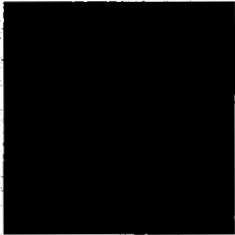


# Form B02

(June 2019)



The **ACT**<sup>®</sup>

2018|2019

In response to your request for Test Information Release materials, this booklet contains the test questions, scoring keys, and conversion tables used in determining your ACT scores. Enclosed with this booklet is a report that lists each of your answers, shows whether your answer was correct, and, if your answer was not correct, gives the correct answer.

If you wish to order a photocopy of your answer document—including, if you took the writing test, a copy of your written essay—please use the order form on the inside back cover of this booklet.

## ENGLISH TEST

45 Minutes—75 Questions

**DIRECTIONS:** In the five passages that follow, certain words and phrases are underlined and numbered. In the right-hand column, you will find alternatives for the underlined part. In most cases, you are to choose the one that best expresses the idea, makes the statement appropriate for standard written English, or is worded most consistently with the style and tone of the passage as a whole. If you think the original version is best, choose "NO CHANGE." In some cases, you will find in the right-hand column a question about the underlined part. You are to choose the best answer to the question.

You will also find questions about a section of the passage, or about the passage as a whole. These questions do not refer to an underlined portion of the passage, but rather are identified by a number or numbers in a box.

For each question, choose the alternative you consider best and fill in the corresponding oval on your answer document. Read each passage through once before you begin to answer the questions that accompany it. For many of the questions, you must read several sentences beyond the question to determine the answer. Be sure that you have read far enough ahead each time you choose an alternative.

## PASSAGE I

**Eddie Sweat: A Groom's Groom**

In 1973 the three-year-old colt Secretariat won each event of the Triple Crown of Thoroughbred Racing (the Kentucky Derby, the Preakness Stakes, and the Belmont Stakes), a feat accomplished only eleven times in the twentieth century. While many factors contributed to Secretariat's success—selective breeding, top-notch trainers, and a skillful jockey, to name a few—the expertise and diligent care of the horse's groom, Eddie Sweat, who deserves

some of the credit. 2

1. A. NO CHANGE  
B. Sweat; who deserves  
C. Sweat, deserve  
D. Sweat; deserve
  
2. At this point, the writer is considering adding the following true statement:  

Another key figure was Ron Turcotte, the skillful jockey who rode Secretariat to victory in the Triple Crown races.

Should the writer make this addition here?

  - F. Yes, because it concludes the paragraph with a logical transition to the rest of the essay.
  - G. Yes, because it identifies the "skillful jockey" mentioned in the preceding sentence.
  - H. No, because it detracts from the paragraph's focus on horses that have won the Triple Crown.
  - J. No, because it detracts from the paragraph's purpose of introducing the essay's main topic.

Although often overlooked and underappreciated, a groom plays a significant role in the life of a racehorse.

A groom's basic tasks include washing and brushing the horse, trimming its mane and tail, and they clean its

hooves. [A] A groom also cleans stalls and takes care of

riding equipment. [B] Those whom witnessed Sweat with Secretariat attest that his care surpassed the usual duties of

a groom. He'd talk to the horse constantly, he'd soothe him

in Gullah, a Creole-English language commonly spoken in the South Carolina African American community Sweat

grew up in. [C] After cooking Secretariat a mash of oats and corn, he'd watch him eat, taking note of any changes

in appetite noticeable to him while the horse was eating.

He'd also examine Secretariat's teeth and take his

temperature daily, attention to any signs of illness or

distress. [D] Sweat would spend extra time massaging the

horse's legs, applying healing poultices made from herbs

he had gathered. However, on nights before big races, he'd

even sleep next to the horse's stall. 10

3. A. NO CHANGE  
B. cleaning  
C. to clean  
D. clean
4. Which of the following alternatives to the underlined portion would NOT be acceptable?  
F. Additionally, a groom  
G. A groom, in addition,  
H. In sum, a groom  
J. Also, a groom
5. A. NO CHANGE  
B. who  
C. of whom  
D. of which
6. F. NO CHANGE  
G. constantly. Soothing  
H. constantly; soothing  
J. constantly, soothing
7. A. NO CHANGE  
B. that became apparent while watching him eat.  
C. that were noticeable to him.  
D. DELETE the underlined portion and end the sentence with a period.
8. F. NO CHANGE  
G. attentively to  
H. attentive to  
J. attentively
9. A. NO CHANGE  
B. On  
C. Therefore, on  
D. For example, on
10. The writer wants to divide this paragraph into two in order to separate the general information about a groom's duties from the specific details about Eddie Sweat's work as a groom. The best place to begin the new paragraph would be at:  
F. Point A.  
G. Point B.  
H. Point C.  
J. Point D.

Sweat's constant, companionship, and expert care  
<sup>11</sup>  
 kept Secretariat healthy and calm in a stressful racing

environment <sup>12</sup>. When a bronze statue honoring  
 Secretariat was unveiled at the Kentucky Horse Park  
 in 2004, it featured not only the Triple Crown champion

and his jockey but his groom, Eddie Sweat, as well.

The statue, depicting Sweat with his left hand gripping

the lead rope, his right rests on the horse's side,  
<sup>14</sup>

is a lasting tribute to Sweat's exceptional care.  
<sup>15</sup>

11. A. NO CHANGE  
 B. constant companionship,  
 C. constant, companionship  
 D. constant companionship
12. At this point, the writer is considering adding the following accurate information:  
 that involved much contact with the public, grueling training sessions, and frequent travel  
 Should the writer make this addition here?  
 F. Yes, because it names some of the stresses Secretariat endured.  
 G. Yes, because it provides examples of Sweat's diligent care for Secretariat.  
 H. No, because it shows that Sweat's care had little impact on Secretariat's performances.  
 J. No, because it demonstrates that Secretariat was an unusually difficult racehorse.
13. A. NO CHANGE  
 B. but, his groom, Eddie Sweat  
 C. but, his groom Eddie Sweat,  
 D. but his groom, Eddie Sweat
14. F. NO CHANGE  
 G. would rest  
 H. resting  
 J. rested
15. Given that all the choices are accurate, which one most effectively concludes the sentence and the essay by reinforcing the essay's main point?  
 A. NO CHANGE  
 B. remains there today, a celebration of the spirit of one of the greatest racehorses in history.  
 C. weighs 1,500 pounds and is located in the section of the park called Secretariat Plaza.  
 D. is a beautiful reminder of the special bond that can form between horse and jockey.

## PASSAGE II

### Himalayan Garnets

[1]

When geologist, Elizabeth Catlos, began  
<sup>16</sup>  
 gathering garnets in the Himalayan Mountains in  
 the late 1990s, most scientists had a fairly rigid  
 understanding of the mountain range's history. [A]  
 It was commonly held that the Himalayas had formed  
 approximately 55 million years ago when India drifted  
<sup>17</sup>  
 north on a layer of semimolten rock, collided with Asia.

16. F. NO CHANGE  
 G. geologist, Elizabeth Catlos  
 H. geologist Elizabeth Catlos,  
 J. geologist Elizabeth Catlos
17. A. NO CHANGE  
 B. India, has been drifting  
 C. India, drifting  
 D. India had drifted

The collision forced<sup>18</sup> one tectonic plate into the other, crumpling the land where the plates met. The resulting mountain range, one of the longest in the world, stretches 1,500 miles across six countries and features many impressive mountains. Although<sup>19</sup> the Himalayan range was thought to have remained relatively unchanged over these tens of millions of years, Catlos was surprised to discover that some of the garnets

she had collected formed less than that many years ago. [B]<sup>20</sup>

[2]

Garnets are gemstones with a crystal structure. They are formed many miles beneath the surface of the earth, where high pressures and temperatures allows<sup>21</sup>

them to crystallize. These gemstones are really good in<sup>22</sup>

geologic dating. [C] Resistant to chemical change<sup>23</sup> after they crystallize, scientists can analyze the gemstones to determine the temperature and pressure of the earth when the garnets formed. Such analyses are possible because garnets also contain monazite,

a rare mineral that is easily dated. This allows scientists<sup>24</sup>

to identify the garnets' approximate age. And<sup>25</sup> the earth's conditions when the gemstones formed.

18. F. NO CHANGE  
G. compelled  
H. imposed  
J. coerced
19. The writer is considering revising the underlined portion to the following:  
boasts nine of the world's ten highest peaks.  
Should the writer make this revision?  
A. Yes, because it explains why the Himalayas stretch across so many countries.  
B. Yes, because it provides a specific detail that illustrates the magnitude of the mountain range.  
C. No, because it does not indicate where the tenth highest peak is located.  
D. No, because it repeats information provided earlier in the paragraph.
20. Which choice draws the most specific contrast between the presumed age of the Himalayas and the age of the garnets Catlos collected?  
F. NO CHANGE  
G. only a few million  
H. not very many  
J. DELETE the underlined portion.
21. A. NO CHANGE  
B. has allowed  
C. is allowing  
D. allow
22. F. NO CHANGE  
G. work so well when it comes to  
H. are particularly useful for  
J. do a pretty great job with
23. A. NO CHANGE  
B. Because garnets are resistant to  
C. Since they resist  
D. Resisting
24. F. NO CHANGE  
G. a rare, easily dated mineral that makes these analyses feasible.  
H. a rare mineral that is easily dated without difficulty.  
J. an easily dated, rare mineral found in garnets.
25. A. NO CHANGE  
B. age; and  
C. age, and  
D. age and

[3]

The dating of Catlos's garnets, as well as analysis of the pressures and temperatures encoded in their structure, indicates that they were not formed by a single collision, as was previously thought. Rather, it seems that India has continued to push northward into Asia. According to new estimates, the mountain range as we know it today most likely underwent major changes as recently as five million years ago. Incredibly, as one of Catlos's colleagues notes, "Geologically, the present Himalayan range front was formed just yesterday." [D]

26. F. NO CHANGE  
 G. the Himalayas  
 H. mountains  
 J. some
27. A. NO CHANGE  
 B. as it is known to we  
 C. as we know them  
 D. that us know
28. F. NO CHANGE  
 G. have noted,  
 H. are noting,  
 J. note,

Questions 29 and 30 ask about the preceding passage as a whole.

29. The writer is considering adding the following sentence to the essay:

Specifically, garnets are key minerals scientists use to determine the age and origin of igneous and metamorphic rock.

If the writer were to add this sentence, it would most logically be placed at:

- A. Point A in Paragraph 1.  
 B. Point B in Paragraph 1.  
 C. Point C in Paragraph 2.  
 D. Point D in Paragraph 3.

30. Suppose the writer's primary purpose had been to offer a brief biography of a notable scientist. Would this essay accomplish that purpose?

- F. Yes, because it outlines one scientist's contribution to the study of precious gemstones.  
 G. Yes, because it states that Catlos was the one to discover the true age of the Himalayas.  
 H. No, because it focuses on how one geologic finding changed a long-held scientific belief.  
 J. No, because it includes information about Catlos's colleagues as well.

## PASSAGE III

## Ports of Recall: Hudson River Ferries

The first steam-powered ferry on the Hudson River, the *Juliana*, left Hoboken, New Jersey, for New York City on October 11, 1811, in the nineteenth century. Ferries, mostly of the small sailboat kind called sloops, had been traveling on the Hudson for centuries, carrying cargo and passengers. What made steamboat travel so revolutionary was speed. A trip from New York City to Albany, for example, took seven days in a sloop, a steamboat

shortened that trip to one day. Less vulnerable to the weather, steam-powered ferries were reliable, and thus their popularity grew.

Onboard these ferries, commuters crossed from homes in Hoboken to jobs in Manhattan. Society's upper echelon meandered on scenic upriver excursions. "Passengers" sometimes included horses, goats, and chickens. Many of these vessels offered rudimentary comforts at best. Others, from that time period, boasted

an elegance that unsurpassed the river. For a while, older

styles of ferries, such as those powered by horses brought onboard to turn a paddle wheel, continued to operate. But the steam-powered ferries, hundreds of them, ruled the Hudson River for most of the nineteenth, and part of the twentieth centuries.

31. A. NO CHANGE  
 B. marking the first such trip by a steam-propelled ferry.  
 C. on the Hudson River.  
 D. DELETE the underlined portion and end the sentence with a period.
32. F. NO CHANGE  
 G. days, in a sloop,  
 H. days in a sloop;  
 J. days: in a sloop
33. Given that all the choices are accurate, which one best completes the contrast set up in the first part of the sentence?  
 A. NO CHANGE  
 B. on the Hudson River.  
 C. in terms of time.  
 D. measurably.
34. F. NO CHANGE  
 G. Hoboken, to jobs  
 H. Hoboken to jobs,  
 J. Hoboken, to jobs,
35. Which choice most vividly reinforces the information in the rest of the sentence?  
 A. NO CHANGE  
 B. according to authoritative sources,  
 C. dubbed "floating palaces,"  
 D. incidentally,
36. F. NO CHANGE  
 G. unsurpassed with  
 H. unsurpassed on  
 J. unsurpassed in
37. A. NO CHANGE  
 B. forced  
 C. trotted  
 D. engaged
38. F. NO CHANGE  
 G. nineteenth and,  
 H. nineteenth and  
 J. nineteenth, but

1 ■ ■ ■ ■ ■ ■ ■ ■ ■ ■

Bear Mountain Bridge was built by the Harriman  
<sup>39</sup>  
family. Until bridges spanned the Hudson River—more  
<sup>39</sup>

than a mile wide in places,  
<sup>40</sup>  
 car owners relied on ferries  
 to transport their vehicles from one shore to the other.

Bearing names like *Elmira*, *Lackawanna*, *Tuxedo*, and  
*Skillypot*, ferry travel helped transform the region into  
<sup>41</sup>  
 one of the biggest economic and cultural centers of the

world. At its' peak in 1927, ferry service between  
<sup>42</sup>

New Jersey to New York reached twenty-seven million  
<sup>43</sup>  
 passengers annually. In a few years that number  
 plummeted. The Hudson River Vehicular Tunnel, later  
 renamed the Holland Tunnel, opened in 1927, followed by  
<sup>44</sup>  
 the George Washington Bridge in 1931. By the time the  
 first cars traveled 1.5 miles through the Lincoln Tunnel in  
 1937, the golden age of ferries on the Hudson had ended.

39. Given that all the choices are true, which one best introduces the topic of the paragraph?

- A. NO CHANGE
- B. When automobiles arrived, they did not immediately replace ferries.
- C. Suspension bridges are now considered part of what makes trips up the Hudson River so scenic.
- D. Some ferries in operation today have the capacity to take automobiles onboard.

40. F. NO CHANGE

- G. places—
- H. places;
- J. places

41. A. NO CHANGE

- B. ferry transportation in general
- C. travel by ferry
- D. ferries

42. F. NO CHANGE

- G. their
- H. its
- J. it's

43. A. NO CHANGE

- B. on the way to
- C. plus
- D. and

44. F. NO CHANGE

- G. following in the footsteps of
- H. and it followed
- J. following

Question 45 asks about the preceding passage as a whole.

45. Suppose the writer's primary purpose had been to provide a detailed comparison of sloops and steamboat ferries that operated on the Hudson River in the nineteenth century. Would this essay accomplish that purpose?

- A. Yes, because the essay explains that of the two types of transportation, steamboat ferries were much faster.
- B. Yes, because the essay compares the age, speed, and style of both types of vessels on the Hudson.
- C. No, because the essay focuses on the speed with which the auto industry shut down ferryboat travel on the Hudson River.
- D. No, because although the essay offers some basic information about sloops, it focuses on the rise and fall of steamboat ferries on the Hudson.



