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 circle 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

A Long-Term Commitment

Asparagus is a popular, vegetable, but it can be [1]
expensive in the market, so many gardeners consider growing their own at home. Anyone thinking about growing asparagus, as a result, [2] should know that it takes years of hard work and dedication before a gardener gets to harvest even a single stalk. For this hard work, the payoff [3] is that a well-tended bed of asparagus will produce for as long as twenty years.

Choose a spot with full sun and well-draining soil for an asparagus bed. This bed should be about four feet wide, because asparagus spreads, and the soil should be prepared by removed [4] any weeds and roots before adding aged manure or compost to the soil. It's possible to grow asparagus from seeds, but it is more efficient to start with one-year-old "crowns," or seedlings. Plant the crowns six

1. **A.** NO CHANGE
B. popular vegetable but it can be,
C. popular vegetable, but it can be
D. popular vegetable, but it, can be

2. **F.** NO CHANGE
G. however
H. therefore
J. meanwhile

3. **A.** NO CHANGE
B. reckoning
C. bribe
D. calculation

4. **F.** NO CHANGE
G. removing
H. remove
J. removes

Go On to the Next Page.

inches deep and about two feet apart in a single foot-wide trench in the center of the prepared bed, and then top them [5] with about three inches of soil. Every two weeks add another inch or two of soil until slight mounds like manmade anthills [6] that mound up over the crowns develop along the trench. [6]

Also must weed. [7]

[1] While watering, check for asparagus beetles and asparagus miners, pests that can destroy the crop before it even begins to produce. [2] For the first two years regularly, [8] the asparagus bed needs to be watered and fertilized in the spring and fall. [8] [3] Remember to not harvest any wispy, fern-like asparagus' spears' [9] that appear during the first two years because the plants need to devote their energy to building deep roots. [4] When getting ready for winter, cover the bed with straw and any lingering foliage, just remember [10] to destroy the fern-like foliage before the new growth appears in the spring. [11]

5. **A.** NO CHANGE
B. themselves
C. they
D. theirs

6. **F.** NO CHANGE
G. until slight mounds like miniature, rounded versions of the great pyramids develop
H. until rolling mounds, reminiscent of low hills or mountains made entirely of dirt, begin to develop
J. until slight, rounded mounds develop

7. **A.** NO CHANGE
B. Weed the asparagus bed as needed.
C. Must weed as needed.
D. Also, must weed the asparagus bed as needed.

8. **F.** NO CHANGE
G. For the first two years, the asparagus bed needs to be watered regularly and fertilized in the spring and fall.
H. Regularly, for the first two years, the asparagus bed needs to be watered and fertilized in the spring and fall.
J. For the first two years, regularly, in the spring and the fall, the asparagus bed needs to be watered and fertilized.

9. **A.** NO CHANGE
B. asparagus spears'
C. asparagus' spears
D. asparagus spears

10. **F.** NO CHANGE
G. foliage just remember
H. foliage; just remember
J. foliage just remember;

11. For the sake of logic and coherence, Sentence 1 should be placed:

A. where it is now.
B. after Sentence 2.
C. before Sentence 4.
D. after Sentence 4.

In the third season, the asparagus is finally ready to be harvested. [12] In the fourth year, the asparagus grows more robustly, and the harvest period lasted [13] for eight weeks.

Eventually, over many years it may be necessary to pick [14] asparagus as much as twice a day to keep up. [14]

12. At this point the writer is considering adding the following sentence:

> Harvest the spears during a four-week period by cutting them with a sharp knife at or just below the ground level.

Should the writer make this addition?

F. Yes, because the focus of the paragraph is harvesting asparagus.

G. Yes, because if readers understand how to pick asparagus they will want to plant some.

H. No, because the paragraph focuses on how many times per day asparagus must be picked.

J. No, because the paragraph doesn't say anything about why asparagus must be cut at or below ground level.

13. **A.** NO CHANGE

B. would have lasted

C. would last

D. lasts

14. **F.** NO CHANGE

G. Eventually, it may be necessary to pick asparagus as often as twice a day to keep up.

H. After the fourth year, it may eventually be necessary to harvest the asparagus spears as often as twice each day to keep up with the production.

J. After many years it may eventually become necessary to pick asparagus as much as twice a day to keep up.

Question 15 asks about the preceding passage as a whole.

15. Suppose the writer had chosen to write an essay that indicates that growing asparagus is an economically viable business for a new farm. Would this essay successfully fulfill the writer's goal?

A. Yes, because the essay explains the essay explains how much asparagus costs to grow, and what it sells for.

B. Yes, because the essay details the amount of asparagus that must be planted in order to earn a profit.

C. No, because the essay does not explain how to establish and care for an asparagus patch.

D. No, because the essay is limited to describing how to establish and care for an asparagus patch.

Passage II

The Stranger and the Palm Reader

[1]

I grew up by the shore at the heart of Miami Beach where there [16] were always more vacationers than there were locals. Mom ran a guesthouse, so there were always strangers around. I never spoke with them—Mom was somewhat dead-set on [17] this rule—except that I would usually say "hello" and most [18] of the guests were kind enough to return the greeting.

[2]

Even if I had wanted to become friendly with, our guests, they rarely stayed [19] for more than a few days; after all, there was only so much one could do in Miami Beach. Most would reserve one day for the beach, another for shopping, both nights for either a show or a nightclub, and maybe a third day for a visit to downtown Miami—but that was about it. [20]

16. **F.** NO CHANGE
G. Miami Beach, there
H. Miami Beach, where there
J. Miami Beach. Where there

17. **A.** NO CHANGE
B. strict about
C. fiercely stern about
D. utterly fixed on

18. **F.** NO CHANGE
G. "hello," and most
H. "hello," most
J. "hello" most

19. **A.** NO CHANGE
B. with our guests they rarely stayed
C. with our guests, they rarely stayed
D. with our guests, they rarely stayed,

20. The writer is considering deleting the following phrase from the preceding sentence:

—but that was about it

If the writer were to make this deletion, would the meaning of the sentence change?

F. Yes, because the phrase adds a new item to the list of activities that tourists enjoyed in Miami Beach.
G. Yes, because the phrase emphasizes the point that there was a limited selection of activities available in Miami Beach.
H. No, because the phrase repeats information provided earlier in the sentence.
J. No, because the sentence already implies that there are other activities available in Miami Beach.

Go On to the Next Page.

[3]

One summer, though, a man booked a room at the
21
guesthouse for a whole month. He didn't have much luggage with him, and I remember Mom, bemused and perhaps slightly suspicious, double- and triple-checking the booking. She let him in, but only after some hesitation. He didn't seem suspicious to me: maybe a little downcast, but harmless.

[4]

During his time with us, he made frequently visits
22
to one of the palm readers who roamed the shore while he
23
was staying with us. That was strange: it didn't
23
happened very often that a clairvoyant would see the same
24
tourist more than once, as most tourists just saw a session as an afternoon's entertainment. But the two seemed to really connect; the palm-reader would even have visited the house
25
in the afternoons, and they would talk for hours at a time.

After about two weeks of this, the man left—they didn't
26
even check out, he was just gone.

21. **A.** NO CHANGE
B. bloke
C. gent
D. dude

22. **F.** NO CHANGE
G. frequent
H. frequented
J. frequency

23. **A.** NO CHANGE
B. who roamed the shore
C. whom he visited while she roamed the shore
D. who, while he was with us, roamed the shore

24. **F.** NO CHANGE
G. happening
H. happen
J. happens

25. **A.** NO CHANGE
B. visit
C. have been visiting
D. be visiting

26. **F.** NO CHANGE
G. those
H. him
J. he

[5]

I never speak to our guests. I don't even remember
27

most of them, but I've never stopped wondering about that
28

man and the palm-reader.

27. At this point, the writer wants to repeat a fact provided in an earlier part of the story in order to create a dramatic contrast with her continuing curiosity about the man who saw the fortune teller. Which of the following sentences best accomplishes this?

A. NO CHANGE
B. There wasn't much to do in Miami Beach.
C. Most of our guests would spend a day shopping.
D. There were palm readers on the beach.

28. **F.** NO CHANGE
G. them, and
H. them, as
J. them; in fact,

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

29. The writer has decided to add the following sentence:

I never understood why it was such a popular vacation spot.

What would be the best place to add this sentence?

A. After the last sentence of Paragraph 1.
B. After the last sentence of Paragraph 2.
C. Before the first sentence of Paragraph 4.
D. Before the first sentence of Paragraph 5.

30. Suppose the writer's primary purpose had been to relate a story from the narrator's childhood that illustrated why the narrator does not trust strangers. Would this essay accomplish that goal?

F. Yes, because the stranger that the story focuses on is clearly described as "suspicious" and "downcast."
G. Yes, because the story focuses mainly on how the narrator rarely interacted with strangers.
H. No, because the story ends by emphasizing the narrator's abiding love of strangers.
J. No, because while the narrator's mother is suspicious of the stranger, the narrator is curious about the stranger.

Passage III

The "Wind Walls" of Japan

[1]

The Japanese screens known as byōbu were first used to block drafts, introduced to Japan by the Chinese during the eighth century. In fact, byōbu means "wind wall," and the earliest single-panel screens were purely feasible additions to open-layout homes of that period.

When byōbu were adopted by members of the imperial court, however, the screens became most ornate than the first screens. Simple rice paper panels were enhanced with sumptuous materials and elegant calligraphy or paintings, by the 17th century byōbu became an art form that was highly valued as a status symbol.

[2]

Yet the structure of byōbu remained relatively basic it starts with a lattice bamboo structure held together with bamboo nails that serves as the skeleton for each panel. Layers of washi, Japanese paper made from the fibers of the mulberry tree, are fastened to the structure with glue made from rice to create a firm base for the next layers that transform this humble screen into an art form.

31. **A.** NO CHANGE

B. Introduced to Japan by the Chinese during the eighth century, the Japanese screens known as byōbu were first used to block drafts.

C. Introduced to Japan by the Chinese during the eighth century, the Japanese screens were first used to block drafts, known as byōbu.

D. Known as byōbu, the Japanese screens were first used to block drafts, introduced to Japan by the Chinese during the eighth century.

32. **F.** NO CHANGE

G. practical

H. down-to-earth

J. applied

33. **A.** NO CHANGE

B. mostly ornate

C. more ornate

D. ornate

34. **F.** NO CHANGE

G. paintings, and by

H. paintings by

J. paintings; and by

35. **A.** NO CHANGE

B. Yet the structure of byōbu remained relatively basic, it starts with a lattice bamboo structure held together with bamboo nails that serves as the skeleton for each panel.

C. Yet the structure of byōbu remained relatively basic. It starts with a lattice bamboo structure held together with bamboo nails serves as the skeleton for each panel.

D. Yet the structure of byōbu remained relatively basic. A lattice bamboo structure held together with bamboo nails serves as the skeleton for each panel.

[3]

Although the washi used to make the "canvas" was a
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traditional hand-crafted paper, it was often actually stronger
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than modern wood-pulp paper is. That "canvas" was then
36
covered with a layer of silk or gold leaf, which served as the background for most traditional byōbu. The most famous screens from the 17th century featured pen-and-ink calligraphy, monochromatic landscapes, and nature-themed scenes, while later byōbu can be bought online even
37
today. 38
37

[4]

Once a screen was painted, a layer of silk brocade was added to create a frame for the piece. Although the
39
byōbu are sturdy, their surfaces are quite fragile, a
40

36. Given that all of the following sentences are true, which one provides the most effective transition from paragraph 2 to paragraph 3?

F. NO CHANGE

G. Modern byōbu panels are joined by paper hinges, which are light enough for the portable frames but strong enough to endure regular use.

H. Once the individual screens are assembled, they could be joined together with paper hinges to create a "canvas" as wide as the artist desires.

J. Canvas is actually a form of cloth made from plant fibers or yarn, but the word "canvas" is often used metaphorically to refer to any surface suitable for painting—including byōbu.

37. Given that all the choices are true, which one provides the most relevant information with regard to how byōbu evolved over time?

A. NO CHANGE

B. depicted everything from mythical dragons to scenes of daily life

C. could be made in factories instead of by hand

D. became even more popular when they were made of wood

38. The writer is considering adding the following sentence:

The byōbu were decorated with both calligraphy and painting.

Should the writer make this addition here?

F. Yes, because it explains the evolution of the art depicted on the byōbu.

G. Yes, because it provides a significant detail about how byōbu became more popular.

H. No, because it repeats information that has already been expressed in the passage.

J. No, because it deviates from the paragraph's focus on the construction of byōbu.

39. **A.** NO CHANGE

B. added, to create a frame for the piece

C. added to create a frame, for the piece

D. added, to create a frame, for the piece

40. **F.** NO CHANGE

G. fragile, a:

H. fragile a

J. fragile: a

Go On to the Next Page.

misplaced finger can easily poked a hole.
41

Therefore, lacquered wooden frames were often applied to
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protect the edges of the screen. Such precautions proved
43

vital because, although the byōbu were considered an art
43

form, they were also considered portable, and they were
43

often stored between uses.
43

41. **A.** NO CHANGE
B. poke
C. pokes
D. poking

42. **F.** NO CHANGE
G. Otherwise,
H. In contrast,
J. Yet,

43. **A.** NO CHANGE
B. Although byōbu were considered an art form, they were considered a portable art form, and they had to be stored between uses, so such precautions proved vital.
C. Such precautions proved vital, even after byōbu became an art form, because they were an art form that was portable, and they were stored between uses.
D. Such precautions proved vital, because byōbu were portable art pieces that were stored between uses.

Questions 44 and 45 ask about the preceding passage as a whole.

44. For the sake of the logic and coherence of the essay, Paragraph 4 should be placed

F. where it is now.
G. before Paragraph 1.
H. before Paragraph 2.
J. before Paragraph 3.

45. Suppose the writer's goal had been to provide a general overview of a specific Japanese art form. Would this essay accomplish that goal?

A. Yes, because it provides an overview of the history, style, and construction of one form of Japanese art.
B. Yes, because it describes the general forms and style of Japanese art using a specific art form as an example.
C. No, because it focuses on Japanese art in general rather than a specific art form.
D. No, because it provides specific details about multiple art forms rather than a general overview of one art form.

Passage IV

A Writer's Struggles

[1]

Louisa May Alcott is most best known for *Little* 46
Women, but her own life was just as fascinating as the story of the four March sisters. She grew up surrounded by liberal thinkers of the day, they included the most famous writers in 47
American literature. Educated primarily by her schoolteacher father Bronson, Louisa also received lessons from his closest friends, Ralph Waldo Emerson and Henry David Thoreau.

48 Margaret Fuller and Nathaniel Hawthorne helped Louisa learn how to write stories and poems.

[2]

[1] After this impoverished childhood, Louisa dreamed of becoming a rich and famous actress to support her parents' and her three sisters'. [2] However, 49
because of Bronson's idealism, the family struggled financially. [3] When Louisa was eleven, Bronson moved the family to a utopian agrarian commune that collapsed in just seven months 51
50

46. **F.** NO CHANGE
G. more best
H. more better
J. best

47. **A.** NO CHANGE
B. the day. The most
C. the day; the most
D. the day, including the most

48. At this point the writer wants to add a sentence that would further describe Louisa's educational experiences. Which of the following sentences would best accomplish this?

F. Thoreau was well-known for writing *Walden: or Life in the Woods.*
G. Emerson was a poet, essayist, and philosopher.
H. Louisa spent hours with Emerson in his library, and Thoreau taught her science at Walden Pond.
J. Both of the men had studied at Harvard, a private school in Cambridge, Massachusetts.

49. **A.** NO CHANGE
B. her parents' and her three sisters.
C. her parents and her three sister's.
D. her parents and her three sisters.

50. **F.** NO CHANGE
G. months?
H. months.
J. months,

51. For the sake of the logic and coherence of Paragraph 2, Sentence 1 should be:

A. placed where it is now.
B. placed after Sentence 2.
C. placed after Sentence 4.
D. OMITTED, because the paragraph focuses only on Louisa's experiences.

[4] The Alcotts moved back to Concord, where Emerson
52
helped them buy a new home, almost completely bankrupt.
52
[5] By the age of fifteen, though, she was forced to going to work. [6] The future novelist toiled as a governess,
53
teacher, seamstress, laundress, and live-in household servant.

[3]

In conclusion, Louisa began to achieve some success
54
as a writer of short stories, and poetry. In 1862, she began
55
writing melodramatic novellas using the pen name A. M. Barnard. On her thirtieth birthday, Louisa volunteered to nurse soldiers, those of whom were wounded in the
56
American Civil War. This experience inspired her first serious book, *Hospital Sketches*, a collection of fictionalized accounts based on her letters home. Louisa, however, still had to supplement her earnings by taking in sewing until one of her publishers asked her to write a novel for young girls based on her family's life, and the rest was historical.
57

[4]

It took her just a few weeks to write *Little Women*, a book she disdained as a trivial morality tale for children, but
58

52. **F.** NO CHANGE
G. Almost completely bankrupt, the Alcotts moved back to Concord, where Emerson helped them buy a new home.
H. The Alcotts moved back to Concord where, almost completely bankrupt, Emerson helped them buy a new home.
J. The Alcotts moved back to Concord where Emerson, almost completely bankrupt, helped them buy a new home.

53. **A.** NO CHANGE
B. gone
C. went
D. go

54. **F.** NO CHANGE
G. In contrast,
H. Therefore,
J. Eventually,

55. **A.** NO CHANGE
B. short stories and poetry.
C. short, stories and of poetry.
D. short stories, and, poetry.

56. **F.** NO CHANGE
G. soldiers, those of whom had been wounded
H. soldiers wounded
J. soldiers, those that were wounded

57. **A.** NO CHANGE
B. and the rest is history.
C. the rest of which is historical.
D. with the rest of it being history.

58. **F.** NO CHANGE
G. adored
H. promoted
J. deranged

the book brought Louisa the fame she had always desired.

59

59. Which of the following true sentences, if inserted here, would best conclude the essay as well as maintain the tone established earlier in the essay?

A. What's really amazing is that Louisa took so long to write a best-seller; after all, she had studied with the greats of American literature.

B. Imagine her relief at finally being able to support the family that had suffered so many financial hardships in their life.

C. More important to Louisa than the fame, however, the financial success of *Little Women* made it possible for her to finally support her family.

D. By writing *Little Women*, Louisa May Alcott won the kind of fame that lives on long after the author has passed away.

Question 60 asks about the preceding passage as a whole.

60. Suppose the writer's purpose had been to write an essay summarizing the participation of women authors in 19th century literature. Would this essay accomplish that purpose?

