = \ell wh$$



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



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



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



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

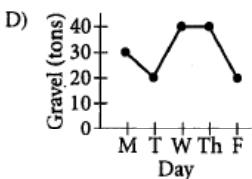
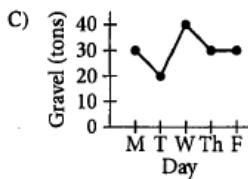
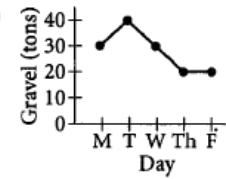
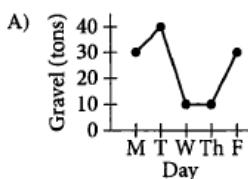
The number of degrees of arc in a circle is 360.

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

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



A gravel company had 30 tons of gravel in stock at the end of the day on Monday. On Tuesday the company shipped 10 tons of gravel and received no deliveries. On Wednesday the company made no shipments and received a delivery of 20 tons of gravel. On Thursday the company made no shipments and received no deliveries. On Friday the company shipped 20 tons of gravel and received no deliveries. Which of the following represents the number of tons of gravel the company had in stock at the end of each day?



2

If  $\sqrt{2x} = 8$ , what is the value of  $x$ ?

- A) 4
- B) 8
- C) 32
- D) 64

3

If  $10 = 2x + 14$ , which of the following must be true?

- A)  $4x = 8$
- B)  $10x = 16$
- C)  $8x = -16$
- D)  $12x = -144$



4

The hardcover books produced by a publisher have pages that are 0.1 millimeter thick and a front cover and a back cover that each are 2 millimeters thick.

Which of the following gives the total thickness  $f(n)$ , in millimeters, of a closed book that has  $n$  pages?

- A)  $f(n) = 4 + 0.1n$
- B)  $f(n) = 2 + 0.1n$
- C)  $f(n) = 0.4 + 0.1n$
- D)  $f(n) = 0.2 + 0.1n$

6

The area enclosed by a circle is  $25\pi$  square inches. What is the length, in inches, of the radius of the circle?

- A) 2.5
- B) 5
- C) 10
- D) 12.5

7

An analysis of a random sample of a type of laptop computer battery estimated that the mean working time was 4.7 hours with a margin of error of 0.7 hours. Which of the following is the most appropriate conclusion based on this analysis?

- A) This type of laptop computer battery has a mean working time of at least 4.7 hours.
- B) This type of laptop computer battery has a mean working time of at least 5.7 hours.
- C) This type of laptop computer battery has a mean working time of between 4.0 and 5.4 hours.
- D) This type of laptop computer battery has a mean working time of between 0.0 and 0.7 hours.

5

A teacher has signed up for a program that automatically delivers books for the classroom library. The classroom library currently consists of 48 books. If the program delivers 12 books a month, how many books will the classroom library consist of after 5 months?

- A) 240
- B) 108
- C) 65
- D) 60



8

$$y = 2x + 7$$

An equation of line  $\ell$  in the  $xy$ -plane is shown above. Another line,  $k$ , has a slope equal to double the slope of  $\ell$  and a  $y$ -intercept equal to double the  $y$ -intercept of  $\ell$ . At which point  $(x, y)$  do lines  $\ell$  and  $k$  intersect?

A)  $\left(-\frac{7}{2}, 0\right)$

B)  $\left(-\frac{2}{7}, 0\right)$

C)  $\left(0, \frac{2}{7}\right)$

D)  $\left(0, \frac{7}{2}\right)$

9

In normal weather conditions, a particular type of jet burns an average of 2.4 gallons of fuel per nautical mile flown. The distance from New York to Los Angeles is about 2,100 nautical miles. Approximately how many gallons of fuel will the jet burn for a trip from New York to Los Angeles in normal weather conditions?

A) 900

B) 1,200

C) 5,000

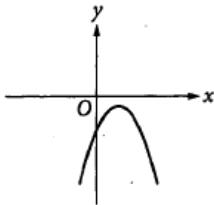
D) 7,000



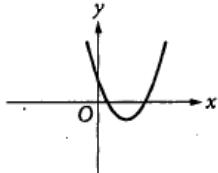
10

The quadratic function  $f$  is defined by  $f(x) = 2(x + 2)^2 - 1$ . In the  $xy$ -plane, which of the following could be the graph of  $y = f(x)$  shifted 3 units to the right?