## PASSAGE IV

## Name That Tune

[1] Crowdsourcing, “recruiting” volunteers from the general public to help perform a task, is often an efficient means of rummaging around massive amounts of data.

[2] But for the Whale Song Project, which focuses on deciphering the songs of killer and pilot whales, crowdsourcing also alleviates the problem of subjective interpretation. [3] It has been instrumental in classifying galaxies and decoding ancient papyri. 47

The key to learning more about the meaning of whale songs, scientists believe, is to study the songs in context.

Their aim is to establish what type of situation elicits a particular song. Two pieces of sophisticated recording equipment is essential in this endeavor: D-tags and

hydrophone arrays. For example, D-tags are noninvasive devices temporarily attached to the whales with suction cups. Hydrophone arrays are webs of underwater

recording devices 51. Using this equipment,

scientists have amassed roughly 15,000 songs, along with other background noises and data about the whales’ locations and movements.

46. F. NO CHANGE  
G. poking about  
H. handling  
J. toting

47. Which sequence of sentences makes this paragraph most logical?  
A. NO CHANGE  
B. 1, 3, 2  
C. 2, 3, 1  
D. 3, 2, 1

48. F. NO CHANGE  
G. songs, scientists believe is,  
H. songs scientists believe, is  
J., songs, scientists believe is

49. A. NO CHANGE  
B. have been  
C. has been  
D. was

50. F. NO CHANGE  
G. On the one hand,  
H. In fact,  
J. DELETE the underlined portion.

51. At this point, the writer is considering adding the following accurate information:  
trailed behind a boat or attached to a buoy  
Should the writer make this addition here?  
A. Yes, because it supports the writer’s assertion that hydrophone arrays are sophisticated recording devices.  
B. Yes, because it helps explain what hydrophone arrays are and how they differ from D-tags.  
C. No, because it adds a level of detail inconsistent with the rest of the essay.  
D. No, because it suggests that hydrophone arrays are less effective than D-tags.

52. F. NO CHANGE  
G. the collection for the project has roughly 15,000 songs,  
H. the roughly 15,000 songs collected are ready for study,  
J. roughly 15,000 songs await scientists’ analysis,

Now scientists are turning to crowdsourcing to meet the next challenge: tagging similar-sounding

53

songs as matches. These matches are vital for the project, they allow scientists to identify and compare multiple situations in which the same song was recorded. The process, which effectively narrows the range of

55

potential factors that possibly could have evoked a particular song, thereby offering better clues to the song's meaning.

56

The variability in human capacity to distinguish high and low tones makes the matching process highly subjective. Crowdsourcing, however, allows scientists to nab significant trends in matchmaking rather than to work

58

from a few listeners' interpretations. Nevertheless, songs can be sorted more reliably. Where so much depends on identifying similarities in sounds that crowdsourcing could provide a crucial step toward understanding what the whales are saying.

60

53. A. NO CHANGE  
B. challenge; that of  
C. challenge;  
D. challenge
54. F. NO CHANGE  
G. project; for  
H. project;  
J. project
55. A. NO CHANGE  
B. process of effectively narrowing  
C. process, effectively narrowing  
D. process effectively narrows
56. F. NO CHANGE  
G. factors that, at least potentially, could have  
H. possible potential factors that  
J. potential factors that
57. A. NO CHANGE  
B. through  
C. with  
D. on
58. F. NO CHANGE  
G. come to find out  
H. spot  
J. stake out
59. A. NO CHANGE  
B. As a result,  
C. Similarly,  
D. Still,
60. F. NO CHANGE  
G. sounds, with  
H. sounds as  
J. sounds,

## PASSAGE V

## A Natural Comedian

[1] When silent comedy films, which debuted<sup>61</sup> in the early 1900s, the public was delighted by slapstick's over-the-top brawls, falls, and pantomimes.

[2] Exaggerated gestures and expressions, long used by actors to hammer home the hilarity of their acts in vaudeville theaters, began to fall flat with filmgoers.

[3] By 1910, however, audiences' tastes were more refined.<sup>62</sup>

[4] Craving comedies, but they lamented the overacting,<sup>63</sup>

audiences began to call for funnier—and more natural—<sup>64</sup>

silent actors. <sup>65</sup>

An illustrator's model, Mabel Normand, proved perfect for the part. Skilled at calling up realistic emotions for magazine art and ads, Normand was invited to take part in a film as an extra. After impressing them<sup>66</sup> with her natural wit and nuanced expressions, directors at the Biograph film company offered her a costar's contract. Within a year, she was accepting starring roles with major studios. <sup>67</sup>

61. A. NO CHANGE  
B. films that debuted  
C. films debuted  
D. films, debuting
62. F. NO CHANGE  
G. audience's tastes were  
H. audience's taste was  
J. audiences' taste was
63. A. NO CHANGE  
B. Though moviegoers craved comedies, they lamented  
C. Despite craving comedies, moviegoers lamented  
D. Craving comedies but lamenting
64. F. NO CHANGE  
G. funnier (and more natural),  
H. funnier—and more natural  
J. funnier, and more natural
65. Which sequence of sentences makes this paragraph most logical?  
A. NO CHANGE  
B. 1, 3, 2, 4  
C. 1, 3, 4, 2  
D. 1, 4, 2, 3
66. F. NO CHANGE  
G. Impressed  
H. An impressive actor  
J. Impressing them
67. If the writer were to delete the preceding sentence, this paragraph would primarily lose:  
A. a suggestion that Normand's success turned the Biograph film company into a major film studio.  
B. an explanation of how Normand switched from dramatic acting to comedic acting.  
C. a detail establishing the idea that Normand was popular with audiences.  
D. an indication of how quickly Normand's acting career flourished.

Normand livened up their usual comedy fare, radiating charisma in case she was waltzing at a garden party or tumbling into a mud puddle. Audiences, starstruck, wrote in to newspapers asking who this new talent was. Actors, too, were inspired by Normand's lively but subtle comedy style. One of her costars, the young Charlie Chaplin, later attributed part of his immense success to Normand's mentoring.

Normand set an example not only for her costars, but also for women entering film. Early comedies cast women

in only a handful of stereotypical parts, such as, the dutiful daughter or the damsel in distress. As Normand's fame increased and she began to write and direct her own films, she created new heroines to better suit her daring

spirit. 72 What's more, they have the last laugh. After getting hit with a pie in the film *The Ragtime Band*,

however, Normand's character, outraged, wipes the pie off her face and flings it right back. Her initiative sets

off a massive food fight, throughout which nobody laughs harder than Normand.

68. F. NO CHANGE  
G. given that  
H. whether  
J. since
69. A. NO CHANGE  
B. was also inspirational for  
C. also inspired  
D. DELETE the underlined portion.
70. F. NO CHANGE  
G. parts; such as,  
H. parts; such as  
J. parts, such as
71. A. NO CHANGE  
B. adorn  
C. equip  
D. join
72. Given that all the following statements are true, which one provides the most effective transition between the preceding sentence and the rest of the paragraph?
- F. Normand's first self-produced film, *Mickey*, set in her native New York City, features characters caught in a love triangle.  
G. Clever and fearless, her characters hog-tie suitors, tame wild animals, fly rescue missions, and officiate marriages.  
H. Before Normand, comic heroines drew laughs mainly by wearing silly makeup and costumes.  
J. Many of these heroines were introduced in her later films costarring Roscoe Arbuckle.
73. A. NO CHANGE  
B. for example,  
C. similarly,  
D. besides,
74. F. NO CHANGE  
G. fight, which, throughout it,  
H. fight, which throughout,  
J. fight that throughout it,

Question 75 asks about the preceding passage as a whole.

75. Suppose the writer's main purpose had been to explore the significance of an early film actor's career. Would this essay accomplish that purpose?
- A. Yes, because it focuses on how the decision to pursue an acting career changed Normand's personality and ambitions.
  - B. Yes, because it discusses how Normand's unique charm and impressive acting talents affected comedy film.
  - C. No, because it describes how Normand left slapstick acting to write and direct more sophisticated comedy films.
  - D. No, because it indicates that, after a brief period of popularity, comedy films like Normand's failed to satisfy audiences.

**END OF TEST 1**

**STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.**



## MATHEMATICS TEST

60 Minutes—60 Questions

**DIRECTIONS:** Solve each problem, choose the correct answer, and then fill in the corresponding oval on your answer document.

Do not linger over problems that take too much time. Solve as many as you can; then return to the others in the time you have left for this test.

You are permitted to use a calculator on this test. You may use your calculator for any problems you choose,

but some of the problems may best be done without using a calculator.

Note: Unless otherwise stated, all of the following should be assumed.

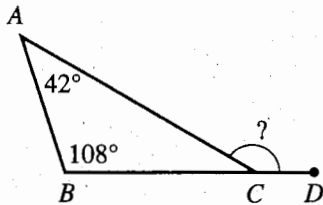
1. Illustrative figures are NOT necessarily drawn to scale.
2. Geometric figures lie in a plane.
3. The word *line* indicates a straight line.
4. The word *average* indicates arithmetic mean.

1. A calculator has a regular price of \$59.95 before taxes. It goes on sale at 20% below the regular price. Before taxes are added, what is the sale price of the calculator?
  - A. \$11.99
  - B. \$29.98
  - C. \$39.95
  - D. \$47.96
  - E. \$54.95

## DO YOUR FIGURING HERE.

2. Given  $r = 6$ ,  $b = 4$ , and  $g = -9$ ,  $(r + b - g)(b + g) = ?$ 
  - F. -95
  - G. -5
  - H. 5
  - J. 13
  - K. 14

3. In the figure below,  $C$  is on  $\overline{BD}$ ,  $\angle BAC$  measures  $42^\circ$ , and  $\angle ABC$  measures  $108^\circ$ . What is the measure of  $\angle ACD$ ?



- A.  $108^\circ$
  - B.  $120^\circ$
  - C.  $132^\circ$
  - D.  $138^\circ$
  - E.  $150^\circ$
4. If  $\frac{3}{5}x + 10 = 17$ , then  $x = ?$ 
    - F.  $-\frac{35}{3}$
    - G.  $\frac{5}{3}$
    - H.  $\frac{35}{3}$
    - J.  $\frac{21}{5}$
    - K. 45



5. What is the length, in inches, of the hypotenuse of a right triangle with a leg that is 9 inches long and a leg that is 2 inches long?

A.  $\sqrt{22}$   
 B.  $\sqrt{77}$   
 C.  $\sqrt{85}$   
 D. 5.5  
 E. 11

DO YOUR FIGURING HERE.

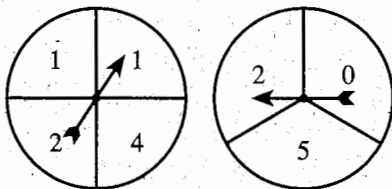
6. A bag contains exactly 18 solid-colored buttons: 3 red, 5 blue, and 10 white. What is the probability of randomly selecting 1 button that is NOT white?

F.  $\frac{1}{18}$   
 G.  $\frac{1}{8}$   
 H.  $\frac{4}{9}$   
 J.  $\frac{2}{3}$   
 K.  $\frac{4}{5}$

7. What is the sum of 3 consecutive odd integers whose mean is 27?

A. 39  
 B. 75  
 C. 81  
 D. 87  
 E. 93

8. Two dials are shown below. When the arrow on each dial is spun, it is equally likely to point at any of the numbered sectors on its dial after it has stopped spinning. After the arrows are next spun, the numbers in the sectors the arrows point at after they stop spinning will be added together. Which of the following values is NOT a possible sum of those 2 numbers?



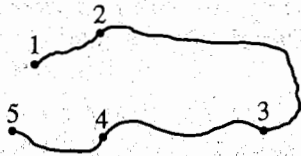
F. 1  
 G. 4  
 H. 6  
 J. 7  
 K. 8



DO YOUR FIGURING HERE.

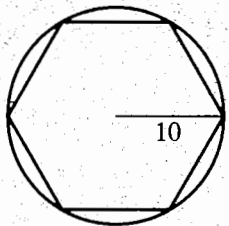
9. On a bike trail there are 5 checkpoints numbered in order, Checkpoint 1 through Checkpoint 5, as shown in the figure below. Some distances along the trail between 2 checkpoints are given: 6.6 miles between 1 and 3; 4.5 miles between 2 and 3; and 9.7 miles between 2 and 5. Which of the following values is closest to the distance, in miles, along the trail between Checkpoint 1 and Checkpoint 5?

- A. 11.1  
B. 11.8  
C. 14.2  
D. 16.3  
E. 20.8



10. In the figure below, a circle with a radius of 10 meters circumscribes a regular hexagon. What is the perimeter, in meters, of the hexagon?

- F. 30  
G.  $30\sqrt{3}$   
H. 60  
J.  $60\sqrt{2}$   
K.  $60\sqrt{3}$



11. To produce aluminum softball bats, it costs the Recreation Equipment Supply Company \$3,500 for overhead, plus \$2 per softball bat produced. What is the maximum number of bats that can be produced by the company for \$15,000?

- A. 1,750  
B. 3,502  
C. 5,000  
D. 5,750  
E. 7,500

12. Given that  $3x + 2 = 4$  and  $2y + 6 = 5$ , what is  $x + y$ ?

- F.  $-\frac{1}{2}$   
G.  $\frac{1}{6}$   
H.  $\frac{2}{3}$   
J.  $\frac{7}{6}$   
K.  $\frac{15}{2}$

13. For all  $x$  such that  $x \neq 0$ , which of the following expressions is equivalent to  $\frac{15x^2 + 25x}{5x}$ ?

- A.  $8x$   
B.  $28x$   
C.  $3x + 5$   
D.  $3x^2 + 5$   
E.  $15x^2 + 5$





14. What is the value of the expression  $\frac{|-3-2|^2+(-1)^3}{16+4 \times 2-5}$ ?

F. -8

G.  $-\frac{2}{3}$

H.  $\frac{2}{3}$

J.  $\frac{26}{3}$

K. 8

DO YOUR FIGURING HERE.

15. Karen invested \$2,000 in a special savings account. The balance of this special savings account will double every 5 years. Assuming that Karen makes no other deposits and no withdrawals, what will be the balance of Karen's investment at the end of 40 years?

A. \$ 80,000

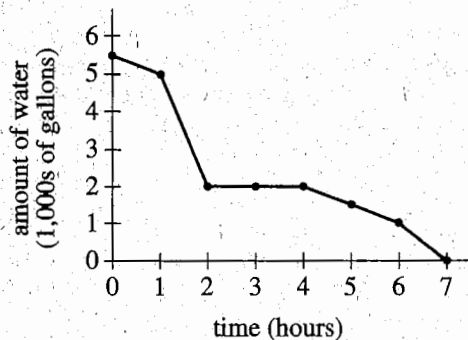
B. \$ 256,000

C. \$ 400,000

D. \$ 512,000

E. \$1,024,000

16. The graph below shows the amount of water in a pond over a period of 7 hours. One of the following values is the number of hours the amount of water in the pond remained constant. Which one?



F. 2

G. 3

H. 3.5

J. 4

K. 7

17. If it rains in Franklin City on a particular day, the probability that it will rain there the following day is 0.70. If it does not rain in Franklin City on a particular day, the probability that it will rain there the following day is 0.10. Given that it rained in Franklin City on Monday, what is the probability that it will NOT rain in Franklin City on Tuesday of the same week?