F. Yes, because it uses a specific author's life as a general example of the lives of most female authors.

G. Yes, because it discusses how 19th century female authors often also had to do other forms of work.

H. No, because it focuses instead on an author who did not live and work in the 19th century.

J. No, because it focuses instead on the life and work of a single female author.

Passage V

The Common Law? Not in the Federal Courts.

The popular view of how laws are made are informed
61

by our understanding of the Constitution's separation of
62

powers. The power to create law is reserved for the
62

legislative branch, and other branches may only enforce it.

61. **A.** NO CHANGE
B. is
C. were
D. have been

62. **F.** NO CHANGE
G. the Constitutions separation of power's
H. the Constitution's separation of power's
J. the Constitutions separation of powers

There is another kind of law, though. The "common law" (63)
that emerges from the history of court decisions stretching back to 15th century Europe. It can guide judges in cracking (64) the written law, or even give them the authority to treat an act as a crime without a written law because the act is custom (65) treated as a crime. Because common law is based on a tradition of court decisions, it is created by the courts—not by the legislature. Moreover, it's still recognized in many U.S. states today.

[F] There is, one area though in which (66) common law has been very narrowly limited: federal criminal law. Ironically, the limitations come not from the legislature, but rather from a Supreme Court decision. However, (67) in the case of *United States v. Hudson and Goodwin*, two men were indicted for seditious libel, the crime of making false, damaging statements about a state authority, after they accused President Thomas Jefferson of conspiring to bribe (68) Napoléon Bonaparte. [G] There was no federal libel law, but there was a history of punishing libel, so they were indicted under the common law. After lower courts failed to resolve there (69) case, it went to the Supreme Court. [H] At trial, no arguments were offered by the attorney for the government, and no attorney even

63. **A.** NO CHANGE
B. kind of law, though: the "common law"
C. kind of law, though, the "common law"
D. kind of law. "Common law"

64. **F.** NO CHANGE
G. disengaging
H. opening up
J. interpreting

65. **A.** NO CHANGE
B. customary
C. accustomed
D. customarily

66. **F.** NO CHANGE
G. There is one area though in which
H. There is, one area though, in which
J. There is one area, though, in which

67. **A.** NO CHANGE
B. Likewise,
C. For example,
D. DELETE the underlined portion and capitalize the first letter of the next word.

68. Given that all of the choices are true, which one is the most relevant to the focus of the paragraph?

F. NO CHANGE
G. Napoléon agreed to the Treaty of Amiens with Spain
H. Jefferson imposed an unpopular embargo on European nations
J. the Supreme Court was defined in the constitution and lower courts were created later

69. **A.** NO CHANGE
B. their
C. they're
D. theirs

appears for the defense. [71] Thus, the Court was left to
70
decide a case that could dramatically limit the scope of

federal authority without any of that stuff.
72

[J] Because there was no federal law against libel and no specific constitutional authority for the federal courts to prosecute common law crimes, the Supreme Court ruled that
73
federal courts had no right to prosecute libel—or any other common law crime. Instead, they declared that the legislature must pass a law making an act a crime in order for federal courts to prosecute it as a crime.[74]

70. **F.** NO CHANGE
G. appeared
H. will appear
J. would appear

71. The writer is considering deleting the previous sentence. If the writer were to delete this sentence, would the overall meaning of the passage change?

A. Yes, because the sentence sets up the information that follows.
B. Yes, because the sentence explains the process by which the supreme court reaches decisions.
C. No, because the sentence serves only to repeat an earlier point.
D. No, because the details provided in this sentence contradict the main idea of the passage.

72. **F.** NO CHANGE
G. on pretty much nothing
H. with basically nothing to even decide on
J. without hearing any arguments

73. **A.** NO CHANGE
B. law crimes: the Supreme Court ruled
C. law crimes, and the Supreme Court ruled
D. law crimes. The Supreme Court ruled

74. The writer is planning to split the information in this paragraph into one paragraph that describes events leading up to the trial, and another that describes the trial and subsequent decision. The best point to divide the paragraph in order to achieve that goal would be:

F. F.
G. G.
H. H.
J. J.

1

Question 75 asks about the preceding passage as a whole.

75. Suppose the writer's primary purpose had been to tell the story of a change in the powers of federal courts. Would this essay accomplish that purpose?

A. Yes, because it discusses how the Supreme Court limited the powers of federal courts.

B. Yes, because it explains how the Supreme Court transferred the powers of state courts to federal courts.

C. No, because it is irrelevant whether federal courts can prosecute for common law crimes if state courts can do so.

D. No, because the passage focuses mainly on a specific case, rather than on legal matters in general.

End of Test 1.

Stop! Do not turn the page until you are told to do so.

Do not return to the previous test.

Mathematics Test

60 Minutes—60 Questions

DIRECTIONS: For each problem, solve for the correct answer and fill in the corresponding circle on your answer document.

Some problems may take a longer time to solve, but do not take too much time on any single problem. Solve the easier questions first, then return to the harder questions in the remaining time for this test.

A calculator is allowed on this test. While you may be able to solve some problems without a calculator, you are allowed to use a calculator for all of the problems on this test.

Note: Unless otherwise directed, all of the following statements are considered correct.

1. All drawn figures are NOT necessarily drawn to scale.
2. All geometric figures are in a plane.
3. The word *line*, when used, is the same as a straight line.
4. The word *average*, when used, is the same as arithmetic mean.

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1. Danielle, Arthur, and Carlos are responsible for bringing marshmallows to a party. Danielle has $1\frac{3}{4}$ bags, Arthur has $4\frac{2}{3}$, and Carlos has $3\frac{1}{2}$. How many bags of marshmallows do they have in total?

A. $8\frac{2}{3}$

B. $8\frac{11}{12}$

C. $9\frac{1}{2}$

D. $9\frac{11}{12}$

E. 10

2. Fourteen boards cost \$26. How many boards can be purchased for \$6?

F. 2

G. 3

H. 4

J. 5

K. 6

3. Which of the following values is smallest?

A. $\frac{26}{51}$

B. $\frac{1}{2}$

C. $\frac{6}{12}$

D. $\frac{3}{8}$

E. $\frac{51}{100}$

4. In the standard (x,y) coordinate plane, which of the following lines is parallel to the line defined by the equation $4y = 8x + 4$?

F. $-y = \frac{x+3}{2}$

G. $y = \frac{-5x-8}{10}$

H. $y = \frac{1-x}{2}$

J. $y = 2x + 4$

K. $y = -\frac{1}{2}x$

5. If $y = 2$, then $-3y(1-5) = ?$

A. –36

B. –24

C. –6

D. 12

E. 24

6. All 100 seniors at City High School who are enrolled in either calculus, statistics, or both. If 75 seniors are enrolled in calculus and 50 are enrolled in statistics, what is the probability that a randomly chosen senior is enrolled in both calculus and statistics?

F. $\frac{1}{8}$

G. $\frac{3}{16}$

H. $\frac{1}{4}$

J. $\frac{1}{2}$

K. Cannot be determined from the information given

Go On to the Next Page.

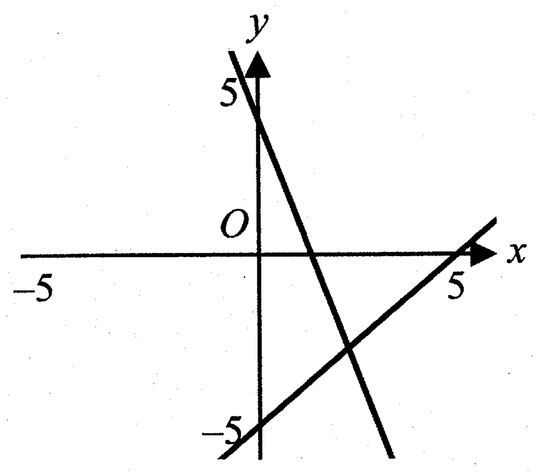
7. Point P is 6 units east of point M on a line, and point Q lies 9 units east of point N on the same line. If point N is 2 units east of point M, how many units are between point P and point Q?

A. 5
B. 6
C. 7
D. 8
E. 9

8. Otto is a traveling beach salesman. He sells beach balls for \$17 and bags of cotton candy for \$4. Every day, he travels along the same beach, and a fisherman gives him a \$2 tip. Which of the following expressions represents Otto's daily profit, in dollars, if he sells b beach balls and c bags of cotton candy?

F. $17b + 4c$
G. $17c + 4b$
H. $17c + 4b - 2$
J. $17b + 4c + 2$
K. $17c + 4b + 2$

9. How many solutions are there for the system of linear equations shown in the graph below?



A. 0
B. 1
C. 2
D. 3
E. Infinite

10. What is the smallest number that, when divided by 4 and 5, will yield a remainder of 2?

F. 12
G. 20
H. 22
J. 42
K. 84

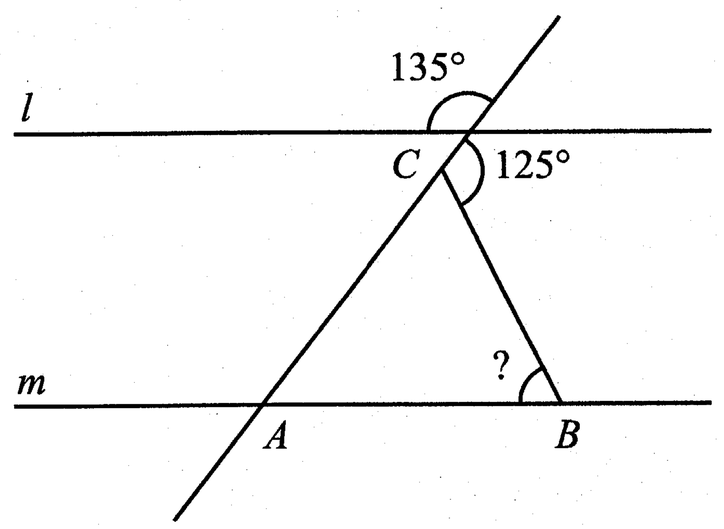
11. Which of the following is equivalent to $(3ab)^3 \cdot (2b)^2 \cdot (-a)^3$?

A. $-108a^6b^5$
B. $-108a^9b^6$
C. $-36a^6b^7$
D. $108a^6b^5$
E. $108a^9b^6$

12. Sausages are sold in drums of 660 and buns are sold in crates of 1,122. Nathan wants to buy the same number of sausages as buns. What is the minimum total number of drums and crates that Nathan must buy?

F. 11
G. 22
H. 27
J. 80
K. 121

13. In the figure below, lines l and m are parallel. What is the measure of $\angle ABC$?



A. 45°
B. 55°
C. 60°
D. 80°
E. 85°

14. Jose's wage of \$19 per hour is directly proportional to the wage of his manager, who is paid \$28 per hour. If Jose's manager's wage increases to \$33 per hour, what is Jose's new wage to the nearest cent?

F. \$20.86
G. \$22.39
H. \$23.53
J. \$24.00
K. \$24.11

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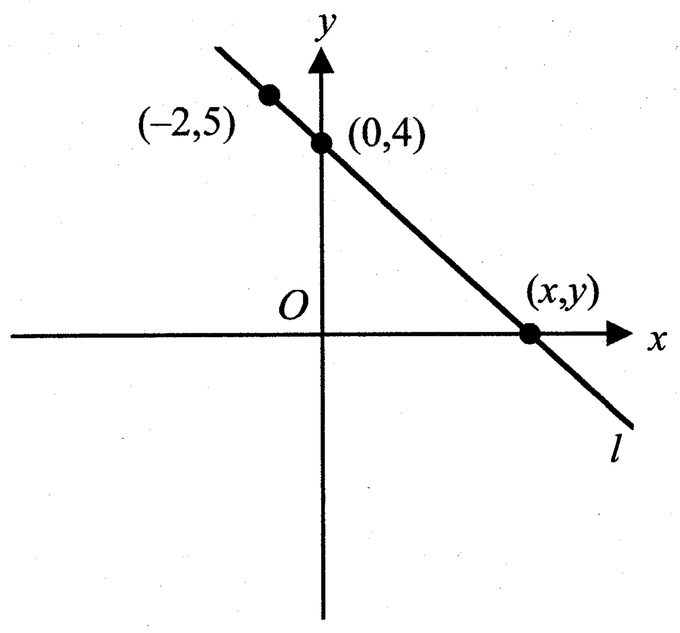
15. At what point (x,y) does line l cross the x-axis?

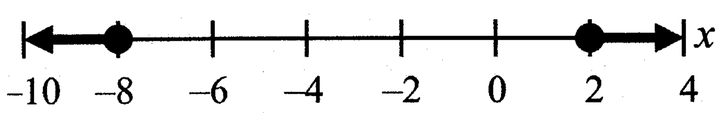


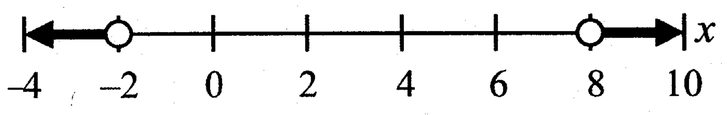
A. (0,4)
B. (2,0)
C. (4,0)
D. (0,8)
E. (8,0)

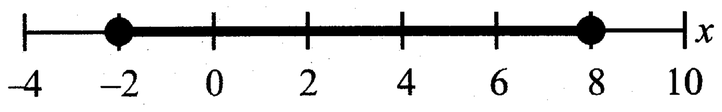
16. Kyle has determined that it will cost him \$90 to paint the 4 walls of his square bedroom. The walls measure six feet in height and the area of his room's floor is 225 square feet. What is the cost of the paint, per square foot?

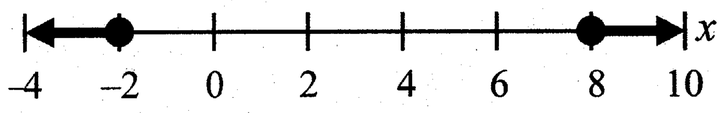
F. \$0.20
G. \$0.25
H. \$0.30
J. \$0.35
K. \$0.40

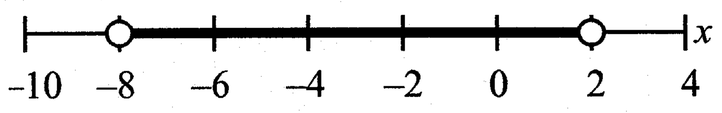
17. Which of the following number lines represents the inequality $|2(x-3)| \geq 10$?

A.


B.


C.


D.


E.


18. Mitch purchased a bottle of mustard on sale for \$4.50, and Craig purchased a smaller bottle at full price for \$3.20. Mitch noticed that the costs per unit of volume of mustard were the same. If Craig's bottle contained 500 mL of mustard and Mitch's contained x mL of mustard, which of the following equations does NOT express the relationship between the volume and cost of Craig's mustard and Mitch's mustard?

F. $\frac{3.2}{500} = \frac{4.5}{x}$
G. $\frac{3.2}{4.5} = \frac{500}{x}$
H. $\frac{4.5}{3.2} = \frac{x}{500}$
J. $\frac{500}{3.2} = \frac{x}{4.5}$
K. $\frac{4.5}{500} = \frac{3.2}{x}$

19. What is the sum of the 2 roots of the equation $x^2 - 7x - 60 = 0$?

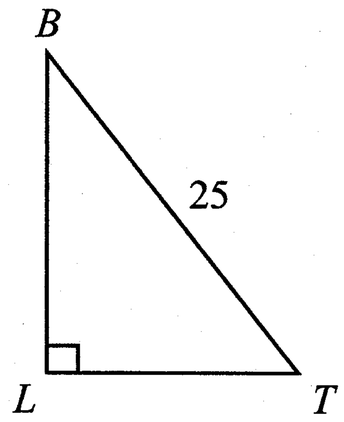
A. –19
B. –7
C. 7
D. 17
E. 19

20. Ella is making a princess costume which includes a tiara, a gown, a pair of gloves, and a pair of shoes. If she chooses from 7 tiaras, 9 gowns, 4 pairs of gloves, and 3 pairs of shoes, how many possible different costumes could she make?

F. 8
G. 16
H. 28
J. 40
K. 756

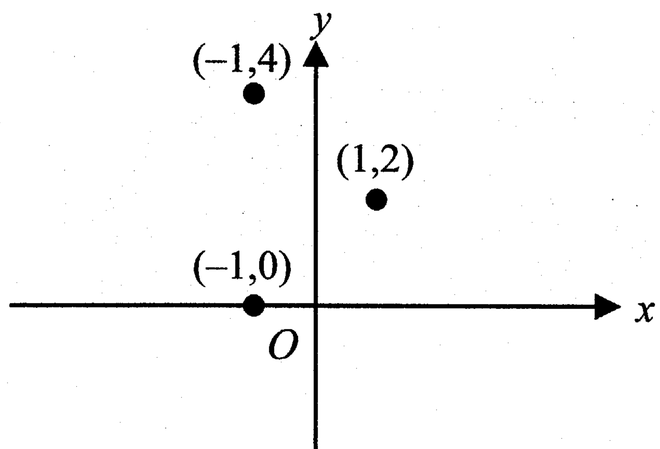
Go On to the Next Page.

21. The hypotenuse of the right triangle ΔBLT shown below is 25 meters. The tangent of $\angle T$ is $\frac{4}{3}$. How many meters long is $\overline{BL}$?



A. 3
B. 4
C. 9
D. 16
E. 20

22. In the standard (x,y) coordinate plane below, 3 of the 4 vertices of a square are shown. Which of the following coordinates is the fourth vertex of the square?



F. (–3,2)
G. (–3,3)
H. (–3,1)
J. (–2,2)
K. (–2,1)

23. If $2^x \cdot 8^2 = 16^2$, then $x = ?$

A. 0
B. 1
C. $\frac{4}{3}$
D. 2
E. 3

24. Which of the following statements is FALSE?

F. The sum of any 2 odd numbers is even.
G. The sum of any 2 even numbers is even.
H. The sum of any odd number and any even number is odd.
J. The product of any odd number and any even number is even.
K. The product of any 2 odd numbers is even.

25. Alex has noticed that the price of a dozen apples has been increasing steadily. Alex's data are shown in the table below.

Year	2010	2011	2012	2013	2014
Price of a dozen apples ($)	6.75	6.84	6.93	7.02	7.11

If the price of a dozen apples over time can be expressed in the form $y = mx + b$, where y is the price of apples and x is the year, what is the value of m?