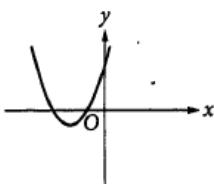
A)



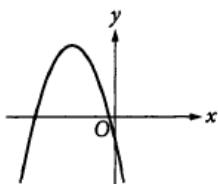
B)



C)



D)



11

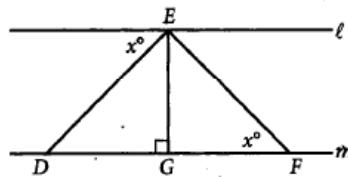
$$5x + 2y = 22$$

$$4x + y = 17$$

In the system of equations above, what is the value of  $x + y$ ?

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

12



Note: Figure not drawn to scale.

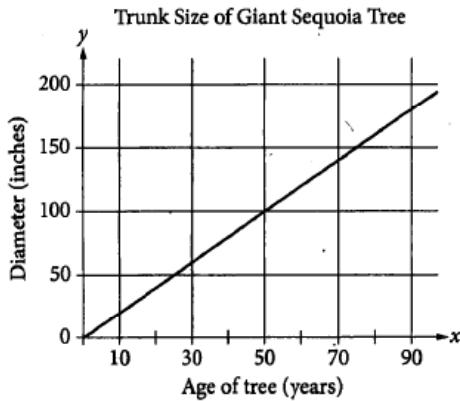
In the figure above, line  $\ell$  is parallel to line  $m$ . If  $x = 40$ , what is the measure of  $\angle DEF$ ?

- A)  $140^\circ$
- B)  $100^\circ$
- C)  $80^\circ$
- D)  $50^\circ$



**Questions 13–15 refer to the following information.**

Under the right conditions, giant sequoia trees are the fastest-growing conifer on Earth. In good growing conditions, a giant sequoia tree will form a 1-inch growth ring each year, increasing the size of its trunk diameter by 2 inches per year. This relationship is represented in the graph below. A giant sequoia tree can also grow 4 feet vertically every three years.



13

Which of the following equations represents the relationship between the diameter, in inches, of a giant sequoia tree's trunk and that tree's age, in years?

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

Assuming good growing conditions, how many years old is a giant sequoia tree with a trunk diameter of 19 feet? (1 foot = 12 inches)

- A) 9.5
- B) 38
- C) 114
- D) 494

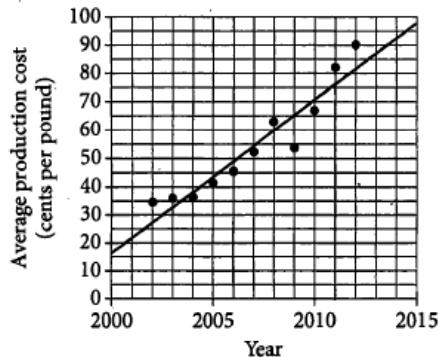
14

The linear model  $z = \frac{4}{3}w$  can be used to find the height, in feet, of a giant sequoia tree. What does  $w$  represent?

- A) The age of the tree, in years
- B) The height of the tree, in feet
- C) The amount, in feet, the tree grows in one year
- D) The amount, in feet, the tree grows in three years



16



The scatterplot above shows the average production cost, in cents per pound, of coffee in Ecuador for the years from 2002 to 2012. A line of best fit is also drawn. Which of the following is closest to the difference, in cents per pound, between the actual average production cost in 2012 and the average production cost in 2012 predicted by the given line of best fit?

- A) 4
- B) 8
- C) 16
- D) 50

17

Emma mows grass at a constant rate of 1.5 acres per hour. She mowed 2 acres before lunch and plans to spend  $t$  hours mowing after lunch. If Emma wants to mow at least 8 acres of grass today, which of the following inequalities best represents this situation?

- A)  $1.5t \geq 8$
- B)  $1.5t - 2 \geq 8$
- C)  $1.5t + 2 \geq 8$
- D)  $2t + 1.5 \geq 8$

May QAS 5/5/18

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18

$$\begin{aligned}kx + y &= 1 \\y &= -x^2 + k\end{aligned}$$

In the system of equations above,  $k$  is a constant. When the equations are graphed in the  $xy$ -plane, the graphs intersect at exactly two points. Which of the following CANNOT be the value of  $k$ ?