A. 0.10

B. 0.30

C. 0.60

D. 0.70

E. 0.90

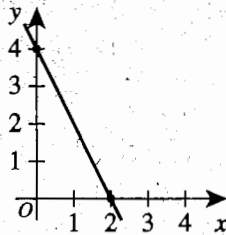


18. In the standard  $(x,y)$  coordinate plane, what is the slope of the line given by the equation  $5x = 9y + 18$ ?

F.  $-\frac{5}{9}$   
 G.  $\frac{5}{9}$   
 H.  $\frac{9}{5}$   
 J. 5  
 K. 9

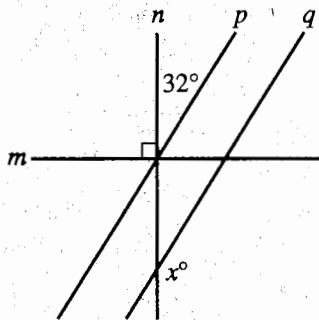
DO YOUR FIGURING HERE.

19. One of the following equations represents the line graphed in the standard  $(x,y)$  coordinate plane below. Which one?



A.  $y = -2x + 2$   
 B.  $y = -2x + 4$   
 C.  $y = 2x + 4$   
 D.  $y = 4x - 2$   
 E.  $y = 4x + 2$

20. In the figure below, line  $m$  is perpendicular to line  $n$ , and line  $p$  is parallel to line  $q$ . Lines  $m$ ,  $n$ , and  $p$  intersect at a single point. Some angle measures are given. What is the value of  $x$ ?



F. 32  
 G. 58  
 H. 122  
 J. 148  
 K. 158

21. A bag contains 10 solid-colored marbles of the same size: 3 red, 2 green, 1 yellow, and 4 blue. Which of the following expressions gives the probability of drawing, at random and without replacement, a blue marble on the 1st draw, a green marble on the 2nd draw, and a blue marble on the 3rd draw?

A.  $\left(\frac{4}{10}\right)\left(\frac{2}{10}\right)\left(\frac{3}{10}\right)$   
 B.  $\left(\frac{4}{10}\right)\left(\frac{2}{10}\right)\left(\frac{4}{10}\right)$   
 C.  $\left(\frac{4}{10}\right)\left(\frac{2}{9}\right)\left(\frac{4}{8}\right)$   
 D.  $\left(\frac{4}{10}\right)\left(\frac{2}{9}\right)\left(\frac{3}{8}\right)$   
 E.  $\left(\frac{4}{10}\right)\left(\frac{3}{9}\right)\left(\frac{3}{8}\right)$



22. A physical education teacher recorded the distances, in inches, that her students jumped during a long jump lesson. The distances of 1 jump by each of the students are represented in the stem-and-leaf plot below.

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

Key: 5 | 2 = 52 inches

What is the probability that a student chosen at random from the class will have jumped *at least* 60 inches?

- F.  $\frac{5}{24}$
- G.  $\frac{8}{24}$
- H.  $\frac{5}{19}$
- J.  $\frac{7}{19}$
- K.  $\frac{8}{19}$
23. Given that the function  $f$  defined as  $f(x) = 5 - 3x$  has domain  $\{-1, 0, 2\}$ , what is the range of  $f$ ?
- A.  $\{-2, 0, 4\}$
- B.  $\{-1, 2, 8\}$
- C.  $\{-1, 5, 8\}$
- D.  $\{2, 5, 8\}$
- E.  $\{2, 5, 11\}$
24. To the nearest 1 foot, what is the height of a rectangular prism with a base length of 15 feet, a base width of  $1\frac{1}{3}$  feet, and a volume of 100 cubic feet?

- F. 5
- G. 7
- H. 9
- J. 20
- K. 75

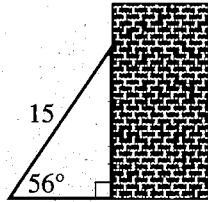
DO YOUR FIGURING HERE.



25. Tables of values for the 2 functions  $f$  and  $g$  are shown below. What is the value of  $g(f(5))$ ?

$x$	$f(x)$	$x$	$g(x)$
-7	9	-3	5
-3	-7	1	-1
1	5	3	-5
5	3	5	-7

- A. -21  
 B. -7  
 C. -5  
 D. 3  
 E. 9
26. In the figure shown below, a ladder 15 feet long forms an angle of  $56^\circ$  with the level ground as it leans against the vertical side of a building. The distance along the building, in feet, between the ground and the top of the ladder is equal to which of the following expressions?



- F.  $\frac{15}{2}$   
 G.  $\frac{15\sqrt{3}}{2}$   
 H.  $15 \sin 56^\circ$   
 J.  $15 \cos 56^\circ$   
 K.  $15 \tan 56^\circ$
27. The isotope iodine-131 has a half-life of 8 days, which means that the amount of iodine-131 remaining after  $t$  days is  $N\left(\frac{1}{2}\right)^{\frac{t}{8}}$ , where  $N$  is the number of grams of iodine-131 at  $t = 0$ . How many grams of iodine-131 will remain after 16 days if there were 32 grams of iodine-131 at  $t = 0$ ?

- A. 0  
 B. 2  
 C. 8  
 D. 16  
 E. 128
28. Which of the following expressions is equivalent to  $\sqrt[4]{256x^{16}}$ ?
- F.  $4x^4$   
 G.  $4x^{12}$   
 H.  $16x^4$   
 J.  $64x^{12}$   
 K.  $128x^8$

DO YOUR FIGURING HERE.

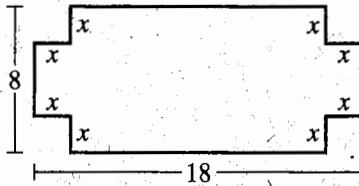


29. Two concentric circles have radii of 5 centimeters and 6 centimeters, respectively. How many centimeters longer is the circumference of the larger circle than that of the smaller circle?

A. 1  
 B.  $\pi$   
 C.  $2\pi$   
 D.  $11\pi$   
 E.  $22\pi$

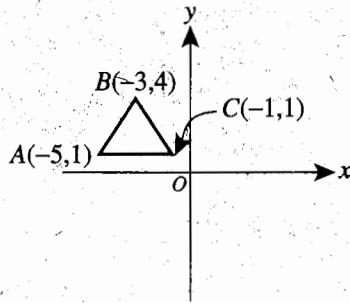
DO YOUR FIGURING HERE.

30. Squares with sides of length  $x$  cm have been removed from each corner of a rectangle measuring 8 cm by 18 cm, resulting in the figure shown below. In terms of  $x$ , what is the area, in square centimeters, of the figure?



F.  $52 - 4x^2$   
 G.  $144 - 4x^2$   
 H.  $144 + 4x^2$   
 J.  $144 - 8x$   
 K.  $144 - 52x + 4x^2$

31. In the standard  $(x,y)$  coordinate plane below,  $\triangle ABC$  will be translated 10 units down and then the resulting image will be reflected over the  $y$ -axis. What will be the coordinates of the final image of  $A$  resulting from both transformations?



A.  $(-5, 9)$   
 B.  $(-1, 9)$   
 C.  $(1, -9)$   
 D.  $(5, -10)$   
 E.  $(5, -9)$

32. Olivia, Ashton, and Jane are standing on a soccer field such that Olivia is 20 meters due west of Ashton and Jane is 40 meters due north of Ashton. Their positions are at the vertices of a triangle. Which of the following expressions gives the degree measure of the angle of the triangle at the vertex where Olivia is standing?

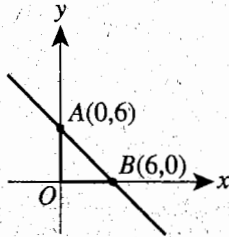
F.  $\cos^{-1}\left(\frac{40}{20}\right)$   
 G.  $\sin^{-1}\left(\frac{40}{20}\right)$   
 H.  $\sin^{-1}\left(\frac{20}{40}\right)$   
 J.  $\tan^{-1}\left(\frac{40}{20}\right)$   
 K.  $\tan^{-1}\left(\frac{20}{40}\right)$



Use the following information to answer questions 33–35.

DO YOUR FIGURING HERE.

In the standard  $(x,y)$  coordinate plane below,  $\triangle AOB$  is formed by  $\overleftrightarrow{AB}$ , the  $x$ -axis, and the  $y$ -axis.



33. What is the area of  $\triangle AOB$  in square coordinate units?

- A. 6
- B.  $6\sqrt{2}$
- C. 12
- D. 18
- E. 36

34. What is the length of  $\overline{AB}$  in coordinate units?

- F.  $2\sqrt{6}$
- G.  $6\sqrt{2}$
- H.  $6\sqrt{3}$
- J. 6
- K. 12

35. Which of the following is an equation of  $\overleftrightarrow{AB}$ ?

- A.  $y = -x + 6$
- B.  $y = x - 6$
- C.  $y = x + 6$
- D.  $y = -6x - 6$
- E.  $y = 6x + 6$

36. Which of the following arranges the numbers  $\frac{9}{5}$ ,  $1.\overline{8}$ ,  $1.0\overline{8}$ , and  $1.\overline{08}$  into ascending order? (Note: The overbar notation shows that the digits under the bar will repeat. For example,  $1.\overline{73} = 1.737373\dots$ )

- F.  $\frac{9}{5} < 1.\overline{08} < 1.0\overline{8} < 1.\overline{8}$
- G.  $\frac{9}{5} < 1.0\overline{8} < 1.\overline{08} < 1.\overline{8}$
- H.  $1.\overline{08} < 1.0\overline{8} < \frac{9}{5} < 1.\overline{8}$
- J.  $1.0\overline{8} < 1.\overline{08} < 1.\overline{8} < \frac{9}{5}$
- K.  $1.0\overline{8} < 1.\overline{08} < \frac{9}{5} < 1.\overline{8}$



37. Andre's Floral Shop asked each of 20 customers to give a rating of the shop's service. The table below summarizes the 20 customer ratings.

Rating	Number of customers
3	6
2	8
1	2
0	4

Which of the following values is closest to the mean of the 20 customer ratings?

- A. 1.8  
 B. 2.0  
 C. 2.3  
 D. 2.7  
 E. 3.3
38. Which of the following operations will produce the largest result when substituted for the blank in the expression  $14 \text{ --- } \left(-\frac{1}{40}\right)$ ?
- F. Plus  
 G. Minus  
 H. Divided by  
 J. Multiplied by  
 K. Averaged with
39. A local bowling league established its handicap for bowlers who have an average of 200 or less as 75% of the difference between 200 and the bowler's average score. If  $H$  represents the handicap of such a bowler and  $A$  represents his or her average score, which of the following equations gives  $H$  in terms of  $A$ ?
- A.  $H = 150 - A$   
 B.  $H = A - 150$   
 C.  $H = 200 - \frac{A}{0.75}$   
 D.  $H = 200 - 0.75A$   
 E.  $H = 0.75(200 - A)$
40. The equation  $t = -0.0066a + 15$  models the noon temperature,  $t$  degrees Celsius,  $a$  meters above sea level, on a certain day on Laurel Mountain. According to this equation, what would be the noon temperature for that certain day on Laurel Mountain at sea level?
- F.  $0^\circ\text{C}$   
 G.  $0.0066^\circ\text{C}$   
 H.  $14.9934^\circ\text{C}$   
 J.  $15^\circ\text{C}$   
 K.  $15.0066^\circ\text{C}$

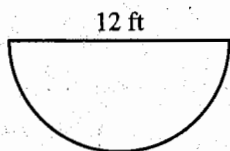
DO YOUR FIGURING HERE.



41. The semicircular top surface of Ron's patio is shown below. Which of the following values is closest to the area, in square feet, of the top surface of the patio?

DO YOUR FIGURING HERE.

- A. 18  
B. 36  
C. 54  
D. 108  
E. 186



42. Which of the following equations is that of a circle that is in the standard  $(x,y)$  coordinate plane, has center  $(1,-4)$ , and has a radius of 5 coordinate units?

- F.  $(x - 1) + (y + 4) = 5$   
G.  $(x + 1) + (y - 4) = 5$   
H.  $(x - 1)^2 + (y + 4)^2 = \sqrt{5}$   
J.  $(x - 1)^2 + (y + 4)^2 = 25$   
K.  $(x + 1)^2 + (y - 4)^2 = 25$

43. What is the smallest positive integer having exactly 5 different positive integer divisors?

- A. 5  
B. 6  
C. 12  
D. 16  
E. 18

44. If  $49^a = 7$  and  $3^{a+b} = 81$ , then  $b = ?$

- F.  $\frac{1}{2}$   
G.  $\frac{3}{2}$   
H.  $\frac{5}{2}$   
J. 3  
K.  $\frac{7}{2}$

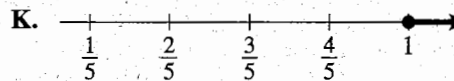
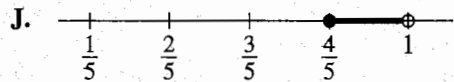
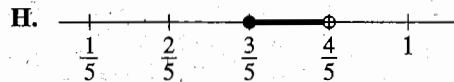
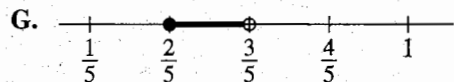
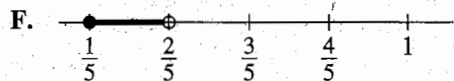
45. Florencia has 60 feet of fencing and a 4-foot-wide gate to use to enclose a dog pen. Among the following, a dog pen of which shape and dimensions will have the largest area if only the fencing and the gate are used to enclose it?

- A. A square with a side length of 16 feet  
B. A square with a side length of 17 feet  
C. A rectangle with a length of 14 feet and a width of 16 feet  
D. A rectangle with a length of 15 feet and a width of 17 feet  
E. A rectangle with a length of 15 feet and a width of 18 feet





46. The difference  $\frac{3}{5} - \frac{-1}{3}$  lies in which of the following intervals graphed on the real number line?



**DO YOUR FIGURING HERE.**

47. The recursive formula for a sequence is given below, where  $a_n$  is the value of the  $n$ th term.

$$a_1 = 10$$

$$a_n = a_{n-1} + 5$$

Which of the following equations is an explicit formula for this sequence?

- A.  $a_n = -5n + 10$   
 B.  $a_n = 5n + 5$   
 C.  $a_n = 5n + 10$   
 D.  $a_n = 10n - 5$   
 E.  $a_n = 10n + 5$
48. The probabilities that each of 2 independent events will occur are given in the table below.

Event	Probability
A	0.20
B	0.40

What is the probability that both Events A and B will occur—that is,  $P(A \text{ and } B)$ ?

- F. 0.08  
 G. 0.20  
 H. 0.30  
 J. 0.50  
 K. 0.60
49. What is the solution set of the equation  $x^4 + 21x^2 - 100 = 0$ ?
- A.  $\{-25, 4\}$   
 B.  $\{-25, -2, 2\}$   
 C.  $\{-5, -4, 5\}$   
 D.  $\{-5, 5, -2i, 2i\}$   
 E.  $\{-2, 2, -5i, 5i\}$



Use the following information to answer questions 50–52.

DO YOUR FIGURING HERE.

Skyline Tours is offering hot-air-balloon tours. The tables below give information about the balloon, the equipment, and the tours offered.

Hot-air-balloon information	
Volume of balloon	80,000 cubic feet
Maximum capacity of basket	8 people
Weight of balloon	200 pounds
Weight of basket	150 pounds
Weight of burner	50 pounds

Tour information			
Tour	Ticket price	Duration, in minutes	Maximum altitude, in feet
A	\$100	45	500
B	\$125	60	600
C	\$200	90	1,000

50. Jarrod is looking up at a hot-air balloon. The balloon is currently at the maximum altitude during Tour C. The angle of elevation from the horizon is  $37^\circ$ , as shown in the figure below. Which of the following expressions is closest to the distance,  $d$  feet, from Jarrod to the basket?