A. 0.09
B. 0.13
C. 0.18
D. 0.27
E. 0.32

26. Which of the following is equivalent to the inequality $2x + 5 > x - 11$?

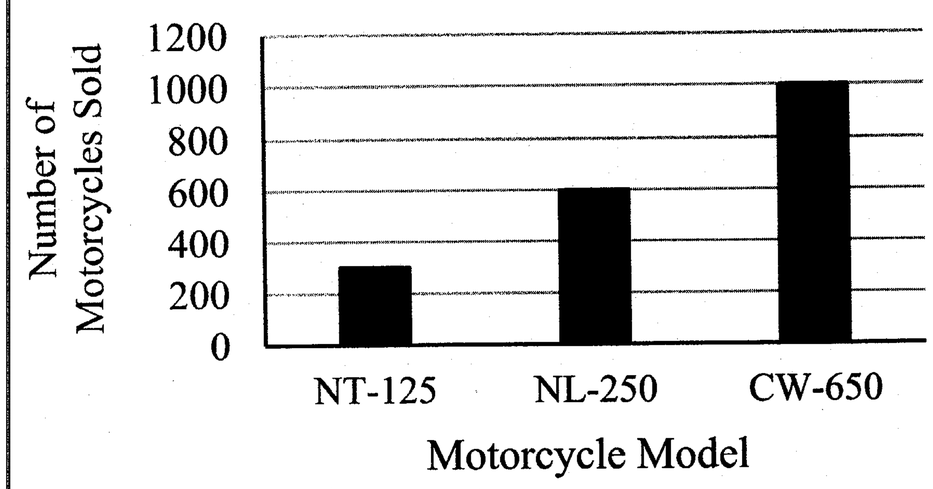
F. $x > -16$
G. $x < -16$
H. $x > 16$
J. $x > -8$
K. $x < 8$

27. When $\frac{(x^2 - 1)}{(x + 1)}$ is written in the form $y = mx + b$, where m and b are integers, what is the value of $m + b$?

A. –2
B. –1
C. 0
D. 1
E. 2

Go On to the Next Page.

28. The graph below shows the number of different motorcycle models Grant's Bikes sold in 2014. In 2015, if sales increased by 400 for NL-250 models, decreased by 200 for CW-650 models, and stayed the same for the NT-125 model, by approximately what percent of total sales did the NT-125 model's sales change between 2014 and 2015?



F. –10%

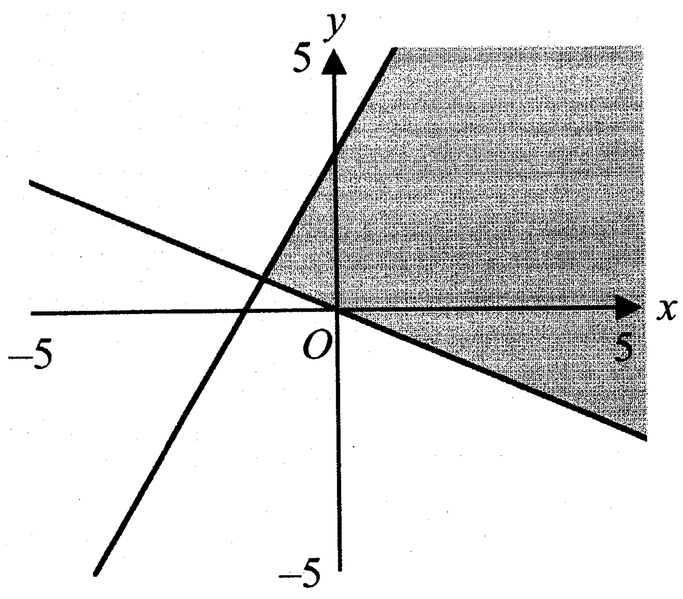
G. –5%

H. –2%

J. +2%

K. +5%

29. Which of the following systems of inequalities is represented by the shaded region of the graph below?



A. $y \leq 2x + 3$ and $y \geq -\frac{1}{2}x$

B. $y \leq 2x + 3$ or $y \geq -\frac{1}{2}x$

C. $y \geq 2x + 3$ and $y \geq -\frac{1}{2}x$

D. $y \geq 2x + 3$ or $y \geq -\frac{1}{2}x$

E. $y \leq 2x + 3$ and $y \leq -\frac{1}{2}x$

30. What is the sum of the first 12 terms of the arithmetic sequence 19, 13, 7, 1…?

F. 40

G. –162

H. –168

J. –204

K. –240

31. The median of a set of data containing 5 numbers is known. Two numbers were added to the set. One of these numbers was greater than the original median, and 1 was less than the original median. Which of the following statements *must* be true about the median of the new data set?

A. It is less than the original median.

B. It is greater than the original median.

C. It is the same as the original median.

D. It is equal to the mean of the 2 new values.

E. None of the above statements are true.

32. In the figure below, isosceles triangle ΔBEF is located between two parallel lines, $\overline{AC}$ and $\overline{DG}$. Lines $\overline{BE}$ and $\overline{BF}$ are congruent. If $\angle ABE$ is equal to $2x - 10°$ and $\angle BFE$ is equal to $x + 30°$, what is the value of $\angle EBF$?

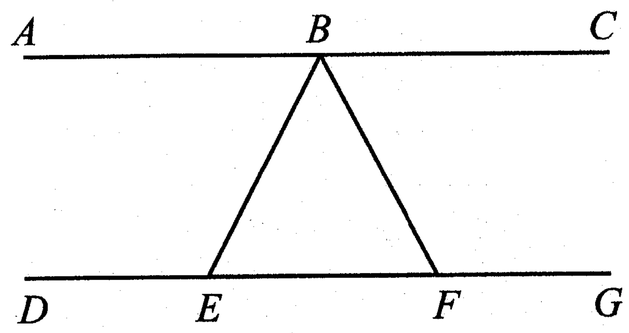
F. 20°

G. 30°

H. 40°

J. 70°

K. 100°



33. x is a positive integer greater than 1. If $x^{\frac{a}{b}} < 1$, which of the following relations *must* be true?

A. $a < b$

B. $a > b$

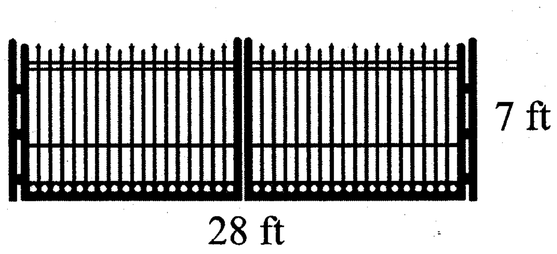
C. $\frac{a}{b} < 0$

D. $\frac{a}{b} > 0$

E. $\frac{a}{b} = 0$

Go On to the Next Page.

34. Miriam plans to build a large gate at the end of her driveway as shown below. The height of the gate is 7 feet, and the width is 28 feet. Which of the following expressions represents the relationship of the gate's height (h) to its width (w)?



F. $h = w - \frac{1}{28}w^2$

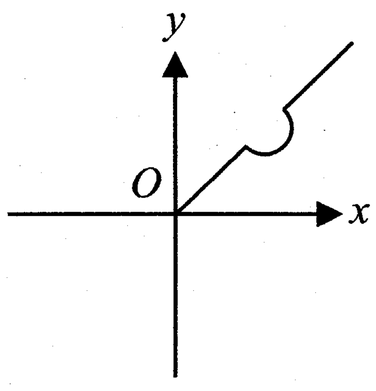
G. $7h = 28w$

H. $\frac{4h+1}{w} = \frac{w+1}{4h}$

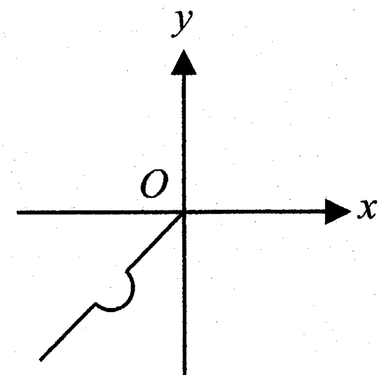
J. $h = \frac{1}{7}w + 4$

K. $h = w^2 - 7w + 4$

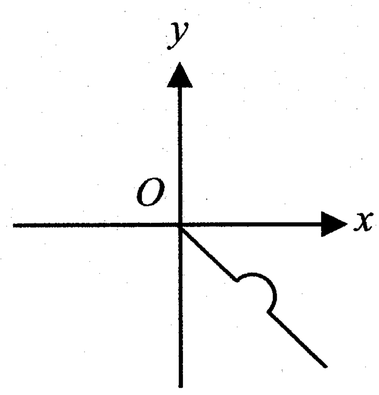
35. The graph shown below in the standard (x,y) coordinate plane is rotated 180° clockwise about the origin. Which of the following graphs shows the result of this rotation?



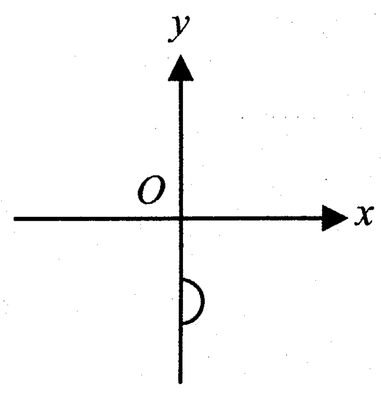
A.



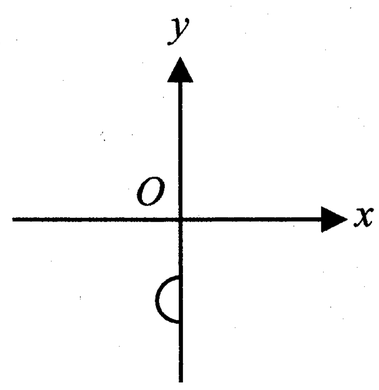
B.



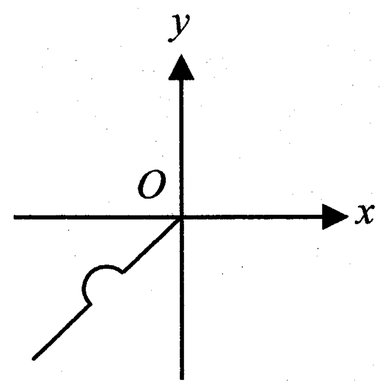
C.



D.



E.



36. What is the matrix product $\begin{bmatrix}5 & 1 & 4\end{bmatrix}\begin{bmatrix}3\\8\\2\end{bmatrix}$?

F. $\begin{bmatrix}15 & 8 & 8\end{bmatrix}$

G. $\begin{bmatrix}15\\8\\8\end{bmatrix}$

H. $[31]$

J. $\begin{bmatrix}15 & 3 & 12\\40 & 8 & 32\\10 & 2 & 8\end{bmatrix}$

K. $\begin{bmatrix}15 & 40 & 12\\3 & 8 & 32\\12 & 32 & 8\end{bmatrix}$

37. A circle has a radius of 6 units and its center is at (3,2). What is the equation of the circle?

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

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

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

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

E. $(x+3)^2 + (y+2)^2 = 36$

38. In order for seedless watermelons to grow, $\frac{1}{3}$ of all plants in the field must be pollinators, and $\frac{2}{3}$ must be fruit-bearing. If a farmer plants 3,111 watermelons per acre on a field that is 26 acres, how many plants will be pollinators?

F. 20,221

G. 26,962

H. 35,472

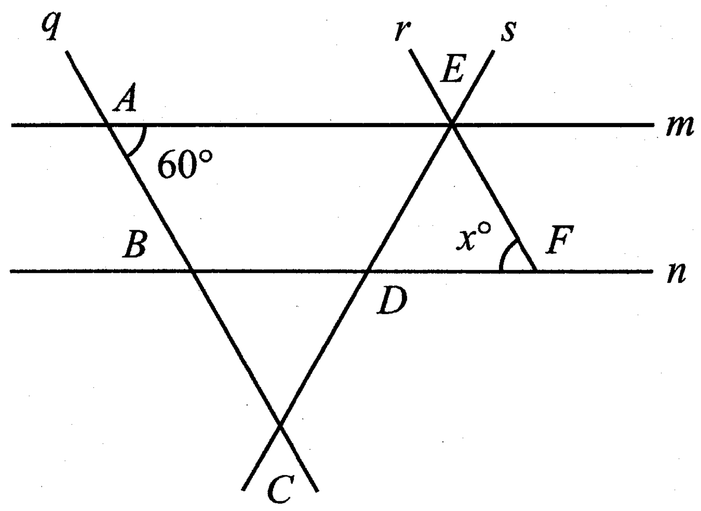
J. 53,924

K. 80,886

Go On to the Next Page.

2

39. In the figure below, lines m and n are parallel, and transversals q and s intersect to form the equilateral triangle ΔBCD. If $\angle E$ is equal to $\angle C$, what is the value of x?



A. 60
B. 70
C. 80
D. 100
E. 120

Use the following information to answer questions 40-41.

Event planners are setting up tables for their event. Each table holds a maximum of 5 people and the room holds 15 tables. Since the event is for charity, some donors are allowed 2 free tickets each, and other tickets are sold in advance.

40. If the planners sell 60% of their tickets and 20% of the remaining tickets are given to donors, how many tickets are left over?

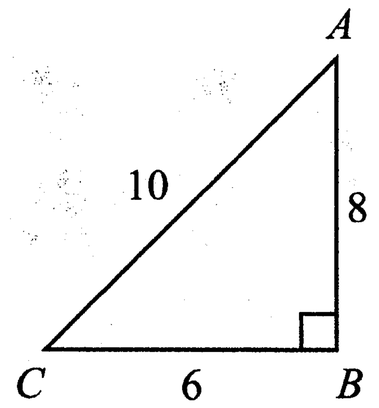
F. 15
G. 21
H. 24
J. 45
K. 60

41. A minimum of 2 people must sit at each table. If 60 people come to the event and NO tables are empty, what is the maximum possible number of full tables?

A. 8
B. 9
C. 10
D. 11
E. 12

42. For the right triangle shown below, which of the following statements is FALSE?

F. $\cot(C) = \frac{6}{8}$
G. $\csc(C) = \frac{10}{8}$
H. $\tan(C) = \frac{6}{8}$
J. $\sin(C) = \frac{8}{10}$
K. $\cos(C) = \frac{6}{10}$



43. The point $(3, -5)$ is reflected across the x-axis and translated 4 units down and 5 units left. What quadrant was the point originally in, and what quadrant is it located in now?

A. Quadrant I, now Quadrant II
B. Quadrant II, now Quadrant IV
C. Quadrant IV, now Quadrant I
D. Quadrant IV, now Quadrant II
E. Quadrant IV, now Quadrant IV

44. A tightrope walker is stringing 2 ropes, r and s, between the roofs of 2 parallel buildings of the same height, A and B. He fastens them so that they form straight lines between the buildings. Rope r is attached to building A, with an interior angle of 75°. Rope s is attached to building A so that it intersects rope r at rope r's midpoint, forming a 15° angle with rope r. What is a possible angle used to attach rope s to building A?

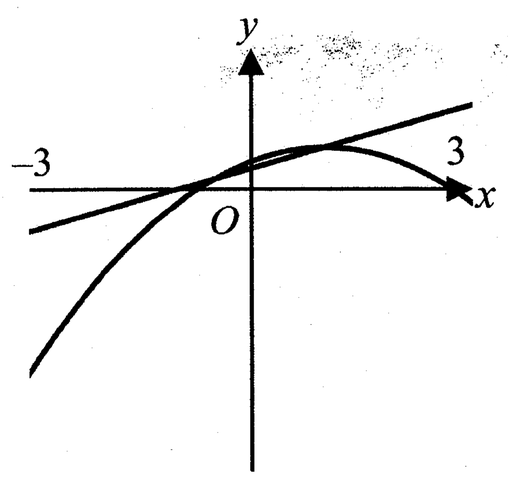
F. 15°
G. 30°
H. 45°
J. 80°
K. 90°

45. Two perpendicular lines intersect at the point $(-3,1)$ in the (x,y) coordinate plane. If one of the lines crosses through the point $(0,2)$, where does the other line intersect with the y-axis?

A. $(-4, 0)$
B. $(-2, 0)$
C. $(0, -2)$
D. $(0, -4)$
E. $(0, -8)$

Go On to the Next Page.

46. The equation of a parabola is $-(x-1)^2+3=y$. A line with an x-intercept of $(-1,0)$ intersects with the parabola at its vertex in the standard (x,y) coordinate plane, as shown in the graph below. What is the slope of the line that intersects with the parabola?



F. -2

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

H. $-\frac{1}{2}$

J. 1

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

47. A 3-inch-by-7-inch rectangle is inscribed in a circle, as shown below. What is the radius of this circle, in inches?

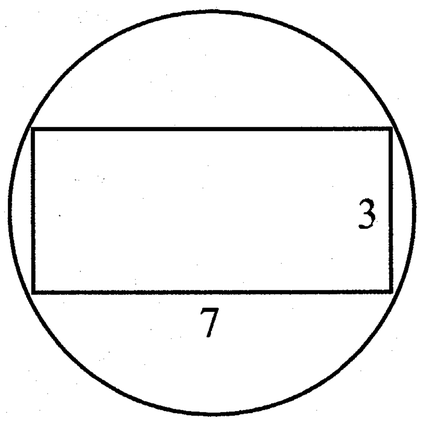
A. $\frac{7}{2}$

B. $\frac{\sqrt{58}}{2}$

C. $\frac{\sqrt{85}}{2}$

D. $\sqrt{58}$

E. 85



48. In the standard (x,y) coordinate plane, the points P, Q, and R have coordinates $(7,-1)$, $(-1,-3)$, and $(-5,-6)$. Which of the following expresses the average distance from P to R and Q to R?

F. 6

G. 7

H. 8

J. 9

K. 10

49. If $\log_x a = p-q$ and $\log_x b = -q$, then $\log_x(ab) = ?$

A. p

B. $p+q$

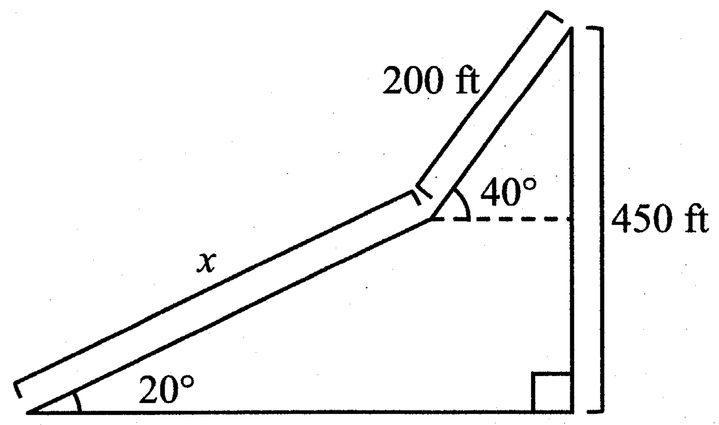
C. $p-q$

D. $p+2q$

E. $p-2q$

50. Julie slides down the longest slide at the waterpark, as shown below. How long is the lower, less steep portion of the slide (x), to the nearest foot?