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

19

Of 100 people who played a certain video game, 85 scored more than 0 but less than 10,000 points, 14 scored between 10,000 and 100,000 points, and the remaining player scored 5,350,000 points. Which of the following statements about the mean and median of the 100 scores is true?

- A) The mean is greater than the median.
- B) The median is greater than the mean.
- C) The mean and the median are equal.
- D) There is not enough information to determine whether the mean or the median is greater.

48

CONTINUE



**Questions 20–22 refer to the following information.**

In spring 2015, three separate studies on the fitness level of tenth graders were conducted in the city of Mistwick. In each study, every student in a group of tenth graders took the same fitness test and received a score on it. The possible scores on the fitness test are the whole numbers from 50 to 100, inclusive. The distribution of the scores for each of the studies is shown in the table below.

Score range	Study I	Study II	Study III
50–59	24	50	88
60–69	36	67	67
70–79	22	52	65
80–89	11	14	41
90–100	7	17	39
Mean score	68.6	68.7	70.4
Total number of participants	100	200	300

The participants for the studies were selected as follows.

- For Study I, 100 tenth graders were selected at random from all tenth graders in Mistwick.
- For Study II, 200 tenth graders were selected at random from all tenth graders in Mistwick.
- For Study III, 300 tenth graders from Mistwick volunteered to participate.

No tenth grader participated in more than one of the three studies.

20

What percent of all the scores reported in the three studies were in the 50–59 range?

- A) 24%
- B) 25%
- C) 26%
- D) 27%

21

Which of the following could be the median score in Study III?

- A) 59
- B) 68
- C) 70
- D) 82

22

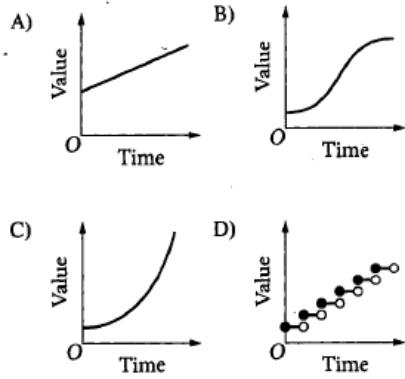
The results of which of the studies can appropriately be generalized to all tenth graders in Mistwick in spring 2015?

- A) Study III only
- B) Studies I and II only
- C) Studies II and III only
- D) Studies I, II, and III



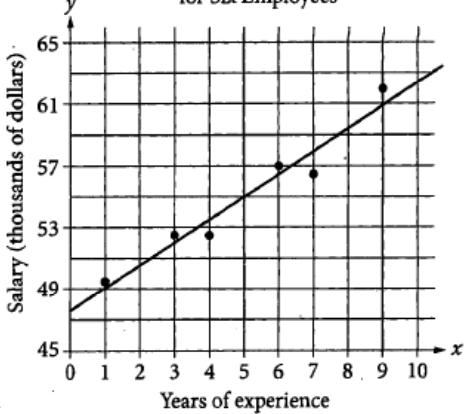
23

In 1789, Benjamin Franklin gave an amount of money to Boston, Massachusetts. The money was to be invested for 100 years in a trust fund. If the value of the trust fund doubled every  $n$  years, which of the following graphs best models the value of the trust fund over time for the 100 years?



25

Salary and Years of Experience  
for Six Employees



The scatterplot above represents the salary  $y$ , in thousands of dollars, and the number of years of experience,  $x$ , for each of six employees at a company. A line of best fit for the data is also shown. Which of the following could be an equation of the line of best fit?

- A)  $y = \frac{3}{2}x$
- B)  $y = \frac{3}{2}x + \frac{95}{2}$
- C)  $y = \frac{2}{3}x + \frac{95}{2}$
- D)  $y = \frac{2}{3}x + 55$

24

$$x(x+1) + 2(x+1) = ax^2 + bx + c$$

In the equation above,  $a$ ,  $b$ , and  $c$  are constants. If the equation is true for all values of  $x$ , what is the value of  $a + b + c$ ?

- A) 6
- B) 5
- C) 4
- D) 3



26

$$y = (x - h)^2(x + h)(x + k)$$

The equation above is graphed in the  $xy$ -plane. If  $h$  and  $k$  are positive constants and  $h \neq k$ , how many distinct  $x$ -intercepts does the graph have?