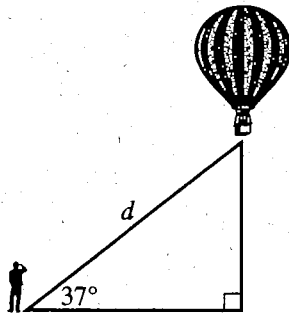
F.  $\frac{1,000}{\sin 37^\circ}$

G.  $\frac{1,000}{\cos 37^\circ}$

H.  $1,000 \sin 37^\circ$

J.  $1,000 \cos 37^\circ$

K.  $1,000 \tan 37^\circ$



51. Skyline Tours made \$5,000 in 1 day by selling a total of 30 tickets for Tours A, B, and C. They sold twice as many tickets for Tour B as for Tour A. How many tickets were sold for Tour C?

- A. 4  
 B. 8  
 C. 12  
 D. 16  
 E. 18



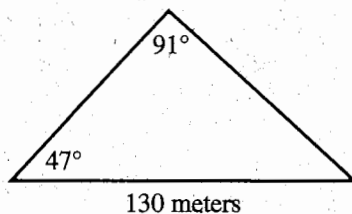
52. Jarrod went on Tour A, and his trip covered a distance of 6 miles. Bhumi went on Tour C, and her trip covered a distance of 9 miles. Which of the following values is the difference, in miles per hour, of the average speeds of their balloons during their tours?

F. 0  
G. 2  
H. 3  
J. 8  
K. 9

DO YOUR FIGURING HERE.

53. A forest fire is contained within a triangular region, which is shown below. The supervising firefighter plans to fight the fire by positioning a firefighter about every 4 meters along the perimeter of the triangle. Among the following, which expression best estimates the planned number of firefighters along the perimeter?

(Note: The law of sines states that in every triangle, the 3 ratios of length of a side to the sine of the angle opposite that side are equal.)



A.  $\frac{130 + \left(\frac{130 \sin 42^\circ}{\sin 91^\circ}\right) + \left(\frac{130 \sin 47^\circ}{\sin 91^\circ}\right)}{4}$

B.  $\frac{130 + \left(\frac{130 \sin 91^\circ}{\sin 42^\circ}\right) + \left(\frac{130 \sin 91^\circ}{\sin 47^\circ}\right)}{4}$

C.  $130 + \frac{130 \sin 42^\circ}{\sin 91^\circ} + \frac{130 \sin 47^\circ}{\sin 91^\circ}$

D.  $\frac{\frac{1}{2} \left(\frac{130 \sin 47^\circ}{\sin 91^\circ}\right)}{4}$

E.  $\frac{\frac{1}{2}(130)}{4}$

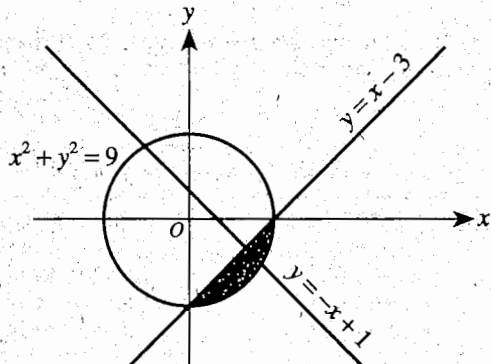
54. How many integers between, but not including, 20 and 30 have a prime factorization with exactly 3 factors that are NOT necessarily unique?

(Note: 1 is NOT a prime number.)

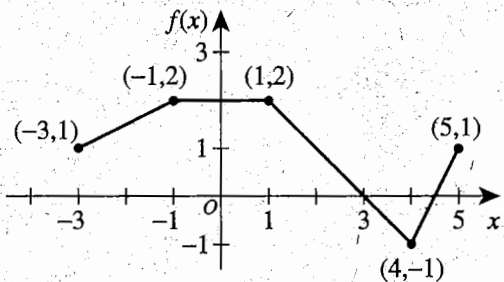
F. 1  
G. 2  
H. 3  
J. 4  
K. 5



55. The graphs of  $y = -x + 1$ ,  $y = x - 3$ , and  $x^2 + y^2 = 9$  are shown in the standard  $(x, y)$  coordinate plane below. The shaded region is the solution set to one of the following systems of inequalities. Which system is it?



- A.  $y \leq x - 3$   
 $x^2 + y^2 \leq 9$
- B.  $y \leq x - 3$   
 $x^2 + y^2 \geq 9$
- C.  $y \leq -x + 1$   
 $x^2 + y^2 \leq 9$
- D.  $y \geq x - 3$   
 $x^2 + y^2 \leq 9$
- E.  $y \geq -x + 1$   
 $x^2 + y^2 \geq 9$
56. The function  $f(x)$  is shown below with several points labeled. Another function,  $g(x)$ , is defined such that  $g(x) = -[f(x) - 3]$ . What is  $g(4)$ ?

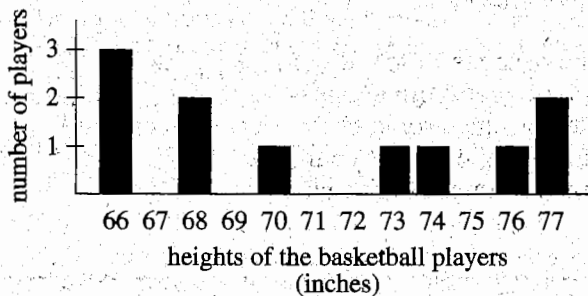


- F. -4
- G. -1
- H. 1
- J. 4
- K. 7
57. The ratio of  $a$  to  $b$  is 6 to 1, and the ratio of  $b$  to  $c$  is 12 to 1. What is the value of  $\frac{2a+3b}{4b+3c}$ ?
- A.  $\frac{3}{8}$
- B.  $\frac{5}{17}$
- C.  $\frac{16}{17}$
- D.  $\frac{60}{17}$
- E.  $\frac{48}{7}$



58. The frequency histogram below shows the distribution of the heights, in inches, of 11 basketball players.

DO YOUR FIGURING HERE.



- Using the data from the frequency histogram, what is the sum of the mean and the median of this distribution?
- F. 141  
G. 142  
H. 143  
J. 144  
K. 145
59. In the standard  $(x,y)$  coordinate plane, what is the  $y$ -intercept of the graph of the function  $y = f(x)$  defined below?

$$f(x) = \begin{cases} x^2 - 1 & \text{for } x < -3 \\ 2x - 5 & \text{for } -3 \leq x \leq 2 \\ |x - 3| & \text{for } x > 2 \end{cases}$$

- A. -5  
B. -3  
C. -1  
D. 2.5  
E. 3
60. What is the matrix product  $\begin{bmatrix} 2 & 4 \\ 6 & 5 \end{bmatrix} \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ ?

- F.  $\begin{bmatrix} 2a & 4b \\ 6c & 5d \end{bmatrix}$   
G.  $\begin{bmatrix} 2a + 4b \\ 6c + 5d \end{bmatrix}$   
H.  $[(2a + 6c)(4b + 5d)]$   
J.  $\begin{bmatrix} (2a + 6b)(4a + 5b) \\ (2c + 6d)(4c + 5d) \end{bmatrix}$   
K.  $\begin{bmatrix} (2a + 4c)(2b + 4d) \\ (6a + 5c)(6b + 5d) \end{bmatrix}$

END OF TEST 2

STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.

DO NOT RETURN TO THE PREVIOUS TEST.

## READING TEST

35 Minutes—40 Questions

**DIRECTIONS:** There are several passages in this test. Each passage is accompanied by several questions. After reading a passage, choose the best answer to each question and fill in the corresponding oval on your answer document. You may refer to the passages as often as necessary.

## Passage I

**LITERARY NARRATIVE:** This passage is adapted from the novel *Bitter Grounds* by Sandra Benítez (©1997 by Sandra Benítez).

Alvaro Tobar gripped the wheel of his convertible and leaned into the approaching curve. He loved the sense of power he experienced when he was in the driver's seat. He'd owned the car since before the war, and maybe now that the war had ended, he would buy a newer model. This convertible he would not sell, however. He patted the wheel as if reassuring the vehicle of his loyalty.

It was a late afternoon in early November. The air was heavy with coming rain, surely one of the last downpours before the dry season. Alvaro would wait for the first drops to fall before he stopped to raise the car's top. He was only a few kilometers from San Salvador and, once inside the city limits, only minutes from home.

Alvaro's thoughts turned to his cotton harvest. For the past week, he'd been on the eastern coast, at his plantation outside Usulután. On this trip, he had helped ready the hacienda for the harvest, which would start at month's end. Much was riding on his cotton. He always referred to it as "mi algodón." My cotton, a venture that he, and not his mother, controlled. He pictured his mother's strong, handsome face. Eugenia Herrera de Tobar. At seventy-three, doña Eugenia was still the undisputed ruler of the Tobar family. As the doyenne, she controlled her business and private affairs with as much vigor as she had since her husband's death. Because she had Alvaro and his four older sisters to raise, she took over the reins of her husband's cattle-ranching operation and his vast property holdings and never relinquished them. Under her control, her husband's enterprises prospered. Oh, there were moments when she cried out against the fate that had sent her down a path strewn with so much responsibility, "It's a heavy burden life has handed me," she liked to say. "A burden I long to have lifted from my shoulders." Even as a youngster, however, when Alvaro heard his mother's lamentations, he had glimpsed into her heart as if her chest were made of glass. In her heart, he had seen the pleasure the burden gave her.

It was power that obsessed her. And could he blame her? He had had a whiff of the heady scent of

power himself. He smelled it in his cotton. He'd been in the business for four years. The first three years were hopeful ones. There was a world war, and unlike coffee, cotton prices rose steadily, thanks to the growth of the local textile industry.

From the start, his mother had not encouraged him to strike out on his own. "Only fools go into cotton when there's cattle to be raised or coffee to be grown," she said, compelling him to work all the harder to prove her wrong. He had spent months scouting for the right land among the family's properties on the flat coastal plain. When he found it, he had lovingly sown the best seed himself. And he had kept a vigil on the growing plants. Lying in a hut next to the field, he was present at the moment the buds broke into flower.

Once Alvaro reached Avenida Cuscatlán, he accelerated, weaving in and out of traffic. Cotton. A man took a risk growing it, for cotton might never make the money coffee would, but Alvaro did not allow this thought to perturb him. He had various means of making a living: There was real estate to be bought and sold, a seat on the bank board, the shrimping business on the coast. He had disbanded his law practice years ago, although, at times, he took a case or two on a consulting basis. But it was in the cotton business that he'd placed his heart and money. Last year, so sure was he of a better-than-ever yield, that he'd invested his wife's money in it as well. It was the inheritance from her grandfather, bequeathed to her twelve years before. Magda had entrusted it to Alvaro, and he had carefully managed the money, seeing to its growth. When the time was right, she would use her inheritance for her own business scheme: a gift shop named Tesoros.

The disaster of last year's harvest flooded his mind. He sank back against the seat, remembering his cotton, the bolls swollen and soon to burst into a cloud of white, infested malevolently with weevils.

But this year would be different. He had taken measures. He had spent the better part of the week stockpiling insecticides that would insure this crop against failure. He had not told Magda any of this, of course. Why cause her concern? It was all a matter of cash flow, of money transferred from one account to the other, of bank loans and promissory notes. This year, because of insecticides, would bring his first bumper crop.

1. Which of the following topics preoccupies Alvaro during his drive?
  - A. The way he has handled doña Eugenia's inheritance
  - B. The falling price of the crop he had hoped would bring him financial security
  - C. The damage he has done to his reputation by making thoughtless career changes over the years
  - D. The personal and practical elements that factor into his efforts to succeed in business
2. Which of the following descriptions best fits Alvaro's approach to growing cotton as it is described in the passage?
  - F. Extremely arrogant; he feels entitled to success without working hard to achieve it.
  - G. Deeply involved; there is little he won't do to succeed.
  - H. Detached; he thinks the pursuit of wealth is better left to those who care about it.
  - J. Naïve; he has ignored the advice of those with years of experience growing the crop.
3. How does Alvaro's opinion of coffee and cotton compare to that of his mother's?
  - A. Alvaro thinks that cotton is the superior crop, but his mother thinks coffee is an equally lucrative crop.
  - B. Alvaro thinks that cotton is the better wartime crop, but his mother thinks coffee is.
  - C. Alvaro thinks that both crops are susceptible to insect infestation, but his mother thinks that neither is.
  - D. Alvaro thinks that cotton holds the more promising future for him, but his mother thinks coffee does.
4. How does Alvaro view the burden of responsibility his mother says she wants lifted from her shoulders?
  - F. As the barrier between Alvaro and his success at growing cotton
  - G. As the sorrow that mars the otherwise happy life of his mother
  - H. As an enduring presence that his mother works to her advantage
  - J. As a heavy weight that lifted from Alvaro's shoulders when he defied his mother
5. Which of the following phrases most accurately describes the last paragraph?
  - A. Wishful thinking supported by more wishful thinking
  - B. Painful realizations followed by widespread blaming
  - C. A sentiment and the experiences that reverse it
  - D. A stand taken by one person and supported by another
6. According to the passage, where is Alvaro headed in his car on a late afternoon in early November?
  - F. His plantation outside Usulután
  - G. His law office
  - H. His mother's hacienda
  - J. His home in San Salvador
7. Which of the following actions is presented in the passage as being more figurative than literal?
  - A. "Gripped the wheel" (line 1)
  - B. "Took over the reins" (line 29)
  - C. "Heard his mother's lamentations" (lines 37-38)
  - D. "Sown the best seed" (lines 54-55)
8. The quality of glass that is most strongly alluded to in lines 36-40 is:
  - F. fragility.
  - G. transparency.
  - H. smoothness.
  - J. sharp edges.
9. To what does Alvaro most directly attribute the rise of cotton prices?
  - A. The end of a world war
  - B. The effectiveness of new pesticides
  - C. The growth of the local textile industry
  - D. The failure of the previous year's harvest
10. In the context of the passage, the primary function of lines 63-67 is to list the occupations that Alvaro:
  - F. dabbled in but found less compelling than cotton farming.
  - G. held in high regard though his mother did not.
  - H. had rejected as representing the foolish notions of his youth.
  - J. envisioned as being within his reach were he to succeed in farming cotton.

## Passage II

**SOCIAL SCIENCE:** This passage is adapted from *The Tipping Point: How Little Things Can Make a Big Difference* by Malcolm Gladwell (©2002 by Malcolm Gladwell).

There is a concept in cognitive psychology called the channel capacity, which refers to the amount of space in our brain for certain kinds of information. Suppose, for example, that I played you a number of different musical tones, at random, and asked you to identify each one with a number. If I played you a really low tone, you would call it one, and if I played you a medium tone you would call it two, and a high tone you would call three. The purpose of the test is to find out how long you can continue to distinguish among different tones. Most people can divide tones into only about six different categories before they begin to make mistakes and start lumping different tones in the same category. This is a remarkably consistent finding. If, for example, I played you five very high pitched tones, you'd be able to tell them apart. And if I played you five very low pitched tones, you'd be able to tell them apart. You'd think, then, that if I combined those high and low tones and played them for you all at once, you'd be able to divide them into ten categories. But you won't be able to. Chances are you'll still be stuck at about six categories.

As human beings, we can only handle so much information at once. Once we pass a certain boundary, we become overwhelmed. What I'm describing here is an intellectual capacity—our ability to process raw information. But if you think about it, we clearly have a channel capacity for feelings as well.

Take a minute, for example, to make a list of all the people whom you would consider yourself truly close to. The average answer is 12 names. Those names make up what psychologists call our sympathy group. Why aren't groups any larger? Partly it's a question of time. If you look at the names on your sympathy list, they are probably the people whom you devote the most attention to. If your list was twice as long, would you still be as close to everyone? Probably not. To be someone's friend requires a minimum investment of time. More than that, though, it takes emotional energy. At a certain point, at somewhere between 10 and 15 people, we begin to overload, just as we begin to overload when we have to distinguish between too many tones.