(Note: You may use the following values, which are accurate to 2 decimal points: $\sin 20° = 0.34$; $\cos 20° = 0.94$; $\tan 20° = 0.36$; $\sin 40° = 0.64$; $\cos 40° = 0.77$; $\tan 40° = 0.84$)



F. 322

G. 343

H. 376

J. 947

K. 1,324

51. A formula used to compute the future value of a savings account is $A = P(1+r)^n$, where A is the future value, P is the initial amount deposited, r is the interest rate for one compounding period, expressed as a decimal, and n is the number of years. Mrs. Skye decides to deposit a principal of \$400 into her savings account when the interest rate is 0.5%. If Mrs. Skye takes out her investment after 3.5 years, which of the following is closest to the value of her savings account at that time?

A. \$ 407.00

B. \$ 407.04

C. \$ 412.20

D. \$ 474.49

E. \$1,407.00

Go On to the Next Page.

52. If $f(x) = x^2 + 3$ and $g(x) = \frac{\sqrt{x}}{2}$, what is the value of $f(g(9))$?

F. $\frac{9}{2}$

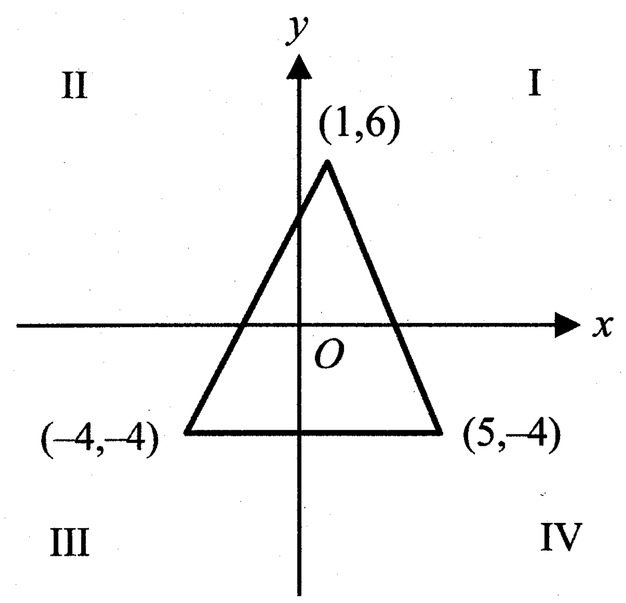
G. $\frac{15}{4}$

H. $\frac{21}{4}$

J. 3

K. 6

53. To the nearest percent, what percent of the area of the triangle below, graphed in the standard (x,y) coordinate plane, is located in the second quadrant?



A. 5%

B. 9%

C. 15%

D. 27%

E. 40%

54. Line $\overline{AB}$ has endpoints at (2,3) and (–7,–19). What are the coordinates of the midpoint of line $\overline{AB}$?

F. $\left(-\frac{5}{2}, -8\right)$

G. (–5,–16)

H. (–9, –8)

J. (–9, 8)

K. $\left(-\frac{9}{2}, -8\right)$

55. The force of gravity (F_G) between 2 objects is related to the product of their masses (m_1 and m_2) and to the distance that separates their centers (r) according to the equation $F_G = \frac{Gm_1m_2}{r^2}$, where G is a constant. If the distance between the 2 objects is tripled and the mass of the first object is halved, the force of gravity between the two objects changes by what factor?

A. $\frac{1}{18}$

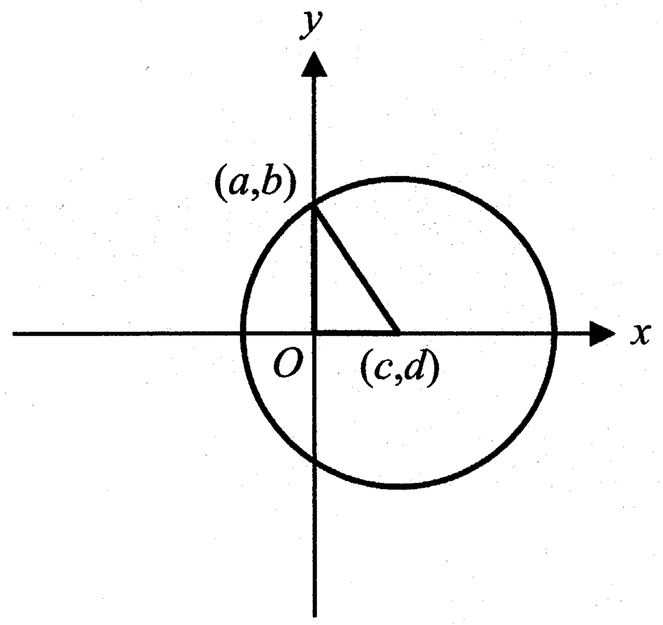
B. $\frac{1}{6}$

C. 2

D. 3

E. 9

56. A triangle is drawn in a circle on an (x,y) coordinate plane, as shown below.



If the circle with center (c,d) intersects the x-axis at points (–2,0) and (8,0), and the y-axis at (a,b). what is the sum of the values for a, b, c, and d?

F. 9

G. 8

H. 7

J. 6

K. 5

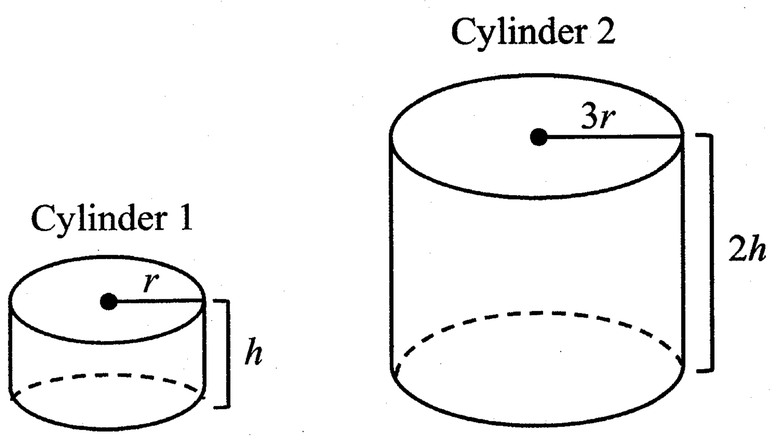
Go On to the Next Page.

57. The function $f(x) = x^3 + 3$ is modified to create $g(x)$. If $g(-x) = -g(x)$, how is $f(x)$ modified to create $g(x)$?

A. $f(x)$ is reflected across the x-axis
B. $f(x)$ is reflected across the y-axis
C. $f(x)$ is translated 3 units right
D. $f(x)$ is translated 3 units down
E. $f(x)$ is rotated about the point (0,0)

58. Two cylinders are shown below, with height and radius indicated. What is the relationship between the volume of Cylinder 1 (V_1) and the volume of Cylinder 2 (V_2)?

(Note: The formula for the volume of a cylinder is $V = \pi r^2 h$, where r is radius and h is height.)

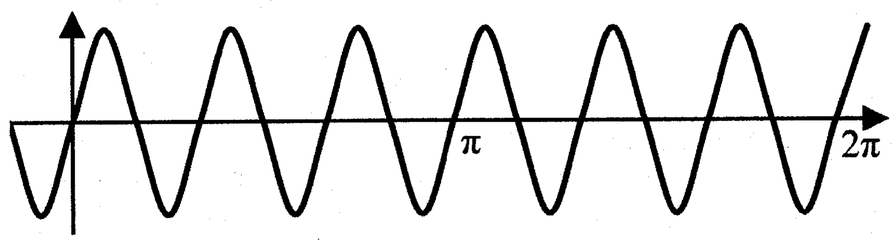


F. $V_2 = V_1$
G. $V_2 = 3V_1$
H. $V_2 = 6V_1$
J. $V_2 = 9V_1$
K. $V_2 = 18V_1$

59. What is the value of i^{1023}? (Note: $i = \sqrt{-1}$)

A. $-i$
B. -1
C. i
D. 1
E. $\sqrt{i}$

60. A trigonometric function with equation $f(x) = a\sin(bx)$, where a, b, and x are real numbers, is graphed in the standard (x,y) coordinate plane below. The *period* (ω) of the function $f(x)$ is the smallest positive number p such that $f(x + p) = f(x)$ for every real number x. Which of the following is the period of this function?



F. $\frac{\pi}{3}$
G. $\frac{\pi}{2}$
H. $\frac{2\pi}{3}$
J. π
K. $\frac{3\pi}{2}$

End of Test 2.

Stop! Do not turn the page until you are told to do so.

Do not return to the previous test.

3

Reading Test

35 Minutes—40 Questions

DIRECTIONS: There are multiple passages on 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 circle on your answer document. You may refer to the passages as often as necessary.

Passage I

Prose Fiction: This passage is adapted from the story "Expiation," by Edith Wharton. Originally published in 1903, the story is set in the early 1900s in New York City, and follows a period in the career of the young Paula Fetherel.

Mrs. Fetherel was the kind of woman whose emotions never communicate themselves to her clothes—and the conventional background of the New York drawing-room, with its pervading implication of an imminent tea-tray and of an atmosphere in which the social functions have become purely reflex, lent to her declaration a relief not unnoticed by her cousin Mrs. Clinch.

"The newspaper clippings," Mrs. Fetherel whispered.

Mrs. Clinch smiled. "Well," she said, "I suppose you were prepared for the consequences of authorship?"

Mrs. Fetherel blushed brightly. "It isn't their coming," she owned—"it's their coming *now*."

"Now?"

"The Bishop's in town."

"Well—weren't you prepared for the Bishop?"

"Not now—at least, I hadn't thought of his seeing the clippings."

"And why should he see them?"

"Bella—*won't* you understand? It's John. He has taken the most unexpected tone—one might almost say out of perversity."

"Oh, perversity—" Mrs. Clinch murmured, observing her cousin between lids wrinkled by amusement. "What tone has John taken?"

Mrs. Fetherel threw out her answer with the desperate gesture of a woman held by a marital grasp. "The tone of being proud of my book."

Mrs. Clinch laughed.

"Oh, you may laugh," Mrs. Fetherel insisted, "but it's no joke to me. In the first place, John's liking the book is so—so—false—it puts me in such a ridiculous position; and then it has set him watching for the reviews—who would ever have suspected John of knowing that books were *reviewed?* Why, he's actually found out about the Clipping Bureau, and whenever the postman rings I hear John rush out of the library to see if there are any yellow envelopes. Of course, when they *do* come he'll bring them into the drawing-room and read them aloud to everybody who happens to be here—and the Bishop is sure to happen to be here!"

Mrs. Clinch repressed her amusement. "The picture you draw is a lurid one," she conceded, "but your modesty strikes me as abnormal, especially in an author. The chances are that some of the clippings will be rather pleasant reading. The critics are not all union men."

Mrs. Fetherel stared. "Union men?"

"Well, I mean they don't all belong to the well-known Society-for-the-Persecution-of-Rising-Authors. Some of them have even been known to defy its regulations and say a good word for a new writer."

"Oh, I dare say," said Mrs. Fetherel, with the laugh her cousin's remark warranted. "But you don't quite see my point. I'm not at all nervous about the success of my book—my publisher tells me I have no need to be—but I *am* afraid of its being a succès de scandale."

"Mercy!" said Mrs. Clinch, sitting up.

The butler and footman at this moment appeared with the tea-tray, and when they had withdrawn, Mrs. Fetherel, bending her brightly rippled head above the kettle, confided, "I suppose to experienced authors there's always something absurd in the nervousness of a new writer, but in my case so much is at stake; I've put

Go On to the Next Page.

so much of myself into this book and I'm so afraid of being misunderstood... of being, as it were, in advance of my time... like poor Flaubert... I *know* you'll think me ridiculous... and if only my own reputation were at stake, I should never give it a thought... but the idea of dragging John's name through the mud..."

Mrs. Clinch, who had risen and gathered her cloak about her, stood surveying from her genial height her cousin's agitated expression.

"Why did you use John's name, then?"

"That's another of my difficulties! I *had* to. There would have been no merit in publishing such a book under an assumed name; it would have been an act of moral cowardice. A writer who dares to show up the hollowness of social conventions must have the courage of her convictions and be willing to accept the consequences of defying society. Can you imagine Ibsen or Tolstoy writing under a false name?" Mrs. Fetherel lifted a tragic eye to her cousin. "You don't know, Bella, how often I've envied you since I began to write. I used to wonder sometimes—you won't mind my saying so?—why, with all your cleverness, you hadn't taken up some more exciting subject than natural history; but I see now how wise you were. Whatever happens, you will never be denounced by the press!"

"Is that what you're afraid of?" asked Mrs. Clinch, as she clutched her umbrella.

Mrs. Fetherel lifted an undaunted brow. "I'm not afraid," she proclaimed; and at the same instant she dropped her spoon with a clatter and shrank back into her seat. "There's the bell," she exclaimed, "and I know it's the Bishop!"

1. At the time of the events of the story, Mrs. Fetherel is:

A. a successful and established novelist.
B. a newly published author.
C. an expert natural historicist.
D. a homemaker and aspiring writer.

2. It can reasonably be inferred from the passage that John is Mrs. Fetherel's:

F. son.
G. husband.
H. brother.
J. father.

3. The statement that John's interest in the reviews of Mrs. Fetherel's book is "out of perversity" (line 23) is meant to suggest that Mrs. Fetherel feels that:

A. John has been using this interest to make unwelcome advances toward Mrs. Fetherel.
B. John is incensed by Mrs. Fetherel's depiction of him in the book.
C. John's interest in book reviews is extreme and embarrassing.
D. John is a devoted fan of literature almost to the point of obsession.

4. The passage states that Mrs. Fetherel is apprehensive about the reviews of her book for all of the following reasons EXCEPT that she:

F. believes the reviews will cause a scandal.
G. worries what the Bishop will think of the reviews.
H. is afraid the reviews will prevent the success of her book.
J. is anxious about potentially damaging John's reputation.

5. Details in the passage suggest that the relationship between Mrs. Fetherel and Mrs. Clinch is:

A. suspicious and distant.
B. insincere and forced.
C. businesslike and formal.
D. candid and close.

6. The passage suggests that Mrs. Clinch reacts to Mrs. Fetherel's worry about the reviews of her book with:

F. hostility.
G. amusement.
H. skepticism.
J. concern.

Go On to the Next Page.

3

7. Why does Mrs. Fetherel say she is "like poor Flaubert" (line 67)?

A. To illustrate the extent of her literary ambition

B. To compare Flaubert's nervousness about reviews to her own

C. To demonstrate her concern that, like Flaubert, she will not be understood

D. To acknowledge that Flaubert would find her apprehension uncalled for

8. The passage states that Mrs. Fetherel used her real name in writing her book because she:

F. believed using her real name was an ethical obligation.

G. wanted the fame that comes with becoming a household name.

H. hoped to expose John, who inspired a character in the book.

J. wished to copy exactly the literary style of writers like Ibsen and Tolstoy.

9. The passage suggests that Mrs. Fetherel dropped her spoon and shrank into her seat as a result of:

A. her indignation at something Mrs. Clinch said.

B. Mrs. Clinch's startling her with a sudden movement.

C. her sudden realization that John would be angry about the reviews.

D. the bell ringing, suggesting the presence of the Bishop.

10. The passage suggests that Mrs. Fetherel:

F. has not seen the Bishop in some time and is excited to see him.

G. is afraid of the Bishop because of his unsavory character.

H. is worried about how the Bishop will react to the reviews of her book.

J. is concerned that the Bishop has already read her book and views it critically.

Go On to the Next Page.

3

Passage II

Social Science: This passage is adapted from the article "Genome Editing Poses Ethical Problems That We Cannot Ignore" by Anthony Wrigley and Ainsley Newson (©2015 Anthony Wrigley and Ainsley Newson).

The ability to precisely and accurately change almost any part of any genome, even in complex species such as humans, may soon become a reality through genome editing. But with great power comes great responsibility—and few subjects start such heated debates about moral rights and wrongs.

Genome editing offers a greater degree of control and precision in how specific DNA sequences are changed than previous genetic engineering techniques do. It could be used in basic science, for human health, or improvements to crops. There are a variety of techniques, but "clustered regularly inter-spaced short palindromic repeats," or CRISPR, is perhaps the foremost. CRISPR has prompted recent calls for a genome editing moratorium from a group of concerned United States academics. Because it is the easiest technique to set up and so could be quickly and widely adopted, the fear is that it may be put into use far too soon, outstripping our understanding of its safety implications and preventing any opportunity to think about how such powerful tools should be controlled.

Ethical concerns over genetic modification are not new, particularly when it comes to humans. However, as more researchers use CRISPR to achieve more genome changes, the implications shift. Our consideration of a technology that is rarely used and only in specific cases will differ from one that is widely used and put to all sorts of uses. Should we reach this tipping point, we will have to reconsider the conclusions of the first few decades of the genetic modification debate. Currently, modifying plants, some animals, and non-inheritable cells in humans is allowed under strict controls. But modifications that alter the human germ-line are not allowed, with the exception of the recent decision in the UK to allow mitochondrial replacement.

While this may mean weighing up potential benefits, risks, and harms, as the potential applications of genome editing are so broad, even this sort of assessment isn't straightforward. Genome editing techniques have so far been used to change genomes in individual cells and in entire (non-human) organisms. Benefits have included better-targeted gene therapy in animal models of some diseases, such as Duchenne Muscular Dystrophy. It's also hoped that it will lead to a better understanding of the structure, function, and regulation of genes. Genetic modification through genome editing of plants has already created herbicide- and infection-resistant crops.

But more contentious is how genome editing might be used to change traits in humans. While this has been the basis for many works of fiction, in real life our capacity to provide the sort of genetic engineering seen in films and books such as *Gattaca* and *Brave New World* has been quite limited. Genome editing potentially changes this, presenting us with the very real possibility that any aspect of the human genome could be manipulated as we desire. This could mean eliminating harmful genetic conditions, or enhancing traits deemed advantageous, such as resistance to diseases. But this ability may also open the door to eugenics, where those with access to the technology could select for traits they prefer, such as eye, skin or hair color, or height.

The concern prompting the United States academics' call for a ban is the potential for altering the human germ-line, making gene alterations inheritable by our children. Gene therapies that produce non-inheritable changes in a person's genome are ethically accepted, in part because there is no risk for the next generation if things go wrong. However to date only one disease—severe combined immunodeficiency—has been cured by this therapy.