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

27

A signal from a spacecraft orbiting Mercury travels to Earth at a speed of  $3 \times 10^8$  meters per second. If the distance between Earth and the spacecraft is  $2.0221 \times 10^8$  kilometers, which of the following is closest to the number of minutes it will take for a signal from the spacecraft to reach Earth?

(1 kilometer = 1,000 meters)

- A) 1
- B) 5
- C) 11
- D) 67



29

The table below shows the number of lakes in the United Kingdom classified by alkalinity and depth.

Depth class	Alkalinity class			Total
	Low	Medium	High	
Shallow	87	61	209	357
Moderate	227	86	110	423
Deep	130	35	21	186
Total	444	182	340	966

If a lake has high alkalinity, which of the following is closest to the probability that the lake also has a shallow depth?

- A) 0.22
- B) 0.37
- C) 0.59
- D) 0.61

30

Radioactive substances decay over time. The mass  $M$ , in grams, of a particular radioactive substance  $d$  days after the beginning of an experiment is shown in the table below.

Number of days, $d$	Mass, $M$ (grams)
0	120.00
30	103.21
60	88.78
90	76.36

If this relationship is modeled by the function  $M(d) = a \cdot 10^{bd}$ , which of the following could be the values of  $a$  and  $b$ ?

- A)  $a = 12$  and  $b = 0.0145$
- B)  $a = 12$  and  $b = -0.0145$
- C)  $a = 120$  and  $b = 0.0022$
- D)  $a = 120$  and  $b = -0.0022$

**DIRECTIONS**

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

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

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

Write answer in boxes.

Grid in result.

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

Answer: 2.5

← Decimal point

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

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

2	1	3	. 6 6 6	. 6 6 7
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7

Answer: 201 – either position is correct

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2

2	0	1	2	0	1
0	0	0	0	0	0
1	1	1	1	1	1

31

A scale drawing of a room uses the scale 2 centimeters = 1 foot. In the drawing, one wall has a length of 22 centimeters. What is the actual length, in feet, of this wall?

32

The function  $f$  has the property that, for all  $x$ ,  $3f(x) = f(3x)$ . If  $f(6) = 12$ , what is the value of  $f(2)$ ?

33

The profit  $p$ , in dollars, from producing and selling  $n$  units of a certain product is given by the equation above, where  $k$  is a constant. If 200 units are produced and sold for a profit of \$1275, what is the value of  $k$ ?

$$p = 9n - (2n + k)$$



34

The numbers of people, in millions, who visited Amusement Park A and Amusement Park B in 2009 through 2013 are listed in the table below. What is the positive difference between the mean number of people, in millions, who visited Amusement Park B and the mean number of people, in millions, who visited Amusement Park A during those years? (Round your answer to the nearest tenth.)

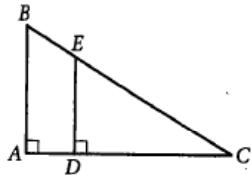
Location	2009	2010	2011	2012	2013
Amusement Park A	15.7	15.2	14.4	14.1	12.3
Amusement Park B	15.9	16.0	16.1	16.0	16.2

35

Lines  $t$  and  $w$  are parallel in the  $xy$ -plane. The equation of line  $t$  is  $4x + 7y = 14$ , and line  $w$  passes through  $(-3, 8)$ . What is the value of the  $y$ -intercept of line  $w$ ?



36



Note: Figure not drawn to scale.

In the figure above,  $ABC$  and  $DEC$  are right triangles. If  $CD = 20$  and the tangent of angle  $ABC$  is 2.5, what is the length of segment  $ED$ ?

**Recommended Daily Intake of Potassium**

Age	Potassium (mg)
0–6 months	400
7–11 months	700
1–3 years	3,000
4–8 years	3,800
9–13 years	4,500
14–17 years	4,700
18 years and up	4,700

The table above shows the recommended amount of potassium, in milligrams (mg) per day, for people of all ages according to the National Academy of Medicine.

37

Andrea's recommended daily intake of potassium is 50% greater than that of her two-year-old brother. What is the least possible age, in years, of Andrea?

38

The recommended daily intake of potassium for an eight-month-old child is what fraction of that recommended for a two-year-old child?

**STOP**

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

May QAS 5/5/18