Perhaps the most interesting natural limit, however, is what might be called our social channel capacity. The case for a social capacity has been made, most persuasively, by the British anthropologist Robin Dunbar. Dunbar begins with a simple observation. Primates—monkeys, chimps, baboons, humans—have the biggest brains of all mammals. More important, a specific part of the brain of humans and other primates—the region known as the neocortex, which deals with complex thought and reasoning—is huge by mammal standards. For years, scientists have argued back and forth about why this is the case. One theory is that our

brains evolved because our primate ancestors began to engage in more sophisticated food gathering: instead of just eating grasses and leaves they began eating fruit, which takes more thinking power. You travel much farther to find fruit than leaves, so you need to be able to create mental maps. You have to worry about ripeness. You have to peel parts away in order to eat the flesh of a fruit, and so on. The problem with that theory is that if you try to match up brain size with eating patterns among primates, it doesn't work. So what does correlate with brain size? The answer, Dunbar argues, is group size. If you look at any species of primate—at every variety of monkey and ape—the larger their neocortex is, the larger the average size of the groups they live with.

Dunbar's argument is that brains evolve, they get bigger, in order to handle the complexities of larger social groups. If you belong to a group of five people, Dunbar points out, you have to keep track of ten separate relationships: your relationships with the four others in your circle and the six other two-way relationships between the others. That's what it means to know everyone in the circle. You have to understand the personal dynamics of the group. If you belong to a group of twenty people, however, there are now 190 two-way relationships to keep track of: 19 involving yourself and 171 involving the rest of the group. Even a relatively small increase in the size of a group creates a significant additional social and intellectual burden. Humans socialize in the largest groups of all primates because we are the only animals with brains large enough to handle the complexities of that social arrangement.

11. Which of the following statements best describes the organizational structure of the passage?
- A. The author describes a psychological concept and then explores aspects of that concept that support a central claim.
  - B. The author presents theories about a psychological concept by describing his own experiences with it.
  - C. The author provides a chronology of the development of a psychological concept.
  - D. The author presents a problem from the field of psychology and then offers several possible solutions to that problem.
12. Based on the passage, which of the following statements best captures the central idea behind the concept of channel capacity?
- F. "There is a concept in cognitive psychology called the channel capacity" (lines 1–2).
  - G. "This is a remarkably consistent finding" (line 14).
  - H. "As human beings, we can only handle so much information at once" (lines 23–24).
  - J. "But if you think about it, we clearly have a channel capacity for feelings as well" (lines 27–28).



13. According to the passage, which of the following is a theory about the evolution of brain size in primates that is supported by some scientists but NOT by Dunbar?
- A. Primates' brains increased in size only slightly as primates evolved.
  - B. Primates' brains became larger as primates' social groups became larger.
  - C. Primates' brains became larger because primates changed their eating habits.
  - D. Primates' brains evolved relatively slowly in comparison to the rest of their bodies.
14. The main idea of the last paragraph is that:
- F. as brains evolve, they decrease in size.
  - G. Dunbar has gone to great lengths to try to prove his argument.
  - H. the neocortex is the part of the brain responsible for tracking social relationships.
  - J. humans have the largest brains of all primates because humans socialize in the largest groups.
15. The passage defines a sympathy group most specifically as:
- A. a small group of animals of the same species.
  - B. any cluster of primates that live together.
  - C. the people one feels truly close to.
  - D. a person's immediate family.
16. Which of the following statements best describes how the author views Dunbar's theory of social channel capacity?
- F. He is intrigued by Dunbar's theory and finds Dunbar's argument compelling.
  - G. He believes Dunbar's argument is problematic but cannot disprove the theory.
  - H. He is unsure that Dunbar's theory will ever be accepted by the larger scientific community.
  - J. He believes Dunbar's argument is indisputable and that the supporting research is exhaustive.
17. Based on the passage, the assertion that primates have the largest brains of all mammals is presented as:
- A. a fact that serves as the author's main point in the passage.
  - B. a fact that serves as the basis for Dunbar's argument.
  - C. an opinion the author offers to explain Dunbar's theory.
  - D. an opinion Dunbar is trying to prove with his theory.
18. As it is used in line 56, the word *sophisticated* most nearly means:
- F. worldly.
  - G. complex.
  - H. cultured.
  - J. genteel.
19. According to the passage, one reason some scientists believe an animal uses more brainpower to eat fruits than it does to eat leaves is because fruits:
- A. are smaller than leaves and require practice to eat.
  - B. cannot be eaten by all animals, unlike leaves.
  - C. offer more nutrition than most leaves.
  - D. are not as easily accessible as leaves.
20. Based on the passage, which of the following statements, if true, would most WEAKEN Dunbar's theory?
- F. Some primates with relatively small neocortexes socialize in larger groups than humans.
  - G. The human brain is continuing to evolve as social networking expands.
  - H. Except for humans, apes have the largest brains among primates.
  - J. Mountain gorillas live in groups that average nine individuals.

## Passage III

**HUMANITIES:** Passage A is adapted from the essay "On Miniatures" by Lia Purpura (©2006 by Lia Purpura). Passage B is adapted from the article "When the Virtual Trumps Reality: The Prayer Book of Claude de France" by James Gardner (©2008 by TWO SL LLC).

## Passage A by Lia Purpura

Why are miniature things so compelling?

The miniature is mysterious. We wonder how all those parts work when they're so small. It's why we linger over an infant's fingers and toes, those astonishing replicas: we can't quite *believe* they work. Chihuahuas work. Birds and bonsai trees work. Miniatures are improbable, unlikely. Causes to marvel. Surprises. Feats of engineering. Products of an obsessive detailer.

Miniatures offer changes of scale by which we measure ourselves anew. On one hand, miniatures posit an omniscient onlooker, able to take in the whole at once. Consider your *self* in relation to dollhouses, snowglobes, frog spawn, aquariums, souvenir keychains you look through to see a picture of the very spot you're visiting, stilled. You are large enough to hold such things fully in hand. On the other hand, miniatures issue invitations to their realm, and suggest we forget or disregard our size. In dollhouse land, you can walk through the kitchen, livingroom, bedroom with your three inch high friend and, face pressed to the window, feel the cushions of the thumbnail loveseat hold you. Fit inside the miniature, we experience certain states of being or belief: worlds in a grain of sand; eternities in wildflowers. Regions beyond our normal-sized perception. Whether we are, in relation to them, omniscient or companionably small beings, miniatures invite us to leave our known selves and perspectives behind.

Miniatures encourage attention—in the way whispering requires a listener to quiet down and incline toward the speaker. Sometimes we need binoculars, microscopes, viewmasters to assist our looking, but mediated or not, miniatures suggest there is more there than meets the eye easily. They suggest there is much to miss if we don't look hard at spaces, crevices, crannies.

The miniature, a working, functioning complete world unto itself, is not merely a "small" or "brief" thing or a "shortened" form of something larger. Miniatures transcend their size. Most strangely to me, miniatures are radically self-sufficient. The beings who inhabit fairylands, those elves and sprites, pixies and trolls, don't usually strive to be our pals. They don't need us. Their smallness is our problem, or intrigue, or desire.

## Passage B by James Gardner

Without meaning to do so, the Morgan Library has created a triumph of conceptual art: the smallest art exhibition in the world. "The Prayer Book of Claude de

France," as the exhibition is called, consists of nothing other than "The Prayer Book of Claude de France." At 2 3/4 by 2 inches, the exhibition and the book are both so small that they can fit in the palm of your hand. That may not sound like much until you realize that this illuminated miniature contains 132 scenes from the lives of Christ, the Virgin, the apostles, and sundry saints. As such, it is a gallery unto itself.

In "The Work of Art in the Age of Mechanical Reproduction," Walter Benjamin's overrated essay of 1936, the author famously asserted that no one would feel the need to stand before the original when one could own a reproduction. The folly of this idea will be self-evident to anyone with the remotest sensitivity to visual art. No matter how good a reproduction, you have to bear physical witness to each pucker and weave of canvas, each splash of puddled ink in an Old Master drawing. Only then can you truly say that you have seen the work of art.

It was with such convictions that I rushed over to the Morgan to see the tiny commodity in question. What a waste of time! Not because the object is lacking in worthiness, but because the Morgan's own Web site offers a means of examining the book that, in this case, far surpasses any direct encounter. Every page of the manuscript is there in living color, and the zoom mechanism is so powerful and so precise that you can get in closer than if you were hunched over the real thing with a strong magnifying glass. Zoom in to one of the figures, scarcely the size of a fingernail, and you see the tiny head in perfect focus. Zooming in deeper, you see the beard on the head, then the hairs on the beard, then the point at which the whole thing dissolves into abstract art, as the strokes of the artist's single-hair brush merge with the warped and mottled surface of the vellum.

The miniature in question was commissioned for Queen Claude of France. Nearly three generations after the invention of printing, there was no practical reason to commission this work. Rather, it was the delight in luxury itself, as well, perhaps, as the spirit of sacrifice that brought this work into existence.

Questions 21–23 ask about Passage A.

21. The organization of Passage A is best described as a list of:
- innovations in miniature art followed by an explanation of techniques for creating miniatures.
  - misconceptions about miniature art followed by a personal account of working with miniatures.
  - qualities miniature things share, including descriptive examples that illustrate these qualities.
  - reasons artists create miniature things, including testimonies from major artists.

22. The example of “dollhouse land” (lines 18–22) primarily serves to illustrate the author’s point that miniatures can encourage people to:

- F. live life at a slower pace.
- G. disregard their own size.
- H. remember important places.
- J. look hard at hidden crevices.

23. As it is used in line 33, the word *mediated* most nearly means:

- A. considered.
- B. advised.
- C. solved.
- D. aided.

Questions 24–27 ask about Passage B.

24. The author of Passage B most likely summarizes the assertions of the essayist Benjamin in order to:

- F. explain the principle the Morgan Library used when deciding whether to show the original prayer book or a reproduction.
- G. present a major argument in the art field that the passage author rejected when deciding to view the prayer book in person.
- H. support the passage author’s assertion that the prayer book is a gallery unto itself.
- J. offer a second reviewer’s opinion of the prayer book.

25. According to Passage B, were the author’s expectations about seeing the prayer book in person ultimately met?

- A. Yes, because he was able to view the detail of the book down to its brushstrokes.
- B. Yes, because he was able to learn about the book’s history while at the exhibit.
- C. No, because he was able to view the book in greater detail using the library’s website.
- D. No, because he found the artwork in the book to be of poor quality.

26. The author of Passage B indicates that the figures in the prayer book are approximately the size of:

- F. a fingernail.
- G. a pucker of canvas.
- H. the palm of a hand.
- J. a single hair.

27. The author of Passage B speculates that one reason the prayer book was commissioned was to allow its owners to:

- A. enjoy the extravagance of possessing an elaborate work of art.
- B. avoid the unpredictability of early printing methods.
- C. help the book’s artist create miniatures for a living.
- D. instill a love of reading in Queen Claude.

Questions 28–30 ask about both passages.

28. Compared to the writing style of Passage B, the writing style of Passage A is more:

- F. indignant and argumentative.
- G. contemplative and whimsical.
- H. flippant and sarcastic.
- J. literal and scientific.

29. Which of the following statements best captures a main difference in the focus of the two passages?

- A. Passage A focuses on the appeal of miniatures in general, while Passage B focuses on the experience of viewing a single miniature object.
- B. Passage A focuses on the author’s memories of miniatures from her childhood, while Passage B focuses on a famous collection of miniatures.
- C. Passage A focuses on the historical significance of miniatures, while Passage B focuses on how miniatures influence contemporary art.
- D. Passage A focuses on miniatures as an art form, while Passage B focuses on the practical uses of miniatures.

30. Based on the passages, both authors would most likely agree that an important factor contributing to the artistic value of a miniature is the artist’s ability to:

- F. create working replicas of larger, real objects.
- G. master the use of unusual and costly materials.
- H. conceal abstract art within more realistic images.
- J. render objects and images with painstaking detail.

## Passage IV

**NATURAL SCIENCE:** This passage is adapted from the article "Back to the Future" by J. Madeleine Nash (©2008 by J. Madeleine Nash).

The Sand Creek Divide is a high point in Wyoming's Big Horn Basin. From it you can see the emerald patchwork of irrigated sugar beet and malt barley fields that hug the Big Horn River as well as the jagged mountain ranges that define the edges of this harsh mid-latitude desert.

But between 55 and 56 million years ago, says Scott Wing, a paleo-botanist at the Smithsonian's Museum of Natural History, the Big Horn Basin was a balmy, swampy Eden, teeming with flora and fauna that would be at home in today's coastal Carolinas. And then, all of a sudden, things got a whole lot warmer. In a geological eye blink—less than 10,000 years, some think—global mean temperatures shot up by around 10 degrees Fahrenheit.

The Big Red, a sinuous ribbon of rose-colored rock, is the most vivid marker of this exceptionally torrid time—the Paleocene-Eocene Thermal Maximum, or PETM, as most paleontologists call it. Even before it had a name, the PETM was starting to fascinate Wing. For some time, it had been clear to paleontologists studying the evolution of mammals that the transition between the Paleocene and the Eocene was marked by the kind of innovative burst that implies sweeping ecological change. Yet no hint of such a change had appeared in any of the fossil leaves Wing had collected. He would stare at leaves from the Paleocene and leaves from the Eocene, but see almost no difference between them. "It was getting to be annoying," he recalls.

The Paleocene is the geological epoch that started 65 million years ago. At the time, mammals were rather simple, general-purpose creatures with few specializations. Then, barely 10 million years later, at the dawn of the Eocene, the first relatives of deer abruptly appear, along with the first primates and first horses.

"You can literally draw a line in the rock," says Philip Gingerich, a vertebrate paleontologist at the University of Michigan. "Above it there are horses; below it there aren't." In fact, where Gingerich works—at Polecat Bench, in the northern sector of the Big Horn Basin—you can actually see the line, in the form of a band of light gray sandstone. Oddly enough, many fossil mammals commonly found above this line, including those first horses, were abnormally small. Typically, Gingerich says, Eocene horses grew to the size of modern-day cocker spaniels, but these horses were "about the size of Siamese cats."

In 1991, as Gingerich and others were marveling over the miniature mammals of Polecat Bench, oceanographers James Kennett and Lowell Stott investigated a major extinction of small, shelly creatures that, during the late Paleocene, lived on the sea floor

off the coast of Antarctica. This massive die-off, they found, coincided with a steep rise in deep-ocean temperatures and a curious spike in atmospheric carbon.

Less than a year later, paleontologist Paul Koch and paleo-oceanographer James Zachos teamed up with Gingerich to show that this geochemical glitch had also left its calling card on land. The trio established this indirectly by measuring the carbon content of fossilized teeth and nodules plucked from the Big Horn Basin's 55.5-million-year-old rocks.

To Wing, it began to seem increasingly implausible that plant communities could have segued through the PETM unaffected. So in 1994, he started a methodical search for the fossils, returning year after year to the Big Horn Basin.

At first, he found just a smattering of leaves, too few to suggest any pattern. Then, in 2005, at the end of a long day, he slid his shovel into a grayish mound and pulled out a tiny leaf. "I knew immediately that this was totally different from anything I'd seen before."

From that one site, Wing went on to extract more than 2,000 leaf fossils representing 30 different species. Missing from the mix are the cypresses and other conifers that were so common during the Paleocene; gone also are the distant cousins of broadleaf temperate zone trees. In their place are the legumes, a family of plants, shrubs and trees that thrive today in seasonally dry tropical and subtropical areas.

"What you see is almost a complete changeover from what was growing here before," Wing marvels. "What this means is that you could have stood in this one spot in Wyoming, surrounded by a forest, and everything would have looked pretty much the same for millions of years. And then, over a few tens of thousands of years, almost all the plants you're familiar with disappear and are replaced by plants you've never seen before in your life."