Germ-line alterations pose much greater ethical concerns. A mistake could harm future individuals by placing that mistake in every cell. Of course the flip side is that, if carried out safely and as intended, germ-line alterations could also provide potentially permanent solutions to genetic diseases. No research is yet considering this in humans, however.

Nevertheless, even if changes to the germ-line turn out to be safe, the underlying ethical concerns of scope and scale that genome editing brings will remain. If a technique can be used widely and efficiently, without careful oversight governing its use, it can readily become a new norm or an expectation. Those unable to access the desired genetic alterations, be they humans with diseases, humans without enhanced genetic characteristics, or farmers without genetically modified animals or crops, may all find themselves gravely and unfairly disadvantaged.

Go On to the Next Page.

3

11. The authors' attitude toward the main subject of the passage can best be described as:

A. complete fascination.
B. reasoned concern.
C. mild interest.
D. detached appreciation.

12. According to the passage, CRISPR is considered the:

F. only precise form of genetic engineering.
G. least dangerous gene therapy.
H. most effective type of genetic modification.
J. easiest genome editing technique to use.

13. As it is used in line 36, the phrase *weighing up* most nearly means:

A. pricing.
B. evaluating.
C. measuring out.
D. seeking.

14. The passage states that compared to current gene therapies, germ-line alterations are:

F. much more risky.
G. much less risky.
H. ethically accepted.
J. more efficient.

15. The word *manipulated*, as it is used in line 57, most nearly means which of the following?

A. Deceived
B. Maneuvered
C. Altered
D. Plotted

16. According to the passage, most regulators do NOT allow genetic modifications on:

F. the human germ-line.
G. any human cells.
H. non-inheritable human cells.
J. most plants.

17. One of the main purposes of the final paragraph is to:

A. prove that proposed genetic alterations are safe.
B. describe potential uses for genetic modifications.
C. summarize the negative possibilities associated with genetically modifying animals.
D. outline one of the major concerns about the adoption of genome editing.

18. In lines 50-54, the authors refer to *Gattaca* and *Brave New World* most likely to emphasize that:

F. the types of genetic engineering they depict are currently possible using CRISPR.
G. changes to human genes that were once impossible could become achievable.
H. works of fiction can influence the use of genome editing in modern society.
J. the altered human traits demonstrated in these works are highly contentious.

19. It can reasonably be inferred from the passage that:

A. some types of genetic modification are allowed on plants but not humans.
B. CRISPR is the only method scientists use for genome editing.
C. the demand for germ-line alterations has led to numerous scientific breakthroughs.
D. no genome editing research is currently performed in the United States.

20. The passage indicates that CRISPR and genome editing could lead to both:

F. decreased research on genetic diseases and new moral questions.
G. potential health benefits for humans and expanded ethical debates.
H. the selection of desirable genetic traits and fewer gene therapies.
J. more genetically modified crops and fewer restrictions on their use.

Go On to the Next Page.

3

Passage III

Humanities: Passage A is adapted from the essay "We're Obsessed With Zombies—Which Says A Lot About Today" by Joseph Gillings (©2015 Joseph Gillings). Passage B is adapted from "Frankenstein or Krampus? What Our Monsters Say About Us" by Natalie Lawrence (©2015 Natalie Lawrence).

Passage A by Joseph Gillings

The zombie invasion is here. Our bookshops, cinemas, and TVs are dripping with the debris of their relentless shuffle to cultural domination.

Since at least the late 19th century, each generation has created fictional enemies that reflect a broader unease with cultural or scientific developments. As the industrial revolution steamed ahead, the speculative fiction of authors such as H. G. Wells began to consider where scientific innovation would take mankind. This trend reached its height in the Cold War during the 1950s and 1960s. Radiation-mutated monsters and invasions from space seen through the paranoid lens of communism all postulated the imminent demise of mankind.

In the 1950s, "the golden age of nuclear fear," radiation and its fictional consequences were the flip side to a growing faith that science would solve the world's problems. In many respects, we are now living with the collapse of this faith. Today we live in societies dominated by an overarching anxiety reflecting the risk associated with each unpredictable scientific development. People have lost faith in assumptions of social and scientific "progress."

As the faith in inexorable scientific "progress" recedes, politics is transformed. The groups emerging from outside the political mainstream engage in much older battles of faith and identity. Whether partisan nationalists or religious fundamentalists, they seek to build "imagined communities" through race, religion, or culture, and "fear" is their currency.

Modern zombies are the product of this globalized, risk-conscious world. No longer the work of a single "mad" scientist re-animating the dead, they now appear as the result of secret government programs creating untreatable viruses. The zombies indiscriminately overwhelm states irrespective of wealth, technology, and military strength, turning all order to chaos. This is a relentless enemy, seeking to cause death and destruction with little or no regard to their own safety. They may be your neighbor, a friend, or teacher—but now they want you dead.

Like those of previous generations, our fictional nemesis reflects deep-seated concerns. As the survivors in *The Walking Dead* have found, such relentless enemies may force even the most upright citizen to confront their moral codes. In the battle for TV ratings, survival, no matter what it takes, may be enough, but in the real world, holding on to our moral compass may be the greatest weapon we possess.

Passage B by Natalie Lawrence

The etymology of monstrosity suggests the complex roles that monsters play within society. "Monster" probably derives from the Latin, *monstrare*, meaning "to demonstrate", and *monere*, "to warn." How they have been created over the centuries is much more indicative of the moral and existential challenges faced by societies than the realities that they have encountered. Though the modern Gothic monster and the medieval chimera may seem unrelated, both have acted as important social tools.

Until relatively recently in history, monsters close to home, such as two-headed calves, were believed to be warnings of divine wrath. Monstrous depictions in newspapers and pamphlets expressed strong political attitudes. Traditional monstrous beasts such as basilisks or unicorns, that were banished to distant regions in maps, represented a frightening unknown.

However, monsters simultaneously represented the wonderful diversity of divine creation, a playful "Nature" that produced many strange forms. Exotic beasts brought to Europe for the first time in the 16th century, such as armadillos or walruses, were often interpreted as "monstrous." More accurately, they were made into monsters when they were defined as such: as things that did not fit into the accepted natural categories. An armadillo became a pig-turtle, while a walrus was a sea-elephant.

So how do we use our monsters today? One of the two monsters set to hit cinemas shortly displays the dangers of overconfident human enterprise (*Victor Frankenstein*); the other provides a dark embodiment of Christmas-spirit gone awry (*Krampus*). Such monsters are images that embody the cultural or psychological characteristics that we as a society find difficult to acknowledge. Through fantastical narratives, we rid ourselves of these undesirable attributes. The consumption of monster-culture provides us with a safe, removed space to explore and banish social anxieties.

It also transforms anxieties into ridiculous figures, such as Krampus. Monsters such as this offer us moral messages in easily-swallowed forms that both highlight their potential threat, and soothe us by defusing it.

Go On to the Next Page.

3

Though it may not seem so, this has always been the most important role that monsters have played: they horrify us, yes, but ultimately their function is to remove what we find horrifying about ourselves. So we can recoil at the gory construction of Frankenstein's monster, or shriek at the toothy maw of Krampus for a few hours, then leave them happily behind when the credits roll.

Questions 21-25 ask about Passage A.

21. When the author of Passage A claims that "Our bookshops, cinemas, and TVs are dripping with the debris of their relentless shuffle to cultural domination," (lines 1-3) he is most nearly referring to the:

A. prevalence of zombies in modern entertainment.
B. view of zombie-related entertainment as purely frivolous.
C. quantity of physical copies of zombie novels and films.
D. previous popularity of zombies in contemporary culture.

22. Passage A indicates that the author believes that modern views towards scientific progress are:

F. no longer captured by contemporary forms of entertainment.
G. shaped almost exclusively by science fiction stories.
H. much less optimistic now than they were in the past.
J. growing increasingly positive with the help of fictionalized portrayals.

23. In the second paragraph, the author brings up radiation-mutated monsters as an example of:

A. lesser-known monsters in literature.
B. the precursors to modern zombies.
C. the type of monsters that dominate entertainment.
D. a way fiction represents cultural fears.

24. Viewed in the context of the passage, the phrase "globalized, risk-conscious world" (lines 30-31) is most likely intended by the author to convey a tone of which of the following about the world?

F. Nostalgia
G. Anxiety
H. Elation
J. Disappointment

25. Passage A explains that one of the most terrifying aspects of zombies is that they:

A. attack in large numbers.
B. spread dangerous viruses.
C. could be anyone.
D. have superhuman strength.

Questions 26 and 27 ask about Passage B.

26. The passage indicates that throughout history, monsters represented both:

F. the unknown and the exotic.
G. the terrifying and the dangerous.
H. the powerful and the magical.
J. the strange and the beautiful.

27. The author most likely includes the figures of Krampus and Frankenstein in order to provide examples of:

A. recent films where monsters were used to depict the grotesque.
B. monsters which can help banish contemporary fears.
C. frightening figures drawn from recent monster literature.
D. historical monsters that still haunt national consciousness.

Questions 28-30 ask about both passages.

28. Both Passage A and Passage B highlight:

F. the history of monsters in different religions.
G. how monsters can be used to represent social fears.
H. the ways in which nuclear fears drove modern monsters.
J. all of the different media that draw upon monsters.

29. Unlike Passage A, Passage B suggests that depictions of fictionalized monsters:

A. are predictive of future cultural issues.
B. demonstrate modern social concerns.
C. are rarely connected to historical legends.
D. can ultimately help reduce fear.

Go On to the Next Page.

3

30. The author of Passage B discusses how monsters "represented the wonderful diversity of divine creation," (lines 65-66) and mentions exotic beasts such as walruses and armadillos as examples. In contrast, the author of Passage A defines monsters as:

F. embodiments of cultural fears rather than the diverse unknown.

G. warnings of divine wrath rather than manifestations of social fears.

H. historical and documented animals rather than fictional creatures.

J. inspiring sources of creativity rather than dull beasts.

Passage IV

Natural Science: This passage is adapted from the article "Meet the Earthquakes That Happen 600 km Underground" by Simon Redfern (©2015 Simon Redfern).

A little more than 90 years ago, British geologist Herbert Hall Turner noticed some earthquake data that suggested a surprising explanation. The only way to explain the data was if the earthquake had occurred hundreds of kilometers beneath the Earth's surface, unlike the more commonly seen near-surface earthquakes.

Since Turner's observations, deep earthquakes have fascinated seismologists. It is still unclear why they happen, but two studies just published in the journal *Science*, taking different approaches, conclude that they are probably a result of rapid changes in minerals at that depth.

Such deep earthquakes do not have immediate consequences for humans. But they hold clues about destructive quakes in the Earth's shallower crust, making it important to understand them. Most earthquakes occur in the stiff, brittle outer shell that includes the Earth's crust. This "seismogenic zone," where the most devastating and dangerous earthquakes occur, goes down to about 15 km beneath the surface.

As you go deeper, pressure and temperature both increase rapidly, so the nature of earthquakes changes. Rocks move slowly, when pushed or pulled by different forces acting on them. At depth, they appear to flow like soft toffee, rather than break like peanut brittle. This is why Turner's observations of earthquakes more than 600 km below the surface were puzzling. If the rocks flow slowly, then there shouldn't really be any sudden shocks that cause earthquakes. Rather, there should be gentle, continuous readjustments to stress.

Suggestions have been floated in the past about what triggers such earthquakes. But Thorne Lay of the University of California Santa Cruz took a step ahead to analyze a deep earthquake that occurred in May, in the Pacific Ocean beneath the Okhotsk plate. At a magnitude of 8.3, it was four times greater than the 1906 San Francisco earthquake. Indeed, it was the biggest ever recorded at a depth of more than 600 km. A near-surface earthquake of the same magnitude could've been very destructive, but at that depth it was barely noticeable at the surface above.

Recent analysis of an earthquake in Bhuj, India, in 2001 suggests it shared similarities with the Okhotsk event, although it was just 16 km deep. In contrast, however, it caused terrible devastation, including an estimated 20,000 deaths. "There may be things we don't understand about more shallow earthquakes that we can learn from studying these deep earthquakes," said Bob Myhill of the University of Bayreuth.

During the Okhotsk event, the Pacific plate of Earth's crust was drawn down into the hot mantle that makes up much of the planet's interior. What Lay found was that the amount of seismic energy released in the event was so large that it caused fractures as long as 180 km below the surface. The rock ruptured at close to the speed of sound, which in the rock would be as much as 14,000 km/h.

But what caused such rapid rupture? Alexandre Schubnel of École Normale Supérieure suggests an explanation that hinges on the mineral making up the deep rock, called olivine. To be sure, he designed lab experiments that could mimic deep earth. Schubnel found that above a critical temperature and pressure, olivine changes into another mineral called spinel. Under stress, this sudden change creates fractures, much like those seen in the earthquake. The mineral change releases stress instantaneously, in just the same way as stress was relieved in the deep earthquake under the Pacific Ocean.

There is one critical difference, however. To make the experiments easier, the olivine used by Schubnel in the lab contained the element germanium instead of silicon. Germanium-olivines are known to behave slightly differently than silicon-olivines, and this may make a lot of difference 600 km below the surface.

Still, while the mini-earthquakes seen in the lab were many orders of magnitude smaller than those in the earth, the reason these experiments can be trusted is because the creaks and groans of minerals in a lab show

3

similar characteristics to those of large earthquakes. So, even though Schubnel's idea is not new, it experimentally confirms suggestions made by researchers before. It opens the way to studying deep earthquakes in the safety and comfort of the lab.

31. According to the passage, the finding that earthquakes can occur deep below the Earth's surface is:

A. surprising, since rock flows differently that far beneath the surface.

B. plausible, since rocks flow both below the surface and between the crust and core.

C. groundbreaking, as it implies that the Earth's crust is in danger of breaking apart.

D. strange, considering the fact that rocks at depth move too quickly to have much friction.

32. What does the passage offer as evidence that deep earthquakes occur as a result of mineral changes?

F. The report of a British geologist, Herbert Hall Turner

G. Two recently published articles in the journal *Science*

H. Experimental evidence from a study conducted by the author

J. The accounts of surviving eyewitnesses like Alexandre Schubnel

33. It can reasonably be inferred that the phrase "seismogenic zone" (line 18) refers to the:

A. zone in the Americas where the most dangerous earthquakes take place.

B. countries where earthquakes are most common.

C. Earth's inner core and mantle where deep earthquakes occur.

D. outer layer of the Earth consisting of stiff, shallow crust.

34. It is reasonable to conclude from the passage that temperature and pressure:

F. are both increased by the occurrence of earthquakes.

G. are not the only factors that contribute to earthquakes.

H. play no role in causing earthquakes below the surface.

J. are the primary catalyst for surface-level earthquakes.

35. The main purpose of the fourth paragraph (lines 21-31) is to point out why:

A. rocks typically move so slowly beneath the Earth's surface.

B. studying earthquakes below the surface is unfeasible.

C. data indicating the existence of deep earthquakes was surprising.

D. Turner discontinued his work on earthquakes in the crust.

36. What does the author suggest about earthquakes of the same magnitude that happen at the surface compared to those that happen at greater depths?

F. The earthquakes happening at the surface will cause greater devastation.

G. The earthquakes happening at greater depths will cause greater devastation.

H. The earthquakes happening at the surface will be more expensive to study.

J. The earthquakes happening at greater depths will be less challenging to study.

37. The passage states that the Okhotsk event was:

A. a devastating surface-level earthquake that led to 20,000 deaths.

B. an earthquake in the Earth's core that traveled to the surface at the speed of sound, 14,000 km/h.

C. an earthquake deep beneath the surface that caused long and rapid rock fractures.

D. an earthquake in the Pacific that led to a tsunami on the coasts of nearby countries.

38. In the passage, the author claims that rapid ruptures happening deep beneath the surface may be a result of:

F. changes in minerals due to stress on the rocks.

G. increased levels of olivine beneath the surface.

H. decreasing temperatures in the mantle and crust.

J. the slow degradation of olivine into spinel over time.

Go On to the Next Page.

3

39. The author indicates that Schubnel's use of germanium instead of silicon:

A. alters the outcome of Schubnel's work and makes it relevant only to surface-level earthquakes.

B. is an important distinction to note, but does not prevent the research from being useful for studying deep earthquakes.

C. is an insignificant substitution that should not be noted when considering future set-ups of the experiment.

D. was an unfortunate oversight that Schubnel plans to remedy in his next round of research.

40. As used in line 80, the term "creaks and groans of minerals in a lab" most likely means:

F. the bubbling of chemicals when made to react with each other.

G. the splitting apart of rocks by earthquakes beneath the Earth's surface.

H. the sounds made by fractures as olivine turned into spinel.

J. the grinding noises of minerals recorded deep in the mantle.

End of Test 3.

Stop! Do not turn the page until you are told to do so.

Do not return to the previous test.

Science Test

35 Minutes—40 Questions

DIRECTIONS: There are several passages on 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 circle 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

Researchers examined the possibility of using pigeons (*Columbia livia*) as visual observers of breast cancer tumors.

Experiment 1

Eight pigeons were trained to discern the difference between images of benign tumors and images of malignant tumors at various magnifications and rotations. They were trained in a closed chamber with continuous white noise, a food pellet dispenser, and a touchscreen for pecking their responses, as shown in Diagram 1. Each pigeon received a food pellet only if its response was correct. The pigeons were trained daily over a period of 15 days using 48 different breast tumor images (24 images of benign tumors and 24 images of malignant tumors) at 3 different magnifications (4x, 10x, and 20x), for a total of 144 images. The pigeons' progress is shown in Figure 1. After their 15-day training period, the pigeons were tested using the 144 original images and 24 rotated images (see Figure 2).