31. Within the passage, the discussion of Wing's scientific research primarily functions as:

- A. an example of a study that resulted in the discovery of the Big Red.
- B. an illustration of the methods used to date geological epochs.
- C. a counterargument to current assumptions about the PETM.
- D. a framework for exploring the PETM and various investigations of it.

32. As summarized in the passage, Wing's research focuses primarily on:
- F. comparing fossilized plant life from the Paleocene and the Eocene.
  - G. measuring the carbon content of fossilized teeth from the time of the PETM.
  - H. determining the rock and mineral content of the Big Red.
  - J. analyzing the mammal fossils found throughout the Big Horn Basin.
33. The last three paragraphs (lines 68–89) support which of the following conclusions about Wing and his research?
- A. He has yet to find concrete support for his hypothesis.
  - B. He has serious reservations about his hypothesis based on the evidence he has found.
  - C. He has discovered evidence that supports his hypothesis.
  - D. He is relying on the findings of other researchers who study ancient plants in order to support his hypothesis.
34. Based on the passage, which of the following features of the Big Horn Basin serves as the best evidence that the transition between the Paleocene and the Eocene was, geologically speaking, abrupt?
- F. The abundance of fossilized sea creatures
  - G. The abundance of fossilized Eocene leaves
  - H. The jagged mountain ranges surrounding the area
  - J. The band of light gray sandstone at Polecat Bench
35. Which of the following events referred to in the passage occurred last chronologically?
- A. Miniature fossils were found at Polecat Bench.
  - B. Wing began his methodical search for fossils in the Big Horn Basin.
  - C. Kennett and Stott investigated a major extinction of small, shelly creatures.
  - D. Koch, Zachos, and Gingerich measured the carbon content of fossilized teeth and nodules.
36. The passage specifically mentions which of the following types of leaf fossils as a type that was found by Wing?
- F. Legume
  - G. Conifer
  - H. Cypress
  - J. Broadleaf
37. The passage indicates that which of the following is true of the first relatives of deer?
- A. They had few specializations.
  - B. They were a precursor to the first horses.
  - C. They are present in the Paleocene fossil record.
  - D. They appeared during the early Eocene.
38. According to the passage, which of the following scientists focused his research on an area outside of the Big Horn Basin?
- F. Wing
  - G. Kennett
  - H. Gingerich
  - J. Zachos
39. As it is used in line 58, the phrase *geochemical glitch* most nearly refers to the:
- A. low carbon levels found in 55.5-million-year-old Big Horn Basin rocks.
  - B. spike in atmospheric carbon that occurred during the late Paleocene.
  - C. steep rise in deep-ocean carbon levels that occurred during the late Paleocene.
  - D. low carbon levels found in fossilized plants.
40. The primary function of the eighth paragraph (lines 63–67) is to:
- F. introduce Wing's theories about the Polecat Bench mammal fossils.
  - G. summarize the passage's preceding discussion of the PETM.
  - H. shift the passage's focus back to Wing and his study of fossilized plants.
  - J. cast doubt on the previously discussed findings of Koch, Zachos, and Gingerich.

END OF TEST 3

STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.

DO NOT RETURN TO A PREVIOUS TEST.

## SCIENCE TEST

35 Minutes—40 Questions

**DIRECTIONS:** There are several passages in this test. Each passage is followed by several questions. After reading a passage, choose the best answer to each question and fill in the corresponding oval on your answer document. You may refer to the passages as often as necessary.

You are NOT permitted to use a calculator on this test.

## Passage I

As an apple ripens, it undergoes changes in its *firmness* (the maximum force that can be applied to the apple without puncturing its skin) and in its production of *volatile* (readily vaporized) compounds. A study examined how the storage time at 1°C affected the firmness and the *volatile abundance* (the concentration of volatile compounds produced) of 4 different varieties of apples. Table 1 shows how the average firmness of each variety changed over time at 1°C. Table 2 shows how the average volatile abundance of each variety changed over time at 1°C. (Note: All the apples were of identical maturity at 0 days.)

Tables adapted from Jinhe Bai et al., "Response of Four Apple Cultivars to 1-Methylcyclopropene Treatment and Controlled Atmosphere Storage." ©2005 by the American Society for Horticultural Science.

Variety of apple	Average firmness (in N*) of apples stored at 1°C for:			
	0 days	60 days	120 days	180 days
Fuji	73	70	58	56
Gala	76	59	51	46
Granny Smith	72	63	49	45
Red Delicious	78	62	52	50

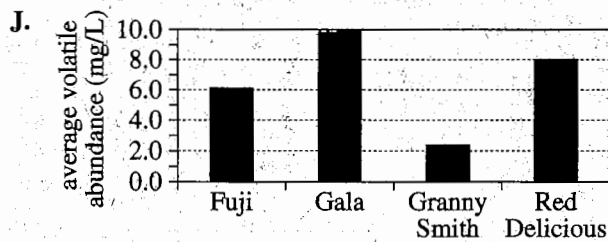
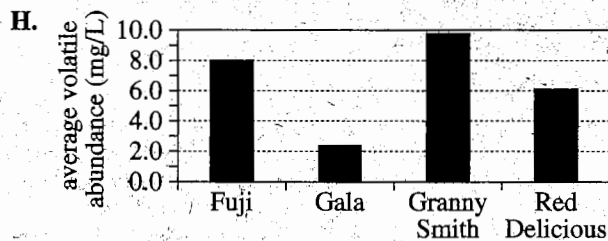
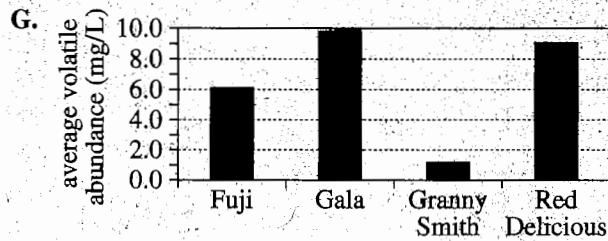
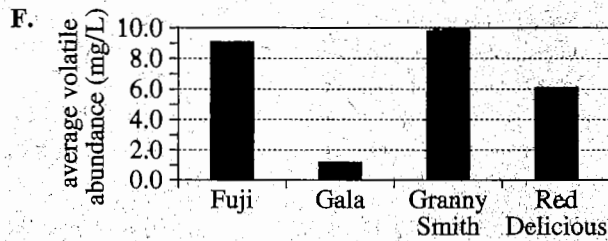
\*newtons

Variety of apple	Average volatile abundance (in mg/L*) of apples stored at 1°C for:			
	0 days	60 days	120 days	180 days
Fuji	4.4	6.1	8.2	9.3
Gala	5.5	9.8	7.7	4.0
Granny Smith	1.0	1.2	2.4	3.3
Red Delicious	2.7	9.1	8.8	8.6

\*milligrams of volatile compounds per liter of air at 1 atmosphere of pressure

- Suppose that a grocery store wants to purchase a variety of apple that will retain as much of its initial firmness as possible when stored at 1°C for 6 months. Based on Table 1, which of the 4 varieties tested would best meet the store's selection criterion?
  - Fuji
  - Gala
  - Granny Smith
  - Red Delicious
- According to Table 2, in the study, was the initial average volatile abundance of the Red Delicious apples greater than 2.0 mg/L, less than 2.0 mg/L, or equal to 2.0 mg/L?
  - Greater
  - Less
  - Equal
  - Cannot be determined from the given information
- A student predicted that as the duration of storage at 1°C increased from 0 days through 180 days, the average concentration of volatile compounds produced by the apples would always increase. According to Table 2, this prediction was consistent with the data for which of the 4 varieties of apples?
  - Granny Smith only
  - Red Delicious only
  - Fuji and Granny Smith only
  - Fuji, Gala, Granny Smith, and Red Delicious

4. Based on Table 2, which of the following graphs best shows the average volatile abundances of the 4 varieties of apples at a storage time of 60 days?



5. Based on Table 1, which of the 4 varieties of apples showed the greatest change in average firmness between 60 days of storage and 120 days of storage?

- A. Fuji  
B. Gala  
C. Granny Smith  
D. Red Delicious

6. Consider the statement "Among the 4 varieties of apples tested, the variety that initially had the least average firmness was also the variety that had the greatest average volatile abundance at a storage time of 180 days." Do the data in Tables 1 and 2 support this statement?

- F. Yes; that variety was Fuji.  
G. Yes; that variety was Granny Smith.  
H. No; on average, the Fuji apples initially had the least firmness, but the Granny Smith apples had the greatest volatile abundance at 180 days.  
J. No; on average, the Granny Smith apples initially had the least firmness, but the Fuji apples had the greatest volatile abundance at 180 days.

Passage II

Mass movement is the movement of soil or rock down a slope. Two types of mass movement are soil creep and block glide (see Figure 1).

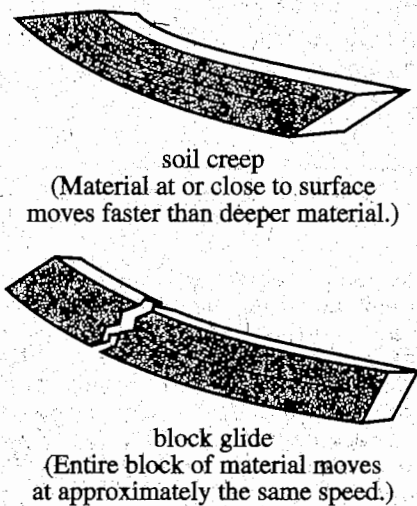


Figure 1

Scientists studied soil creep at 3 sites (Sites 1–3) and block glide at 3 other sites (Sites 4–6) in a particular region. Beginning on March 1, 1995, and every 6 months thereafter until September 1, 1998, the scientists measured the cumulative distance that material at the surface had moved since September 1, 1994. Figures 2 and 3 show the results for Sites 1–3 and for Sites 4–6, respectively. Each figure also shows the amount of precipitation that fell at each of the 3 sites over each 6-month period.

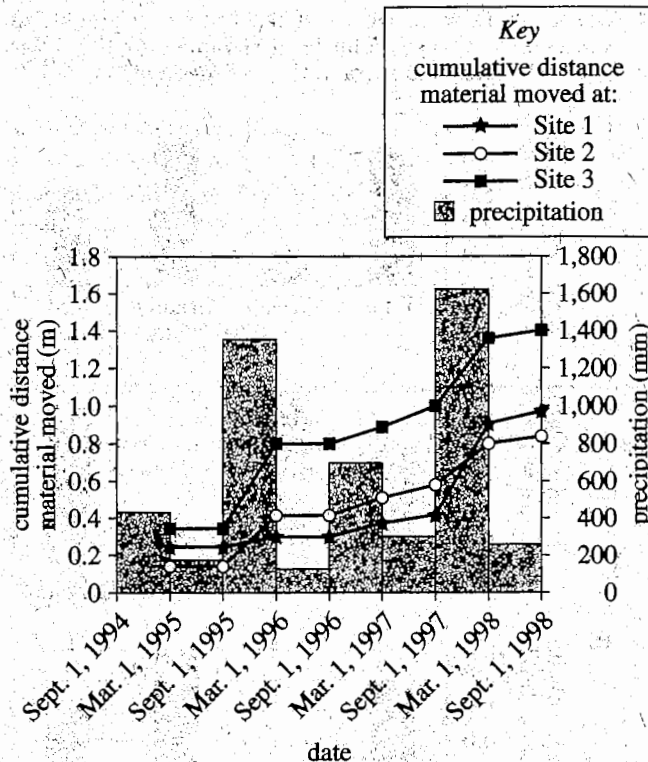


Figure 2

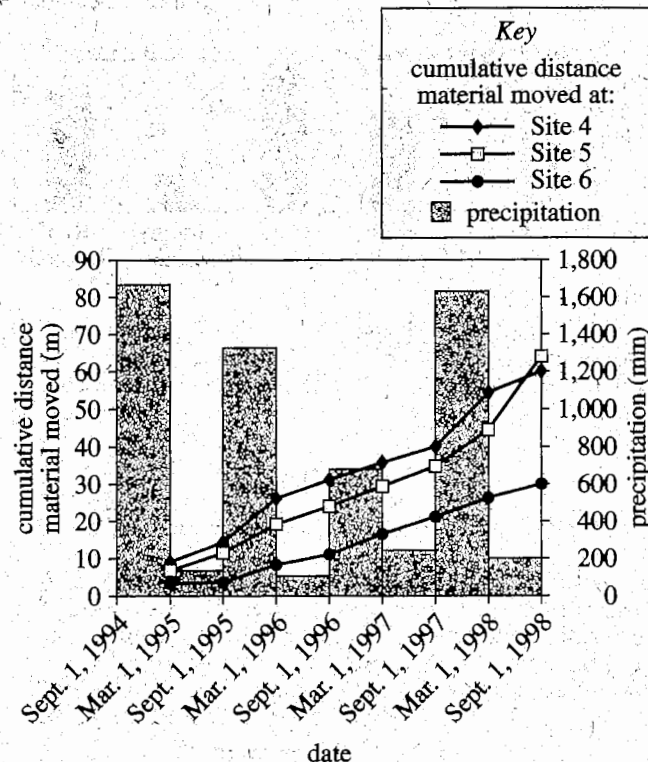
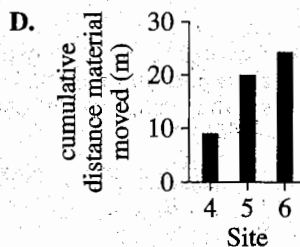
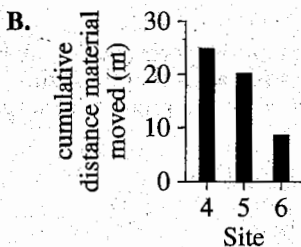
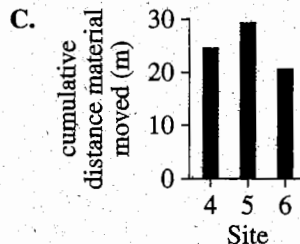
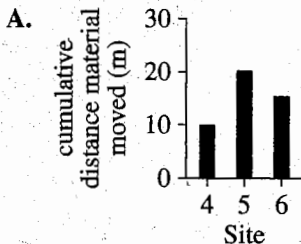


Figure 3



Figures 2 and 3 adapted from D. N. Swanston, R. R. Ziemer, and R. J. Janda, "Rate and Mechanics of Progressive Hillslope Failure in the Redwood Creek Basin, Northwestern California." U.S. Geological Survey Professional Paper 1454-E, 1995.

7. According to Figure 3, the distance that material moved at Site 5 was greatest between which of the following dates?
- March 1, 1995, and September 1, 1995
  - March 1, 1996, and September 1, 1996
  - March 1, 1997, and September 1, 1997
  - March 1, 1998, and September 1, 1998
8. Which of the following statements best explains why precipitation data were collected along with cumulative distance data?
- Water that runs off the surface may decrease the rate of mass movement.
  - Water that runs off the surface may stop mass movement.
  - Water that infiltrates the soil or rock may increase the rate of mass movement.
  - Water that infiltrates the soil or rock may stop mass movement.
9. According to Figure 3, which of the following graphs best shows the cumulative distance that material moved at Sites 4–6 by March 1, 1996?