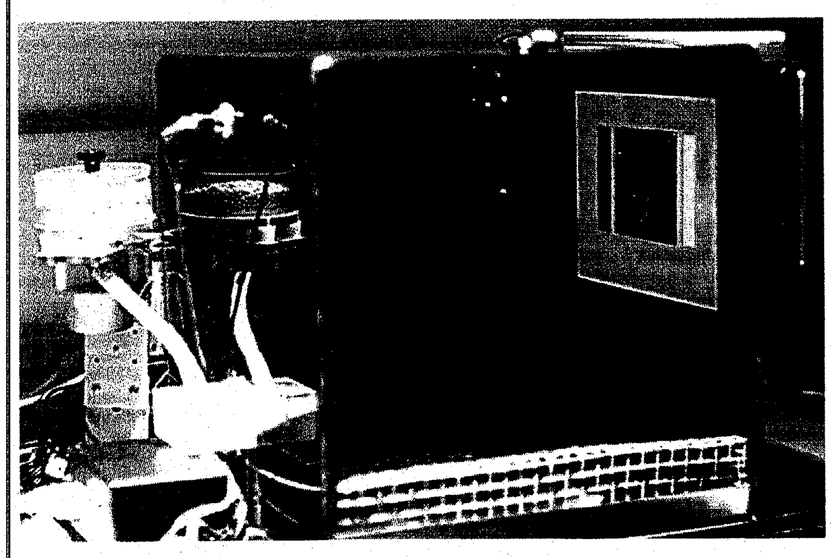


Diagram 1

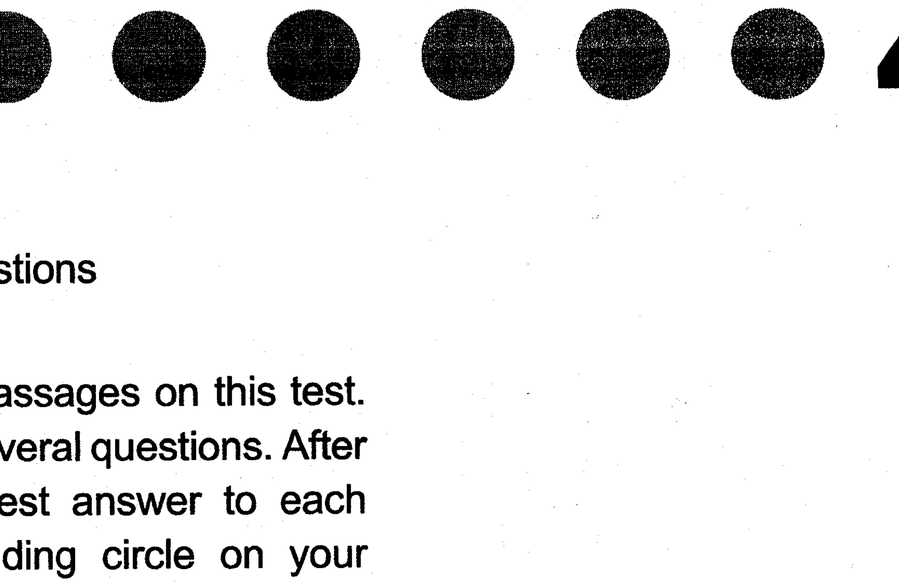


Figure 1

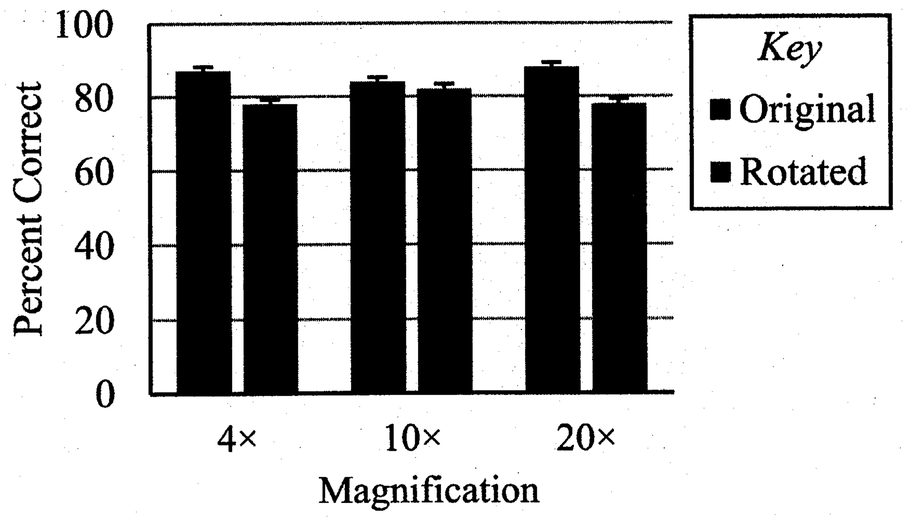


Figure 2

Experiment 2

Eight new pigeons were trained to discern the difference between benign tumors and malignant tumors under different reward systems and at different image compressions. They were trained using the same set-up as in Experiment 1, except three different compressions (uncompressed, 15:1, and 27:1) were used instead of three different magnifications. During their training, half of the birds were *nondifferentially reinforced*, which means they received food pellets regardless of their responses, and half were *differentially reinforced,* which means the received food pellets only if their responses were correct. After their training, the pigeons were tested using the 144 original images. Results are shown in Figure 3.

Go On to the Next Page.

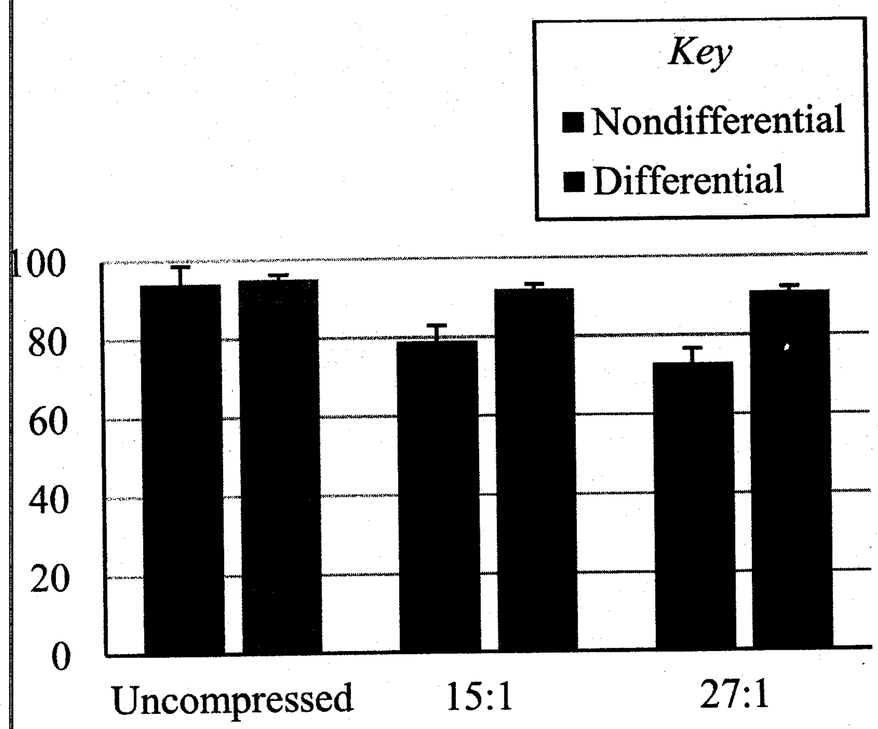


Figure 3

Data adapted from Richard M. Levenson et al. "Pigeons (*Columbia livia*) as Trainable Observers of Pathology and Radiology Breast Cancer Images." ©2015 by PLoS One. 10.1371/journal.pone.0141357

1. According to the results of Experiment 1, if a pigeon correctly identified 52% of breast cancer tumor images on its first day of training, which of the following was most likely the magnification of the images?

A. 1×
B. 4×
C. 10×
D. 20×

2. Suppose that an additional trial in Experiment 2 was performed using a fourth compression, at a ratio of 21:1. The average percent correct for the pigeons that were nondifferentially reinforced in this trial would most likely have been:

F. less than 70%.
G. between 70% and 80%.
H. between 80% and 95%.
J. greater than 95%.

3. Experiment 2 differed from Experiment 1 in that Experiment 2:

A. tested different magnifications.
B. tested different rotations.
C. tested different touchscreen sizes.
D. tested different reinforcements.

4. The researchers had predicted that increasing the magnification of breast tumor images would increase the pigeons' ability, when tested, to determine whether the original images showed benign or malignant tumors. According to Figure 2, are the results of Experiment 1 consistent with this prediction?

F. Yes; as magnification increases from 4× to 10× to 20×, the pigeons' ability to identify the images correctly also increases.
G. Yes; as magnification increases from 4× to 10× to 20×, the pigeons' ability to identify the images correctly decreases and then increases.
H. No; as the training program continues over 15 days with changing magnification, the pigeons' ability to identify the images correctly decreases.
J. No; as magnification increases from 4× to 10× to 20×, the pigeons' ability to identify the images correctly decreases and then increases.

5. Which variables remained constant in Experiments 1 and 2, respectively?

	Experiment 1	Experiment 2
A.	rotation	reinforcement
B.	magnification	compression
C.	reinforcement	rotation
D.	compression	reinforcement

6. The researchers were concerned that the entry and exit of researchers from the lab was interfering with the pigeons' ability to select the correct breast tumor images. Which of the following modifications would best help them eliminate this problem?

F. Increase the volume of the continuous white noise.
G. Increase the total number of images.
H. Decrease the duration of the training program.
J. Decrease the size of the touchscreen.

7. Pigeons belong to which taxonomic domain?

A. Bacteria
B. Archaea
C. Eukaryota
D. Fungi

Go On to the Next Page.

Passage II

In North America, many populations of monarch butterflies make a yearly migration to Mexico for the colder winter months. Some of these monarchs are infected by wing parasites, such as *Ophryocystis elektroscirrha*, which are thought to reduce migration ability by reducing a butterfly's wing size. A group of scientists studied the effect of *O. elektroscirrha* infection on the ability of monarchs to successfully reach Mexico. Taking samples of both infected and uninfected monarchs from two overwintering sites, the scientists measured wing area and hydrogen isotope δ^2H, a measure of the latitude from which each butterfly originated. A higher δ^2H value indicates that the butterfly originated from a more northerly latitude and therefore traveled farther to reach Mexico.

Figure 1 shows the average δ^2H values of infected and uninfected monarchs from the two overwintering sites. Figure 2 is a scatterplot, including a line of best fit, showing the wing area and δ^2H value from all infected butterflies in the study. Figure 3 shows the percentage of heavily infected butterflies originating from three regions in eastern North America.

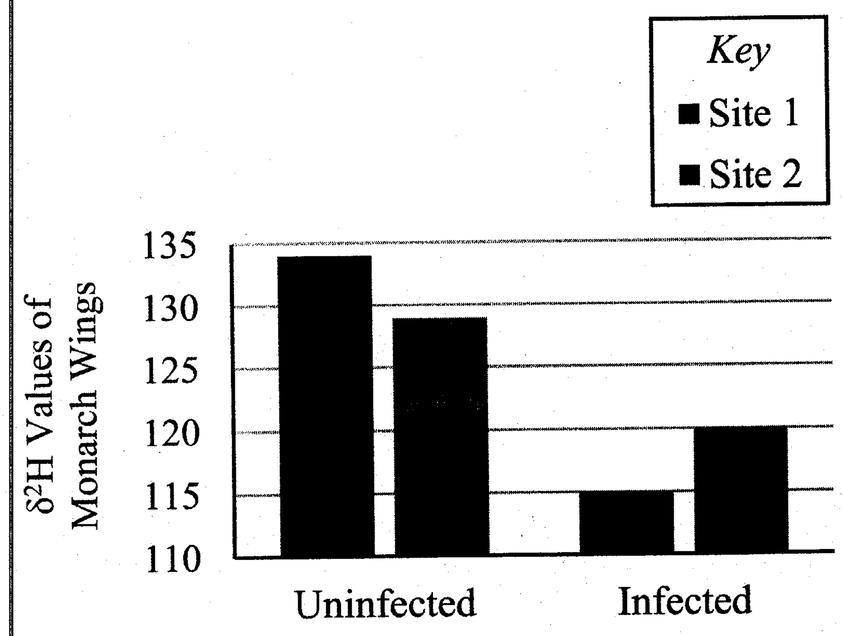


Figure 1

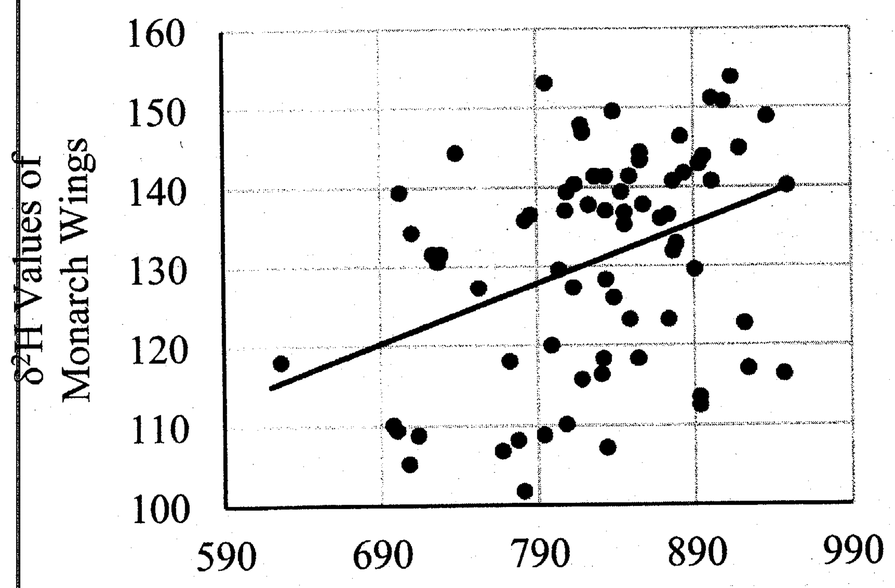


Figure 2

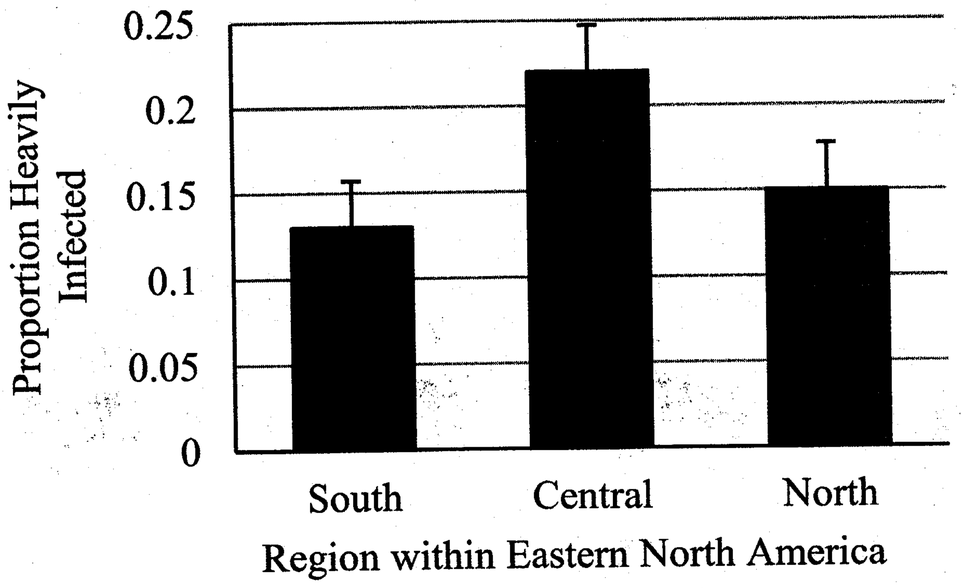


Figure 3

All figures adapted from Sonia Altizer et al. "Do Healthy Monarchs Migrate Farther? Tracking Natal Origins of Parasitized vs. Uninfected Monarch Butterflies Overwintering in Mexico." ©2015 by PLoS One. 10.1371/journal.pone.0141371

8. According to Figure 2, which of the following was the highest δ^2H value measured among all butterflies in this study?

F. 155
G. 122
H. 110
J. 102

9. According to the line of best fit in Figure 2, as wing area increases, δ^2H:

A. increases only.
B. decreases only.
C. increases, then decreases.
D. decreases, then increases.

Go On to the Next Page.

10. Do the data in Figure 1 support the conclusion that infected monarchs tend to originate from more southerly latitudes?

F. Yes, because infected butterflies have lower δ^2H values than uninfected butterflies.

G. Yes, because infected butterflies have higher δ^2H values than uninfected butterflies.

H. No, because infected butterflies have lower δ^2H values than uninfected butterflies.

J. No, because infected butterflies have higher δ^2H values than uninfected butterflies.

11. A scientist in Mexico captures a monarch with a wing area of 690 mm^2. Based on the data in Figure 1 and Figure 2, which of the following conclusions is most likely?

A. This uninfected monarch is from a northerly latitude.

B. This infected monarch is from a northerly latitude.

C. This uninfected monarch is from a southerly latitude.

D. This infected monarch is from a southerly latitude.

12. A scientist discovers a new overwintering ground in Mexico and samples a population of butterflies there. She finds that more than 20% of the population is heavily infected with *O. elektroscirrha*. From which of the following regions did the butterflies at this site most likely originate?

F. North

G. Central

H. South

J. East

13. Do the data from the study support the claim that "uninfected monarchs have higher δ^2H values than infected monarchs because overall infection rates are lower in northern regions"?

A. Yes, because Figure 2 shows that monarchs with larger wings tend to originate from more northerly latitudes.

B. Yes, because Figure 3 shows that overall infection rates are lowest in the northern region.

C. No, because Figure 2 shows that monarchs with larger wings tend to originate from more northerly latitudes.

D. No, because Figure 3 shows that overall infection rates are roughly equal in the southern and northern regions.

Passage III

Whiptail lizards reproduce by *parthenogenesis*, a type of asexual reproduction in which the egg does not need to be fertilized. Consequently, all whiptail lizards are female.

Normal whiptail cells have 46 chromosomes. Like many animals, whiptails undergo *meiosis*, a type of cell division expected to produce *gametes*, or haploid daughter cells, each with 23 chromosomes. However, each whiptail gamete has 46 chromosomes, allowing it to divide into a viable embryo.

Meiosis can be divided into three general, sequential phases: interphase (I), meiosis I (MI), and meiosis II (MII). There are several important events that occur during meiosis, including *DNA replication*, during which an exact copy of a cell's DNA is made. Three hypotheses discuss various models of how meiosis works in whiptail lizards (see Figure 1).

Hypothesis 1

During interphase, DNA replication occurs once, producing a cell with 92 chromosomes. During meiosis I, the cell divides, producing 2 cells that each contain 46 chromosomes. These cells fuse back together to re-form a cell with 92 chromosomes. During meiosis II, this cell divides again, producing 2 daughter cells, each with a full complement of 46 chromosomes. These 2 gametes are the final products of meiosis.

Hypothesis 2

During interphase, DNA replication occurs once, producing a cell with 92 chromosomes. During meiosis I, this cell divides, producing 2 cells that each contain 46 chromosomes. During meiosis II, these cells divide again, producing a total of 4 cells, each with 23 chromosomes. These cells pair up and fuse, producing 2 cells, each with a full complement of 46 chromosomes. These 2 gametes are the final products of meiosis.