10. Consider in Figure 2 the 6-month periods during which there was no soil creep at any of Sites 1–3. During those periods, the amount of precipitation that fell at each of the sites was:
- less than 250 mm.
  - between 250 mm and 275 mm.
  - between 275 mm and 300 mm.
  - greater than 300 mm.
11. Suppose that at Site 2 the scientists had also measured, every 6 months, the cumulative distance that material at a depth of 2 m below the surface had moved since September 1, 1994. Based on Figures 1 and 2, on March 1, 1998, would they have more likely measured a cumulative distance of less than 0.8 m or greater than 0.8 m?
- Less than 0.8 m, because material at a depth of 2 m below the surface moved faster than material at the surface.
  - Less than 0.8 m, because material at a depth of 2 m below the surface moved slower than material at the surface.
  - Greater than 0.8 m, because material at a depth of 2 m below the surface moved faster than material at the surface.
  - Greater than 0.8 m, because material at a depth of 2 m below the surface moved slower than material at the surface.

12. According to Figures 2 and 3, over the study period, was the cumulative distance that material moved due to soil creep less than or greater than the cumulative distance that material moved due to block glide?
- Less; material moved as much as 0.8 m due to soil creep, whereas material moved as much as 30 m due to block glide.
  - Less; material moved as much as 1.4 m due to soil creep, whereas material moved as much as 64 m due to block glide.
  - Greater; material moved as much as 30 m due to soil creep, whereas material moved as much as 0.8 m due to block glide.
  - Greater; material moved as much as 64 m due to soil creep, whereas material moved as much as 1.4 m due to block glide.

**Passage III**

Students performed 3 experiments to investigate the absorption of  $H_2O$  by dried chickpeas (a type of bean).

**Experiment 1**

A sample of 50 dried chickpeas with similar sizes and masses was selected. The total mass of the sample was measured, and the *average initial mass per chickpea* ( $CM_i$ ) was calculated. The sample was immersed in 200 mL of distilled  $H_2O$  at  $20^\circ C$ . After 20 min, 5 chickpeas were removed from the distilled  $H_2O$  and gently patted dry with a paper towel, and their total mass was then measured. The *average final mass per chickpea* ( $CM_f$ ) was calculated. At each of 6 different times thereafter, another 5 chickpeas were removed from the distilled  $H_2O$  and gently patted dry with a paper towel, and their  $CM_f$  was determined. The *average moisture uptake per chickpea* (CMU) was then calculated for each group of 5 chickpeas using the following equation:

$$CMU = \frac{CM_f - CM_i}{CM_i}$$

The results are shown in Table 1.

Soaking time (min)	CMU
20	0.15
40	0.25
60	0.31
90	0.40
120	0.47
180	0.57
270	0.68

**Experiment 2**

The students repeated the procedure from Experiment 1 at 4 other temperatures (see Table 2).

Soaking time (min)	CMU at a temperature (in $^\circ C$ ) of:			
	5	30	40	50
20	0.10	0.19	0.23	0.28
40	0.19	0.32	0.38	0.43
60	0.23	0.40	0.47	0.57
90	0.31	0.50	0.58	0.70
120	0.36	0.57	0.69	0.79
180	0.48	0.69	0.79	0.90
270	0.56	0.79	0.90	0.99

**Experiment 3**

The students repeated the procedure from Experiment 1, except that they replaced the distilled  $H_2O$  with aqueous solutions of NaCl at 3 different concentrations (see Table 3).

Soaking time (min)	CMU at an NaCl concentration (in M*) of:		
	0.5	1.0	3.0
20	0.13	0.12	0.09
40	0.22	0.20	0.17
60	0.26	0.23	0.20
90	0.32	0.28	0.25
120	0.37	0.32	0.29
180	0.42	0.38	0.33
270	0.47	0.41	0.38

\*moles of NaCl per liter of solution

Tables adapted from Gabriel Pinto and Ali Eslin, "Kinetics of the Osmotic Hydration of Chickpeas." ©2004 by Division of Chemical Education, Inc., American Chemical Society.

13. According to the results of Experiment 2, soaking chickpeas in distilled  $H_2O$  for what length of time and at what temperature resulted in the greatest absorption of  $H_2O$ ?

- |    | soaking time | temperature  |
|----|--------------|--------------|
| A. | 120 min      | $30^\circ C$ |
| B. | 120 min      | $50^\circ C$ |
| C. | 270 min      | $30^\circ C$ |
| D. | 270 min      | $50^\circ C$ |

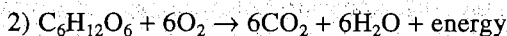
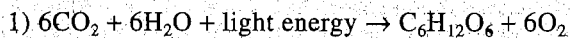
14. If a 2.0 M NaCl solution had been tested in Experiment 3, the CMU at 90 min would most likely have been:

- F. less than 0.20.  
 G. between 0.20 and 0.25.  
 H. between 0.25 and 0.28.  
 J. greater than 0.28.

15. Suppose the procedure of Experiment 1 is repeated at a temperature of  $15^{\circ}\text{C}$ . Based on the results of Experiments 1 and 2, a soaking time of 120 min will most likely result in a CMU that is:
- A. less than 0.31.
  - B. between 0.31 and 0.36.
  - C. between 0.36 and 0.47.
  - D. greater than 0.47.
16. Consider the group of chickpeas in Experiment 1 that were soaked in the distilled  $\text{H}_2\text{O}$  for 60 min. If these chickpeas had *not* been patted dry after being removed from the  $\text{H}_2\text{O}$ , would their CMU more likely have been greater than or less than the value shown in Table 1 for a soaking time of 60 min ?
- F. Greater, because their  $\text{CM}_f$  would have been greater.
  - G. Greater, because their  $\text{CM}_f$  would have been less.
  - H. Less, because their  $\text{CM}_f$  would have been greater.
  - J. Less, because their  $\text{CM}_f$  would have been less.
17. Upon completion of Experiment 1, how many chickpeas had *not* been removed from the distilled  $\text{H}_2\text{O}$  ?
- A. 15
  - B. 20
  - C. 25
  - D. 30
18. Consider the results of Experiments 1 and 3. At any given soaking time, compared with the CMU of the chickpeas soaked in distilled  $\text{H}_2\text{O}$ , the CMU of the chickpeas soaked in an NaCl solution was:
- F. always greater.
  - G. always less.
  - H. always the same.
  - J. sometimes greater and sometimes less, depending on the NaCl concentration.
19. Consider the  $\text{CM}_f$  of any group of soaked chickpeas in Experiment 1. Also consider the  $\text{CM}_i$  of the sample of dried chickpeas in Experiment 1. Was the  $\text{CM}_f$  greater than, less than, or equal to the  $\text{CM}_i$  ?
- A. Greater
  - B. Less
  - C. Equal
  - D. Cannot be determined from the given information

### Passage IV

Carbon dioxide ( $\text{CO}_2$ ) is consumed during photosynthesis and produced during cellular respiration. Photosynthesis and cellular respiration can be summarized by equations 1 and 2, respectively:



When  $\text{CO}_2$  dissolves in an aqueous solution, an acid is formed. Thus, the pH of an aqueous solution is affected by the concentration of  $\text{CO}_2$  dissolved in the solution. A student performed an experiment to determine how the pH of an aqueous solution is affected by the addition to the solution of an organism that is undergoing both photosynthesis and cellular respiration, an organism that is undergoing cellular respiration but not photosynthesis, or both such organisms.

#### Experiment

The student prepared a sterile aqueous solution containing *bromothymol blue*. A bromothymol blue solution can be yellow, green, or blue in color, depending on its pH (see Table 1). The student's solution was green.

pH	Color of bromothymol blue solution
< 6.0	yellow
6.0–7.6	green
> 7.6	blue

The student placed 10 mL of the solution into each of 8 sterile tubes (Tubes 1–8). Then she added a piece of *elodea* (a water plant), a snail, or both to each of Tubes 3–8, placed a cap on each of Tubes 1–8, and incubated all 8 tubes at  $25^\circ\text{C}$  for 24 hr. During the incubation, each tube received either no light for 24 hr (dark treatment) or constant light for 24 hr (light treatment). Table 2 lists, for each tube, the organism(s) present (if either), whether the dark or the light treatment was received, and the color of the solution at the end of the 24 hr incubation.

Tube	Elodea present	Snail present	Dark or light treatment	Color at the end of 24 hr incubation
1	no	no	dark	green
2	no	no	light	green
3	yes	no	dark	yellow
4	yes	no	light	green
5	no	yes	dark	yellow
6	no	yes	light	yellow
7	yes	yes	dark	yellow
8	yes	yes	light	green

20. Suppose that there had been no bromothymol blue in the solution placed in the tubes. Which of the following pieces of equipment would have best allowed the students to determine if the concentration of  $\text{CO}_2$  dissolved in the solution changed during the 24 hr incubation?
- F. Balance  
G. Meterstick  
H. Microscope  
J. pH meter
21. At the end of the 24 hr incubation, the pH of the solution in Tube 1 was closest to which of the following values?
- A. 2.0  
B. 4.0  
C. 7.0  
D. 10.0

22. The conditions for Tube 3 and Tube 5 differed in which of the following ways? Tube 3:
- F. was incubated in the dark, whereas Tube 5 was incubated in the light.
  - G. was incubated in the light, whereas Tube 5 was incubated in the dark.
  - H. contained an organism that is an autotroph, whereas Tube 5 contained an organism that is a heterotroph.
  - J. contained an organism that is a heterotroph, whereas Tube 5 contained an organism that is an autotroph.
23. The student had hypothesized that in the absence of photosynthesis and cellular respiration, light would break down the bromothymol blue in the solution during the 24 hr incubation, causing the solution to become yellow. Are the results of the experiment consistent with this hypothesis?
- A. Yes; the solution in Tube 2 was yellow at the end of the 24 hr incubation.
  - B. Yes; the solution in Tube 5 was yellow at the end of the 24 hr incubation.
  - C. No; the solution in Tube 2 was green at the end of the 24 hr incubation.
  - D. No; the solution in Tube 5 was green at the end of the 24 hr incubation.
24. At the end of the 24 hr incubation, why was the color of the bromothymol blue solution in Tube 7 different from the color of the bromothymol blue solution in Tube 8? In the absence of light, the elodea in Tube 7 could not undergo:
- F. photosynthesis, so it consumed less  $\text{CO}_2$  than did the elodea in Tube 8.
  - G. photosynthesis, so it consumed more  $\text{CO}_2$  than did the elodea in Tube 8.
  - H. cellular respiration, so it consumed less  $\text{CO}_2$  than did the elodea in Tube 8.
  - J. cellular respiration, so it consumed more  $\text{CO}_2$  than did the elodea in Tube 8.
25. At the end of the 24 hr incubation, the student removed the snail from Tube 6 and added 10 drops of a new solution, causing the color of the bromothymol blue solution in the tube to change to blue. Was the new solution more likely acidic or basic?
- A. Acidic, because the pH of the bromothymol blue solution increased when the new solution was added.
  - B. Acidic, because the pH of the bromothymol blue solution decreased when the new solution was added.
  - C. Basic, because the pH of the bromothymol blue solution increased when the new solution was added.
  - D. Basic, because the pH of the bromothymol blue solution decreased when the new solution was added.
26. Suppose that an additional tube, Tube 9, had been included in the experiment and that Tube 9 contained a small fish, but no elodea or snail, and received the light treatment. At the end of the 24 hr incubation, would the color of the bromothymol blue solution in Tube 9 more likely have been yellow or blue?
- F. Yellow, because the fish would have undergone photosynthesis, consuming  $\text{CO}_2$ .
  - G. Yellow, because the fish would have undergone cellular respiration, producing  $\text{CO}_2$ .
  - H. Blue, because the fish would have undergone photosynthesis, consuming  $\text{CO}_2$ .
  - J. Blue, because the fish would have undergone cellular respiration, producing  $\text{CO}_2$ .

## Passage V

If an object is at rest and the sum of the forces acting on it is zero, the object is in a state of *static equilibrium*. In each trial of 2 experiments on static equilibrium, 3 cables and a cylinder were arranged as shown in Figure 1.

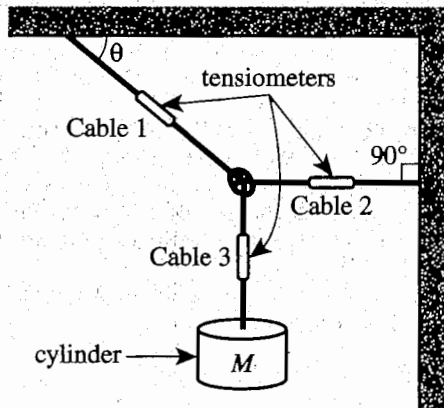


Figure 1

Cables 1, 2, and 3, each with its own *tensiometer* (a device used to measure tension), were joined with a single knot. The free ends of Cables 1 and 2 were attached to an L-shaped support, and a cylinder of mass  $M$  was suspended from the free end of Cable 3. Cable 1 made an angle  $\theta$  with the top of the support, and Cable 2 made a  $90^\circ$  angle with the side of the support. None of the cables stretched under tension. The tension forces acting on the knot, which was in static equilibrium, are shown in Figure 2.

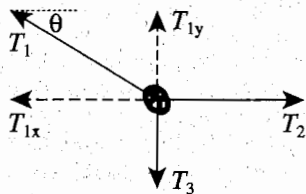


Figure 2

The tension in Cable 1,  $T_1$ , had a horizontal component,  $T_{1x}$ , and a vertical component,  $T_{1y}$ . The tension in Cable 2,  $T_2$ , was purely horizontal, and the tension in Cable 3,  $T_3$ , was purely vertical.

## Experiment 1

In Trials 1–5,  $M$  was 1.0 kg and  $\theta$  was varied. Table 1 lists  $\theta$ , in degrees, as well as  $T_{1x}$ ,  $T_{1y}$ ,  $T_2$ , and  $T_3$ , each in newtons (N), for each trial.

Trial	$\theta$	$T_{1x}$ (N)	$T_{1y}$ (N)	$T_2$ (N)	$T_3$ (N)
1	$10^\circ$	-55.6	9.8	55.6	-9.8
2	$30^\circ$	-17.0	9.8	17.0	-9.8
3	$50^\circ$	-8.2	9.8	8.2	-9.8
4	$70^\circ$	-3.6	9.8	3.6	-9.8
5	$90^\circ$	0.0	9.8	0.0	-9.8

## Experiment 2

In Trials 6–10,  $M$  was varied and  $\theta$  was  $50^\circ$ . Table 2 lists  $M$  as well as  $T_{1x}$ ,  $T_{1y}$ ,  $T_2$ , and  $T_3$  for each trial.