Hypothesis 3

During interphase, DNA replication occurs twice, producing a cell with 184 chromosomes. During meiosis I, this cell divides, producing 2 cells, each with 92 chromosomes. During meiosis II, these 2 cells divide, producing a total of 4 cells, each with a full complement of 46 chromosomes. These 4 gametes are the final products of meiosis.

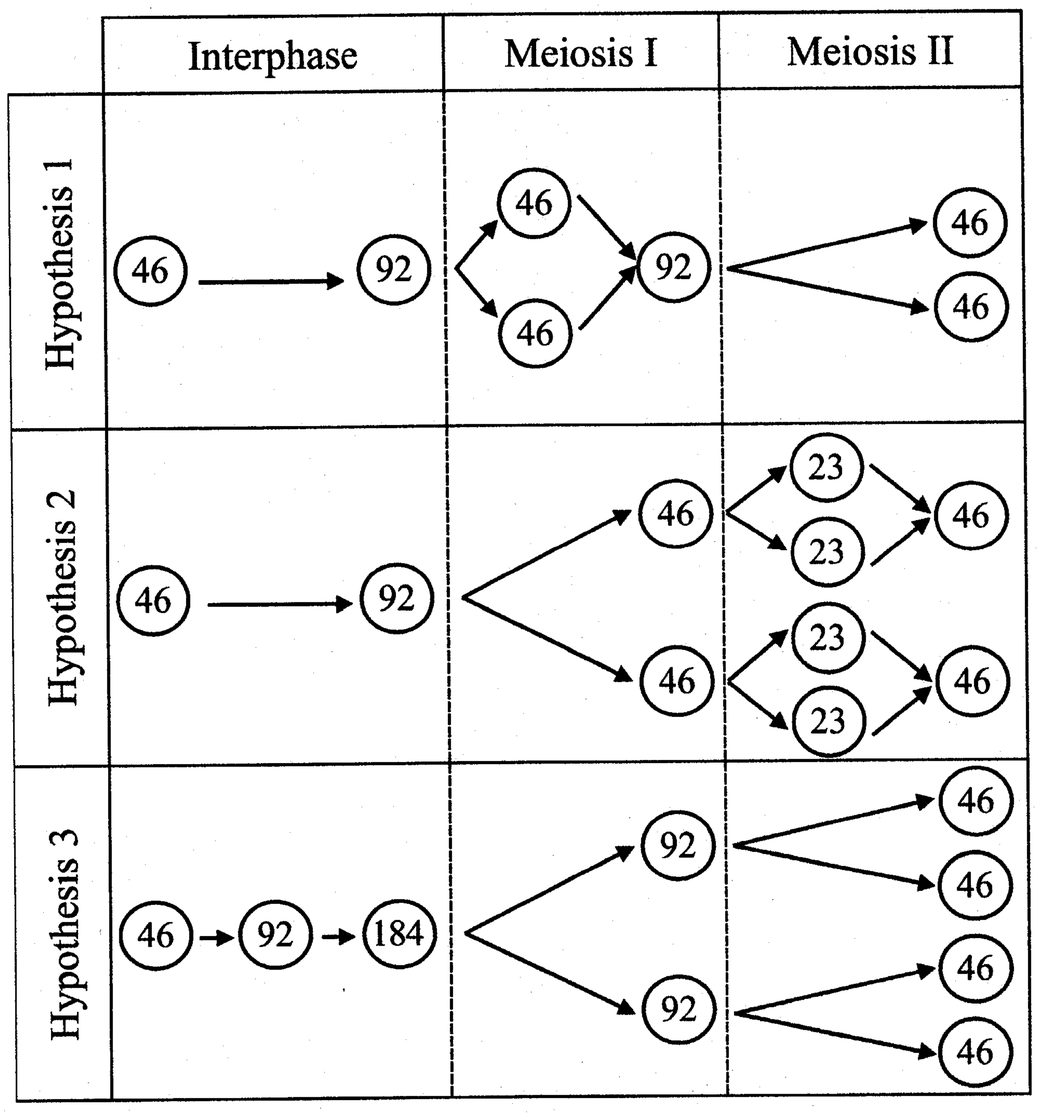


Figure 1

14. Which hypotheses assert that cell fusion takes place during meiosis in the whiptail lizard?

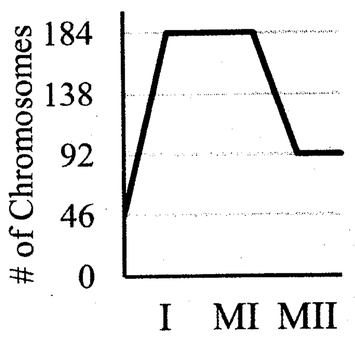
F. Hypothesis 1 only
G. Hypothesis 2 only
H. Hypothesis 1 and Hypothesis 2
J. Hypothesis 1, Hypothesis 2, Hypothesis 3

15. Which hypothesis, if any, asserts that DNA replication occurs after interphase?

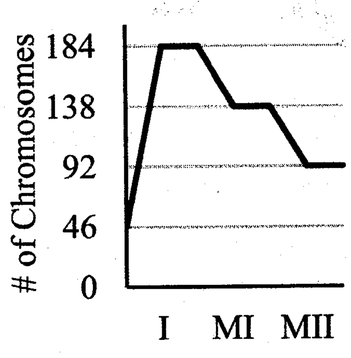
A. Hypothesis 1
B. Hypothesis 2
C. Hypothesis 3
D. None of the hypotheses

16. Based on Hypothesis 3, which of the following graphs depicts the number of chromosomes per cell, from the period before interphase until the end of meiosis II?

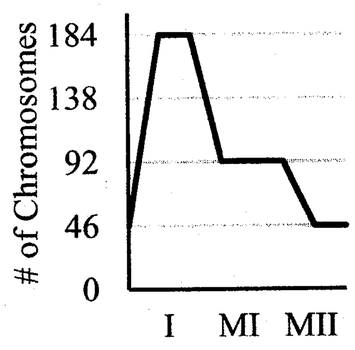
F.



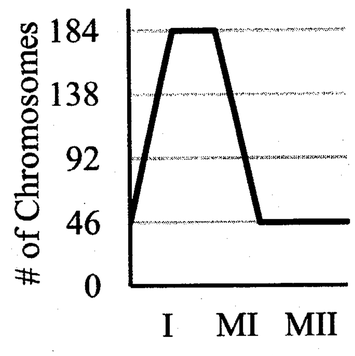
H.



G.



J.



17. Which of the following statements is consistent with all three hypotheses?

A. Whiptail meiosis produces 4 gametes.

B. Whiptail meiosis involves 2 rounds of cell division.

C. Whiptail meiosis involves 2 rounds of DNA replication.

D. At the end of each phase of whiptail meiosis, each cell present contains 46 chromosomes.

18. Suppose that all whiptail cells containing at *least* 46 chromosomes are able to produce a viable embryo. A scientist induces meiosis in a whiptail cell and then arrests the process at the end of meiosis I. Which hypotheses, if any, predict that the cells present at this time will be able to produce viable embryos?

F. Hypothesis 1 and Hypothesis 2

G. Hypothesis 1 and Hypothesis 3

H. Hypothesis 1, Hypothesis 2, and Hypothesis 3

J. None of the hypotheses

19. Suppose that a round of DNA replication requires 20 minutes, a round of cell division requires 5 minutes, and a round of cell fusion requires 10 minutes. A scientist observes a complete whiptail meiosis and discovers that it requires a total of 40 minutes. Which hypotheses are supported by this result?

A. Hypothesis 1

B. Hypothesis 2

C. Hypothesis 1 and Hypothesis 2

D. Hypothesis 1, Hypothesis 2, and Hypothesis 3

20. There are four sub-phases within meiosis I: prophase I, metaphase I, anaphase I, and telophase I. Which of these sub-phases involves the formation of nuclear envelopes in the daughter cells and the splitting of the cytoplasm into two separate cell bodies?

F. Prophase I

G. Metaphase I

H. Anaphase I

J. Telophase I

Passage IV

Torque (τ) is the tendency of a force to rotate an object around an axis. The amount of torque placed on an object depends on both the force applied (F) and the length of the lever arm (r), which is the distance between the applied force and pivot point.

Assuming the force is perpendicular to the lever arm, the equation for torque is as follows:

$$\tau = F \times r$$

Weight is a force that commonly produces a torque. The weight of an object is determined by its mass (m) and by the acceleration due to gravity (g), which on Earth is equal to 9.8 m/sec^2. Because weight is a type of force, it is measured in Newtons (N). The equation for the weight of an object is as follows:

$$\text{weight} = m \times g$$

A student performs two experiments to investigate torque and weight.

Experiment 1

A meter stick was placed on a fulcrum at the 0.5000 m mark so that it was balanced. A 30 N weight was hung on the left side of the fulcrum, at the 0.3500 m mark, as shown in Diagram 1. The student then hung a 10 N test weight on the right side of the fulcrum, finding the position at which she could hang the test weight so that the meter stick was balanced. She recorded the position and then repeated the process with a variety of test weights. Her results are shown in Table 1. All positions are relative to the left end of the meter stick.

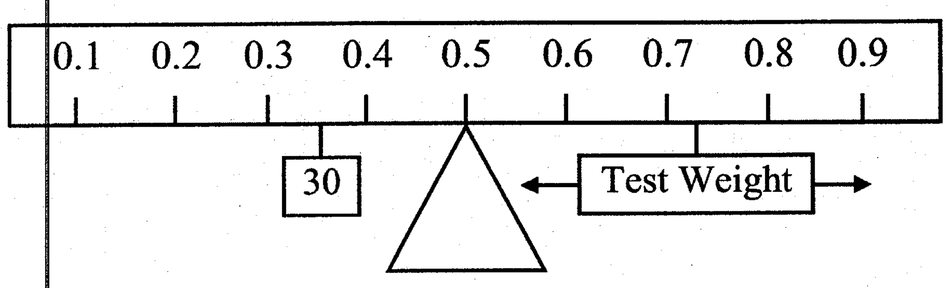


Diagram 1

Table 1	
Test Weight (N)	Position (m)
10	0.9500
20	0.7250
30	0.6500
40	0.6125
50	0.5900
60	0.5750

Experiment 2

The student found 4 blocks of unknown weight, which she named Block A, Block B, Block C, and Block D. In order to investigate the relationships between the weights of these blocks, she performed another meter stick experiment. First, she hung Block A at the 0.0000 m mark on the meter stick and Block B at the 1.0000 m mark. She then placed the meter stick on the fulcrum and moved the fulcrum until the meter stick was balanced, as shown in Diagram 2. She recorded the position of the fulcrum and then repeated the experiment with all possible pairs of blocks. Her results are shown in Table 2.

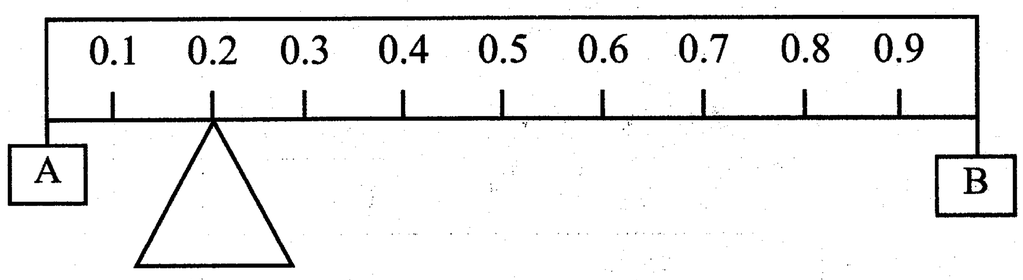


Diagram 2

Table 2	
Blocks Used	Fulcrum Position (m)
A and B	0.2000
A and C	0.4290
A and D	0.6000
B and C	0.7500
B and D	0.8580
C and D	0.6667

Go On to the Next Page.

21. In Experiment 1, as the test weight increased, its balance position on the meter stick:

A. moved to the left only.
B. moved to the right only.
C. moved to the left, then to the right.
D. moved to the right, then to the left.

22. Which of the following statements comparing Experiment 1 with Experiment 2 is FALSE?

F. Experiment 1 used blocks of known weight; Experiment 2 used blocks of unknown weight.
G. Experiment 1 involved a fixed fulcrum position; Experiment 2 involved a fulcrum that could move.
H. Experiments 1 and 2 involved unequal torques on both sides of the fulcrum.
J. Experiments 1 and 2 involved weights that generated equal torque on both sides of the fulcrum.

23. Imagine the student were to perform Experiment 2 on Mars, where the acceleration due to gravity is equal to 3.7 m/sec^2. Would the results of the experiment change?

A. Yes, because the weights of the blocks would change.
B. Yes, because the relationships between the weights of the blocks would change.
C. No, because the weights of the blocks would not change.
D. No, because the relationships between the weights of the blocks would not change.

24. Suppose that the student had tested an additional block in Experiment 1, and the position of that block was 0.5675 m. The weight of the block was most likely:

F. 60 N.
G. 70 N.
H. 80 N.
J. 90 N.

25. Based on the results of Experiment 2, what is the correct order of the 4 blocks from largest weight to smallest weight?

A. A, B, C, D
B. B, C, A, D
C. D, C, A, B
D. D, A, C, B

26. Which of the following is the correct unit of torque in these experiments?

F. N
G. N × m
H. N/m
J. m^2/sec^2

27. Suppose that the student from Experiment 1 exerted a small upward force on the meter stick to the left side of the fulcrum. What effect, if any, would this have on the balance positions of the various test weights in this experiment?

A. All balance positions would shift to the left.
B. All balance positions would shift to the right.
C. Some balance positions would shift to the left, and others would shift to the right.
D. All balance positions would remain the same.

Passage V

Catalysts are chemical compounds that, when added to a reaction, speed up the rate of reaction without changing what is consumed and produced. Catalysts lower the minimum amount of energy (*activation energy*, or E_A) required for the reaction to proceed. Thus, more particles have sufficient energy to react, and the rate of the reaction increases. An *inhibitor* slows the rate of reaction by raising its E_A, without being consumed, so it is the opposite of a catalyst.

A *reaction coordinate* graph shows the energy of particles in a sample as the reaction progresses. Figure 1 shows the reaction coordinate graph for a sample reaction. Note that E_A-catalyzed is lower than E_A-uncatalyzed.

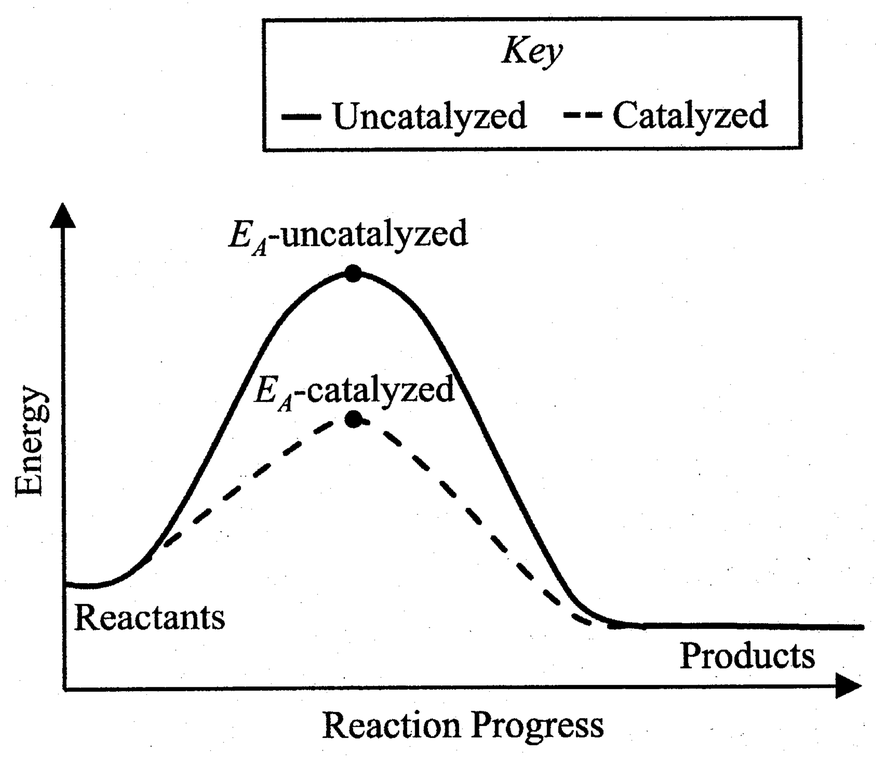


Figure 1

A student investigates the effects of 4 different catalysts and 1 inhibitor on a certain reaction by measuring the rate of gas production of the reaction without a catalyst and with the addition of each catalyst. She performed 2 trials for each reaction condition. The same amount of catalyst was used in all trials, and the catalysts had no effect on the amount of gas produced.

Table 1

Condition	Reaction rate (cm^3/sec)	
	Trial 1	Trial 2
No catalyst	3.2	3.5
Potassium permanganate	4.3	4.4
Silver	11.9	12.4
Aluminum chloride	6.7	6.6
Vanadium oxide	9.0	8.8
Sodium fluoride	2.2	2.3

28. According to the passage, the addition of a catalyst:

- **F.** raises the activation energy and increases the rate of the reaction.
- **G.** raises the activation energy and has no effect on the rate of the reaction.
- **H.** lowers the activation energy and decreases the rate of the reaction.
- **J.** lowers the activation energy and increases the rate of the reaction.

29. According on Table 1, which of the following correctly ranks the 4 catalysts used from smallest effect to largest effect?

- **A.** Potassium permanganate, silver, aluminum chloride, vanadium oxide
- **B.** Silver, vanadium oxide, aluminum chloride, potassium permanganate
- **C.** Potassium permanganate, aluminum chloride, vanadium oxide, silver
- **D.** Silver, aluminum chloride, vanadium oxide, potassium permanganate

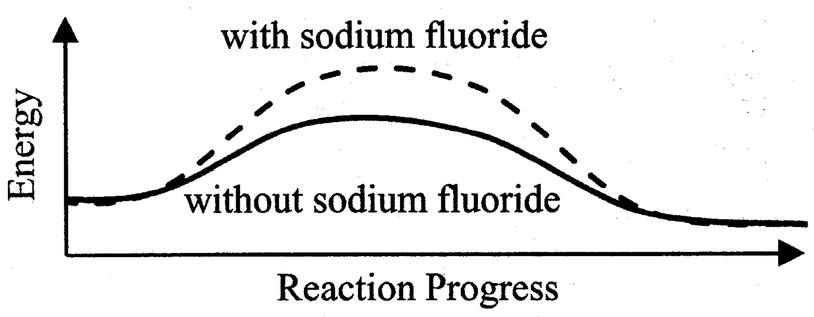
30. Platinum-rhodium is a catalyst that is known to be more effective than potassium permanganate but less effective than vanadium oxide. Which of the following could be the reaction rate after addition of platinum-rhodium?