Trial	$M$ (kg)	$T_{1x}$ (N)	$T_{1y}$ (N)	$T_2$ (N)	$T_3$ (N)
6	2.0	-16.4	19.6	16.4	-19.6
7	3.0	-24.7	29.4	24.7	-29.4
8	4.0	-32.9	39.2	32.9	-39.2
9	5.0	-41.1	49.0	41.1	-49.0
10	6.0	-49.3	58.8	49.3	-58.8

27. According to the results of Experiment 1, as  $\theta$  increased, the tension in Cable 2:
- A. increased only.
  - B. decreased only.
  - C. remained constant.
  - D. varied, but with no general trend.
28. Based on the results of Experiments 1 and 2, which of the following expressions was always equal to zero?
- F.  $T_{1y} + T_3$
  - G.  $T_{1y} - T_3$
  - H.  $T_2 + T_3$
  - J.  $T_2 - T_3$
29. Suppose that Cable 2 was attached to the L-shaped support using a bracket that has a maximum tension rating of 51 N (meaning that it is unsafe to assume that the bracket can support forces greater than 51 N). Based on the results of the experiments, was it safe to use this bracket?
- A. Yes, because  $T_2$  exceeded 51 N in one of the trials.
  - B. Yes, because  $T_2$  did not exceed 51 N in any of the trials.
  - C. No, because  $T_2$  exceeded 51 N in one of the trials.
  - D. No, because  $T_2$  did not exceed 51 N in any of the trials.
30. Based on the results of Experiment 1, in order for the absolute value of  $T_{1x}$  to be equal to  $T_{1y}$ , what angle should Cable 1 make with the top of the support?
- F.  $45^\circ$
  - G.  $55^\circ$
  - H.  $65^\circ$
  - J.  $75^\circ$
31. Suppose that in Experiment 2 a trial had been performed in which  $T_{1y}$  was 68.6 N. The mass of the cylinder in this trial would most likely have been:
- A. less than 6.0 kg.
  - B. between 6.0 kg and 8.0 kg.
  - C. between 8.0 kg and 10.0 kg.
  - D. greater than 10.0 kg.
32. Which of the following statements about  $\theta$  or  $M$  summarizes an important difference between the 2 experiments? In Experiment 1:
- F.  $\theta$  was an independent variable, whereas in Experiment 2,  $\theta$  was held constant.
  - G.  $\theta$  was a dependent variable, whereas in Experiment 2,  $\theta$  was held constant.
  - H.  $M$  was an independent variable, whereas in Experiment 2,  $M$  was held constant.
  - J.  $M$  was a dependent variable, whereas in Experiment 2,  $M$  was held constant.
33. A vector quantity, such as tension, may be written as  $A\hat{x} + B\hat{y}$ , where  $A$  is the vector's horizontal component and  $B$  is the vector's vertical component. For example, the tension (in N) in Cable 1 during Trial 1 could be written as  $-55.6\hat{x} + 9.8\hat{y}$ . Which of the following expressions gives the tension (in N) in Cable 2 during Trial 1?
- A.  $-55.6\hat{x} - 9.8\hat{y}$
  - B.  $-55.6\hat{x} + 0.0\hat{y}$
  - C.  $55.6\hat{x} - 9.8\hat{y}$
  - D.  $55.6\hat{x} + 0.0\hat{y}$

### Passage VI

In the Chryse Planitia area of Mars's surface, numerous winding channels are visible. The channels, some of which are 100 km long, were formed more than 3 billion years ago (bya). Two scientists discuss whether these channels were formed by liquid  $H_2O$  or by liquid  $CO_2$ .

#### Scientist 1

Unlike today, Mars was warm enough prior to 3 bya for liquid  $H_2O$  to exist on the surface. Prior to the formation of the channels, a large volume of liquid  $H_2O$  slowly accumulated in a basin within the Chryse Planitia. Once the volume became great enough, the liquid  $H_2O$  was released suddenly from the basin. The rapidly flowing liquid  $H_2O$  carried away rocks and soil, forming the channels. On Earth, similar features called *outflow channels* are produced by the sudden release of a large volume of liquid  $H_2O$  from a basin.

*Grey hematite* (a mineral) is abundant on Mars's surface within the Chryse Planitia. On Earth, this mineral is associated exclusively with liquid  $H_2O$ . Even today, large quantities of frozen  $H_2O$  are still present in Mars's polar regions.

#### Scientist 2

Before 3 bya, large volumes of  $CO_2$  gas were present a short distance below the surface in the Chryse Planitia. Eventually, the subsurface pressure due to the weight of the overlying rocks and soil became great enough to change the  $CO_2$  to a liquid. When a later major event such as an asteroid impact removed most of the overlying material, the liquid  $CO_2$  quickly moved up to and then along the surface. The rapidly flowing liquid  $CO_2$  carried away rocks and soil, forming the channels. On Earth, gases or liquids that have been under pressure belowground are released to the surface during some volcanic eruptions. These *pyroclastic flows* move rapidly along the ground, forming channels by carrying away rocks and soil.

Since Mars's formation, its average surface temperature has never been greater than  $-50^\circ C$ . This has made it impossible for a significant amount of liquid  $H_2O$  to be present on the surface. If any liquid  $H_2O$  had been present on Mars's surface, it would have reacted with  $CO_2$  to produce *carbonate rock* (a rock composed of carbonate minerals). No carbonate rock has been found on Mars.

34. Both scientists describe how a flowing liquid formed the channels that are more than 3 billion years old. The process described by each scientist is an example of:

- F. erosion.
- G. faulting.
- H. plate tectonics.
- J. volcanism.

35. A study concluded that at all times before 3 bya, the temperature and pressure conditions a short distance below Mars's surface in the Chryse Planitia would have allowed liquid  $H_2O$  to exist but would not have allowed liquid  $CO_2$  to exist. This finding is *inconsistent* with the discussion(s) of which of the scientists, if either?

- A. Scientist 1 only
- B. Scientist 2 only
- C. Both scientists
- D. Neither scientist

36. Consider Scientist 1's and Scientist 2's assertions about the source of the liquid that formed the channels in the Chryse Planitia. According to Scientist 1, was the source on the surface or below the surface; and according to Scientist 2, was the source on the surface or below the surface?

- | <u>Scientist 1</u>   | <u>Scientist 2</u> |
|----------------------|--------------------|
| F. on the surface    | on the surface     |
| G. on the surface    | below the surface  |
| H. below the surface | on the surface     |
| J. below the surface | below the surface  |



37. Studies have shown that prior to 3 bya, liquid  $\text{CO}_2$ , once it reached Mars's surface, would have evaporated completely before it had flowed 2 km. Does this information support or weaken the viewpoint of Scientist 2?
- It supports Scientist 2's viewpoint because none of the channels in the Chryse Planitia are longer than 2 km.
  - It supports Scientist 2's viewpoint because all of the channels in the Chryse Planitia are longer than 2 km.
  - It weakens Scientist 2's viewpoint because all of the channels in the Chryse Planitia are at least 100 km long.
  - It weakens Scientist 2's viewpoint because at least a few of the channels in the Chryse Planitia are 100 km long.
38. The discovery of which of the following features in the Chryse Planitia, if made today, would provide the best support for Scientist 2's viewpoint?
- A thick frozen  $\text{H}_2\text{O}$  layer
  - A large lake of liquid  $\text{H}_2\text{O}$
  - A 3.5-billion-year-old mountain
  - A 3.5-billion-year-old impact crater
39. Suppose liquid  $\text{H}_2\text{O}$  was present on Mars's surface prior to 3 bya. Would Scientist 1 agree that grey hematite might have been present on Mars's surface prior to 3 bya, and would Scientist 2 agree that carbonate rock might have been present on Mars's surface prior to 3 bya?
- |    | Scientist 1 | Scientist 2 |
|----|-------------|-------------|
| A. | yes         | yes         |
| B. | yes         | no          |
| C. | no          | yes         |
| D. | no          | no          |
40. Based on Scientist 2's discussion, did the pressure of rock and soil on subsurface  $\text{CO}_2$  have the effect of increasing the average distance between  $\text{CO}_2$  molecules or of decreasing the average distance between  $\text{CO}_2$  molecules?
- Increasing the average distance, because  $\text{CO}_2$  changed from a liquid to a gas.
  - Increasing the average distance, because  $\text{CO}_2$  changed from a gas to a liquid.
  - Decreasing the average distance, because  $\text{CO}_2$  changed from a liquid to a gas.
  - Decreasing the average distance, because  $\text{CO}_2$  changed from a gas to a liquid.

**END OF TEST 4**

**STOP! DO NOT RETURN TO ANY OTHER TEST.**

**Scoring Keys for Form B02**

Use the scoring key for each test to score your answer document for the multiple-choice tests. Mark a "1" in the blank for each question you answered correctly. Add up the numbers in each reporting category and enter the total number correct for each reporting category in the blanks provided. Also enter the total number correct for each test in the blanks provided. The total number correct for each test is the sum of the number correct in each reporting category.

**Test 1: English—Scoring Key**

Key	Reporting Category*		
	POW	KLA	CSE
1. C			
2. J			
3. B			
4. H			
5. B			
6. J			
7. D			
8. H			
9. B			
10. G			
11. D			
12. F			
13. A			
14. H			
15. A			
16. J			
17. C			
18. F			
19. B			
20. G			
21. D			
22. H			
23. B			
24. F			
25. D			
26. G			
27. A			
28. F			
29. C			
30. H			
31. D			
32. H			
33. A			
34. F			
35. C			
36. H			
37. A			
38. H			

Key	Reporting Category*		
	POW	KLA	CSE
39. B			
40. G			
41. D			
42. H			
43. D			
44. F			
45. D			
46. H			
47. B			
48. F			
49. B			
50. J			
51. B			
52. F			
53. A			
54. H			
55. D			
56. J			
57. A			
58. H			
59. B			
60. J			
61. C			
62. F			
63. D			
64. F			
65. B			
66. G			
67. D			
68. H			
69. A			
70. J			
71. A			
72. G			
73. B			
74. F			
75. B			

**\*Reporting Categories**

**POW** = Production of Writing

**KLA** = Knowledge of Language

**CSE** = Conventions of Standard English

Number Correct (Raw Score) for:	
Production of Writing (POW)	_____ (23)
Knowledge of Language (KLA)	_____ (12)
Conventions of Standard English (CSE)	_____ (40)
Total Number Correct for English Test POW + KLA + CSE)	_____ (75)

Test 2: Mathematics—Scoring Key

Key	Reporting Category*						
	PHM					IES	MDL
	N	A	F	G	S		
1. D							
2. F							
3. E							
4. H							
5. C							
6. H							
7. C							
8. K							
9. B							
10. H							
11. D							
12. G							
13. C							
14. K							
15. D							
16. F							
17. B							
18. G							
19. B							
20. J							
21. D							
22. K							
23. C							
24. F							
25. C							
26. H							
27. C							
28. F							
29. C							
30. G							

Key	Reporting Category*						
	PHM					IES	MDL
	N	A	F	G	S		
31. E							
32. J							
33. D							
34. G							
35. A							
36. K							
37. A							
38. G							
39. E							
40. J							
41. C							
42. J							
43. D							
44. K							
45. A							
46. J							
47. B							
48. F							
49. E							
50. F							
51. E							
52. G							
53. A							
54. G							
55. A							
56. J							
57. D							
58. F							
59. A							
60. K							

Combine the totals of these columns and put in the blank for PHM in the box below.

**\*Reporting Categories**

**PHM** = Preparing for Higher Math

N = Number & Quantity

A = Algebra

F = Functions

G = Geometry

S = Statistics & Probability

**IES** = Integrating Essential Skills

**MDL** = Modeling

Number Correct (Raw Score) for:	
Preparing for Higher Math (PHM) (N + A + F + G + S)	_____ (35)
Integrating Essential Skills (IES)	_____ (25)
Total Number Correct for Mathematics Test (PHM + IES)	_____ (60)
Modeling (MDL) (Not included in total number correct for mathematics test raw score)	_____ (18)

Test 3: Reading—Scoring Key

Key	Reporting Category*		
	KID	CS	IKI
1. D	—		
2. G	—		
3. D	—		
4. H		—	
5. A		—	
6. J	—		
7. B		—	
8. G	—		
9. C	—		
10. F		—	
11. A		—	
12. H	—		
13. C	—		
14. J	—		
15. C	—		
16. F	—		
17. B			—
18. G		—	
19. D	—		
20. F			—

Key	Reporting Category*		
	KID	CS	IKI
21. C		—	
22. G		—	
23. D		—	
24. G		—	
25. C	—		
26. F	—		
27. A	—		
28. G			—
29. A			—
30. J			—
31. D		—	
32. F	—		
33. C	—		
34. J	—		
35. B	—		
36. F	—		
37. D	—		
38. G	—		
39. B	—		
40. H		—	

\*Reporting Categories

KID = Key Ideas & Details

CS = Craft & Structure

IKI = Integration of Knowledge & Ideas

Number Correct (Raw Score) for:	
Key Ideas & Details (KID)	_____ (23)
Craft & Structure (CS)	_____ (12)
Integration of Knowledge & Ideas (IKI)	_____ (5)
Total Number Correct for Reading Test (KID + CS + IKI)	_____ (40)

Test 4: Science—Scoring Key

Key	Reporting Category*		
	IOD	SIN	EMI
1. A	—		
2. F	—		
3. C	—		
4. G	—		
5. C	—		
6. J			—
7. D	—		
8. H		—	
9. B	—		
10. F	—		
11. B	—		
12. G	—		
13. D	—		
14. H		—	
15. C		—	
16. F		—	
17. A		—	
18. G	—		
19. A	—		
20. J		—	

Key	Reporting Category*		
	IOD	SIN	EMI
21. C			—
22. H		—	
23. C			—
24. F			—
25. C		—	
26. G		—	
27. B	—		
28. F	—		
29. C			—
30. F		—	
31. B		—	
32. F		—	
33. D	—		
34. F	—		
35. B			—
36. G			—
37. D			—
38. J			—
39. A			—
40. J			—

\*Reporting Categories

IOD = Interpretation of Data

SIN = Scientific Investigation

EMI = Evaluation of Models, Inferences & Experimental Results

Number Correct (Raw Score) for:	
Interpretation of Data (IOD)	_____ (17)
Scientific Investigation (SIN)	_____ (12)
Evaluation of Models, Inferences & Experimental Results (EMI)	_____ (11)
Total Number Correct for Science Test (IOD + SIN + EMI)	_____ (40)

## Explanation of Procedures Used to Obtain Scale Scores from Raw Scores

On each of the four tests on which you marked any responses, the total number of correct responses yields a raw score. Use the table below to convert your raw scores to scale scores. For each test, locate and circle your raw score or the range of raw scores that includes it in the table below. Then, read across to either outside column of the table and circle the scale score that corresponds to that raw score. As you determine your scale scores, enter them in the blanks provided on the right. The highest possible scale score for each test is 36. The lowest possible scale score for any test on which you marked any responses is 1.

Next, compute the Composite score by averaging the four scale scores. To do this, add your four scale scores and divide the sum by 4. If the resulting number ends in a fraction, round it off to the nearest whole number. (Round down any fraction less than one-half; round up any fraction that is one-half or more.) Enter this number in the blank. This is your Composite score. The highest possible Composite score is 36. The lowest possible Composite score is 1.

ACT Test B02	Your Scale Score
English	_____
Mathematics	_____
Reading	_____
Science	_____
<b>Sum of scores</b> _____	
<b>Composite score (sum ÷ 4)</b> _____	

NOTE: If you left a test completely blank and marked no items, do not list a scale score for that test. If any test was completely blank, do not calculate a Composite score.

Scale Score	Raw Scores				Scale Score
	Test 1 English	Test 2 Mathematics	Test 3 Reading	Test 4 Science	
36	74-75	59-60	40	39-40	36
35	71-73	57-58	89	38	35
34	70	56	37-38	37	34
33	68-69	55	36	36	33
32	67	54	35	35	32
31	66	52-53	34	34	31
30	64-65	50-51	33	—	30
29	62-63	48-49	32	33	29
28	61	46-47	31	32	28
27	59-60	43-45	30	31	27
26	57-58	40-42	29	29-30	26
25	55-56	37-39	28	28	25
24	52-54	34-36	27	26-27	24
23	49-51	32-33	26	25	23
22	46-48	30-31	24-25	23-24	22
21	43-45	28-29	23	21-22	21
20	41-42	27	22	20	20
19	39-40	25-26	20-21	18-19	19
18	37-38	22-24	19	17	18
17	35-36	19-21	17-18	16	17
16	32-34	15-18	16	14-15	16
15	29-31	12-14	14-15	13	15
14	26-28	10-11	13	12	14
13	24-25	8-9	12	10-11	13
12	23	6-7	10-11	9	12
11	20-22	5	9	8	11
10	17-19	4	8	7	10
9	15-16	—	7	6	9
8	13-14	3	6	5	8
7	10-12	2	5	4	7
6	8-9	—	4	3	6
5	6-7	—	3	—	5
4	5	1	—	2	4
3	3-4	—	2	1	3
2	2	—	1	—	2
1	0-1	0	0	0	1