- **F.** 3.8 cm^3/sec
- **G.** 4.0 cm^3/sec
- **H.** 7.7 cm^3/sec
- **J.** 10.4 cm^3/sec

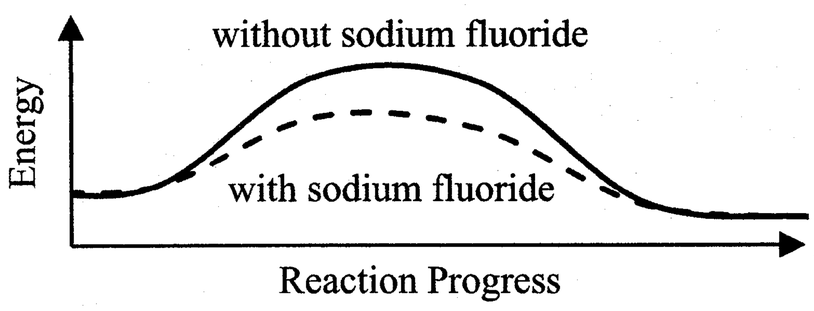
Go On to the Next Page.

31. Based on the student's results, which of the following reaction coordinate graphs best represents the reactions with and without sodium fluoride?

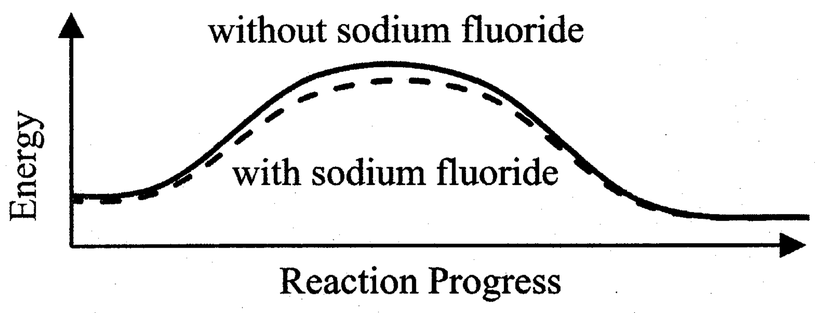
A.



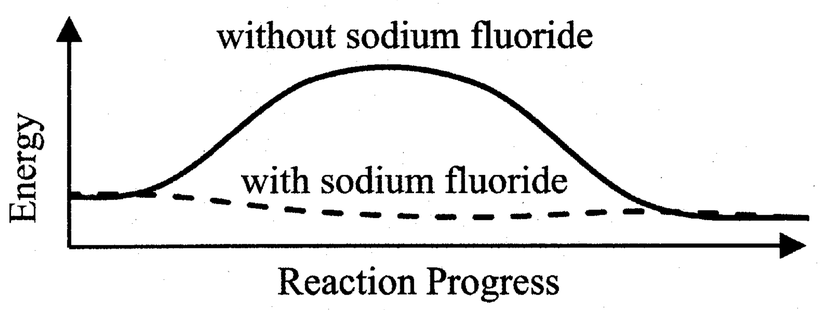
B.



C.



D.



32. Suppose that the student wanted to run the uncatalyzed reaction in reverse, going from products to reactants. According to Figure 1, compared to the rate of the forward reaction, the rate of the reverse reaction would be:

F. Lower, because E_A is lower relative to the products than it is to the reactants.

G. Higher, because E_A is lower relative to the products than it is to the reactants.

H. Lower, because E_A is higher relative to the products than it is to the reactants.

J. Higher, because E_A is higher relative to the products than it is to the reactants.

33. The rate of a chemical reaction depends in part on the nature of the *intramolecular forces* that hold atoms together in a molecule or compound. Which of the following intramolecular forces holds together sodium and fluorine in sodium fluoride?

A. Ionic

B. Metallic

C. Covalent

D. Van der Waals

Passage VI

Scientists have confirmed the existence of over 2000 *exoplanets*—planets that orbit stars other than the Sun. Scientists used three methods to discover and classify exoplanets in the nearby Andromeda galaxy.

Study 1

Scientists used the *light-shift method* to study three unknown stars in the Andromeda galaxy. As it orbits, a planet pulls its star toward itself, which changes the star's position relative to Earth. The star's light then shifts along the electromagnetic spectrum. Light from a star moving toward the Earth is *blueshifted*, which means it moves toward the blue end of the spectrum, and light from a star moving away from the Earth is *redshifted*, which means it moves toward the red end of the spectrum (see Figure 1). The data for the study are shown in Figure 2.

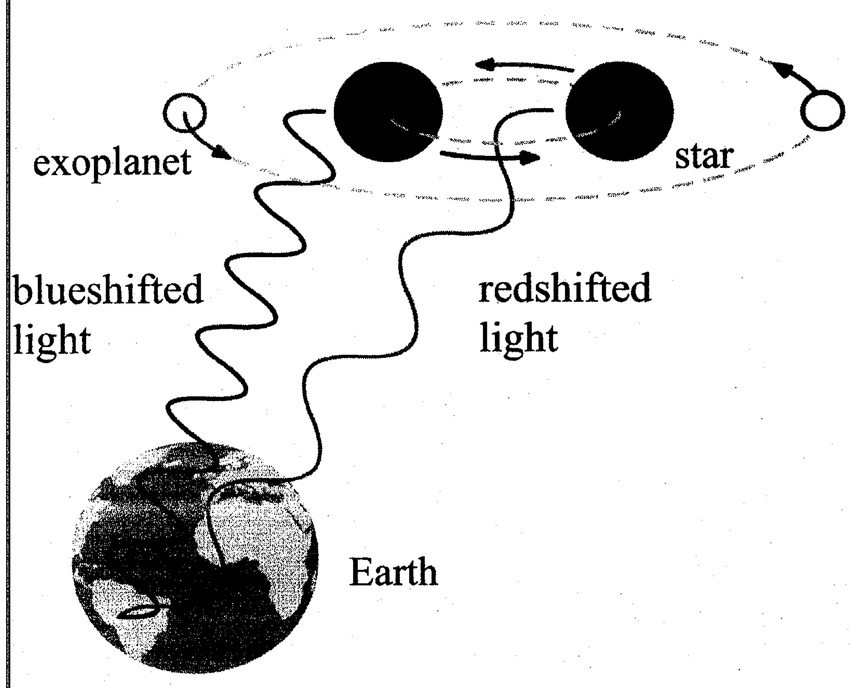
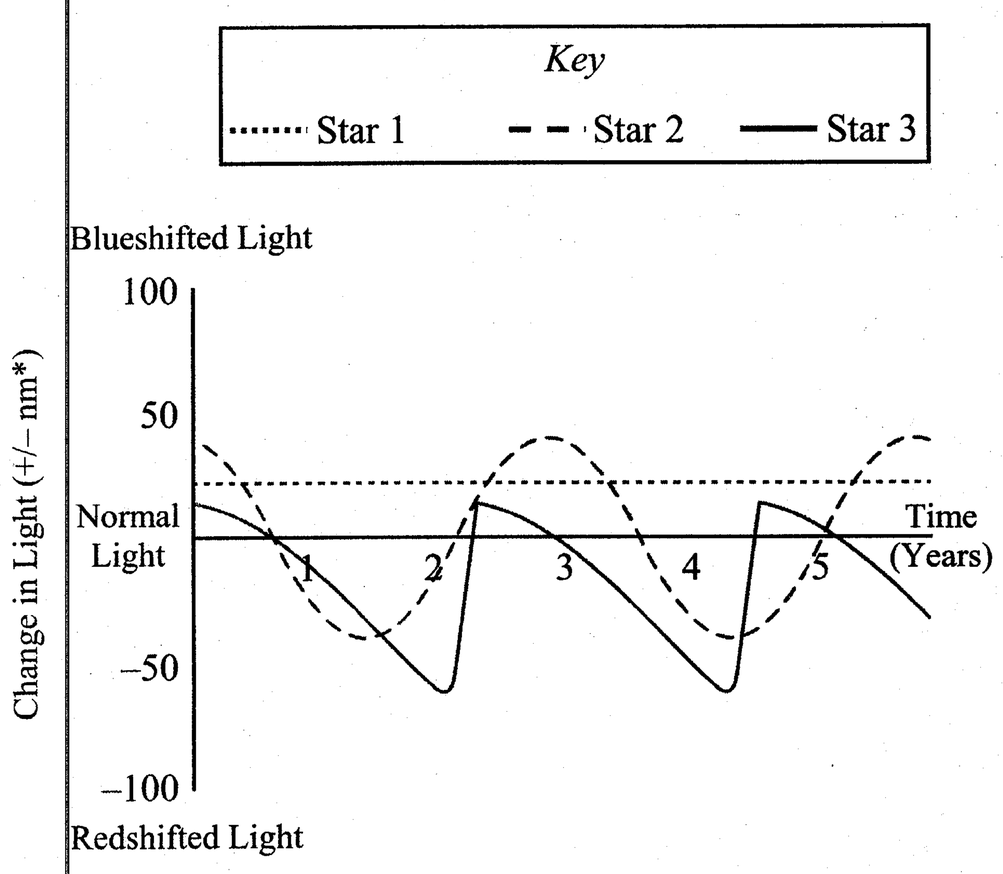


Figure 1



*nm = nanometer

Figure 2

Study 2

The three stars from Study 1 were then studied using the *transit method*. If a planet passes between its star and the Earth, it blocks some of the star's light, thus dimming the star's apparent brightness (see Figure 3). Scientists found that Star 1 maintained a relatively constant brightness over time, Star 2's brightness diminished once every three years, and Star 3's brightness varied irregularly but frequently.

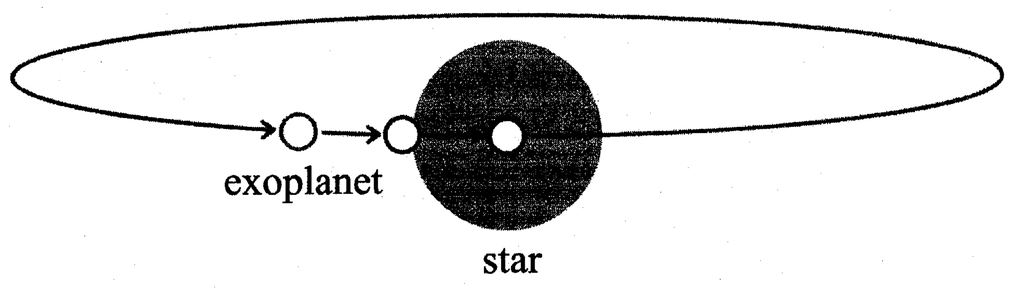


Figure 3

Study 3

Scientists performed *absorption spectroscopy* to determine the atmospheric composition of the possible exoplanet orbiting Star 2. When an exoplanet travels in front of its star, the light from that star passes through the atmosphere of the exoplanet. Certain wavelengths are absorbed by the molecules present in that planet's atmosphere. The result is an *absorption spectrum* (see Figure 4), which is unique to a planet's particular atmospheric composition.

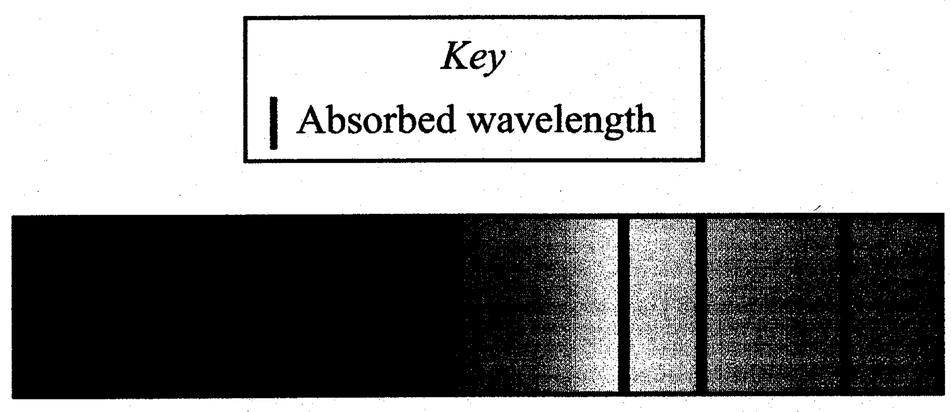


Figure 4

Go On to the Next Page.

34. Based on the results of Study 1, what was the average light shift for Star 3?

F. 40 nm
G. 20 nm
H. 0 nm
J. –20 nm

35. Based on the results of Study 1, what was the approximate time it took for Star 2's exoplanet to complete a full orbit?

A. 1.5 years
B. 3 years
C. 6 years
D. No exoplanet is orbiting Star 2.

36. Based on the results of Study 2, what is the order of the three stars, from the star that has the fewest exoplanets orbiting it to the star that has the most exoplanets orbiting it?

F. Star 1, Star 2, Star 3
G. Star 1, Star 3, Star 2
H. Star 3, Star 1, Star 2
J. Cannot be determined from the given information.

37. Suppose that an additional star in the Andromeda galaxy had been observed using the light-shift method over a period of 6 years. The researchers found that the light from the star was becoming increasingly blueshifted at a constant rate. Which of the following hypotheses best explains this finding?

A. The star is orbited by several exoplanets.
B. The star is orbited by an exoplanet that has a long orbital period.
C. The star is undergoing a supernova.
D. The star is actually an exoplanet.

38. Which of the following types of exoplanet is easiest to observe using both the light-shift method and the transit method?

F. Small planets orbiting close to a massive parent star.
G. Large planets orbiting close to a low-mass parent star.
H. Gaseous planets orbiting around a massive star.
J. Rocky planets that do not pass in front of their star, relative to Earth.

39. The scientists performing Study 3 discovered an interstellar gas cloud between Earth and the Andromeda galaxy. If it had a different molecular composition than the possible exoplanet's atmosphere, the gas cloud could have interfered with the absorption spectrum of the exoplanet orbiting Star 2. Which of the following procedures would best help the scientists investigate this interference?

A. Redshifting the exoplanet's absorption spectrum to account for the blueshifted light from Star 2.
B. Repeating the experiment ten times.
C. Comparing the absorption spectrum of the exoplanet to the spectra of gases known to exist in gas clouds.
D. Using a telescope with better resolution.

40. Based on the results of Study 3 and the absorption spectra below, which of the following gases is NOT present in the atmosphere of the possible exoplanet orbiting Star 2?

F. Hydrogen

H. Nitrogen

G. Helium

J. Sodium

End of Test 3.

Stop! Do not turn the page until you are told to do so.

Do not return to the previous test.

Answers

Part 1

English Test

1. C	16. H	31. B	46. J	61. B
2. G	17. B	32. G	47. D	62. F
3. A	18. G	33. C	48. H	63. B
4. G	19. C	34. G	49. D	64. J
5. A	20. G	35. D	50. H	65. D
6. J	21. A	36. H	51. C	66. J
7. B	22. G	37. B	52. G	67. D
8. G	23. B	38. H	53. D	68. F
9. D	24. H	39. A	54. J	69. B
10. H	25. B	40. J	55. B	70. G
11. B	26. J	41. B	56. H	71. A
12. F	27. A	42. F	57. B	72. J
13. D	28. F	43. D	58. F	73. A
14. G	29. B	44. F	59. C	74. H
15. D	30. J	45. A	60. J	75. A

Math Test

1. D	13. D	25. A	37. C	49. E
2. G	14. G	26. F	38. G	50. J
3. D	15. E	27. C	39. A	51. B
4. J	16. G	28. H	40. H	52. H
5. E	17. D	29. A	41. C	53. B
6. H	18. K	30. H	42. H	54. F
7. A	19. C	31. C	43. D	55. A
8. J	20. K	32. H	44. K	56. H
9. B	21. E	33. C	45. E	57. D
10. H	22. F	34. H	46. K	58. K
11. A	23. D	35. E	47. B	59. A
12. H	24. K	36. H	48. J	60. F

Reading Test

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

Science Test

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

Scoring Your Test

Part 2

To score your tests, first use the answer key to mark each of your responses right or wrong. Then, calculate your **raw score** for each section by counting up the number of correct responses. Use the tables below to help you calculate your scores:

Raw Score		
Test	# of Questions Correct	Raw Score
1. English	_____	_____
2. Math	_____	_____
3. Reading	_____	_____
4. Science	_____	_____

Scaled Scores

Once you have found your raw score for each test, convert it into an approximate **scaled test score** using the following chart. To find a scaled test score for each section, find the row in the Raw Score column which corresponds to your raw score for that section, then check the column for the section you are scoring in the same row. For example, if you had a raw score of 31 for reading, your scaled reading test score would be 28. Keep in mind that these scaled scores are estimates only. Your actual ACT score will be scaled against the scores of all other students at your grade level taking the test on your test date.

Raw Scores					
Scaled Score	Test 1 - English	Test 2 - Math	Test 3 - Reading	Test 4 - Science	Writing
36	75	60	40	40	47-48
35	72-74	58-59	39	39	46
34	71	57	38	38	44-45
33	70	55-56	37	37	42-43
32	68-69	54	35-36	—	41
31	67	52-53	34	36	40
30	66	50-51	33	35	38-39

29	65	48-49	32	34	37
28	63-64	45-47	31	33	35-36
27	62	43-44	30	32	34
26	60-61	40-42	29	30-31	33
25	58-59	38-39	28	28-29	32
24	56-57	36-37	27	26-27	31
23	53-55	34-35	25-26	24-25	29-30
22	51-52	32-33	24	22-23	28
21	48-50	30-31	22-23	21	26-27
20	45-47	29	21	19-20	25
19	43-44	27-28	19-20	17-18	24
18	41-42	24-26	18	16	23
17	39-40	21-23	17	14-15	21-22
16	36-38	17-20	15-16	13	20
15	32-35	13-16	14	12	—
14	29-31	11-12	12-13	11	18-19
13	27-28	8-10	11	10	17
12	25-26	7	9-10	9	16
11	23-24	5-6	8	8	—
10	20-22	4	6-7	7	14-15
9	18-19	—	—	5-6	13
8	15-17	3	5	—	12
7	12-14	—	4	4	—
6	10-11	2	3	3	10-11
5	8-9	—	—	2	9
4	6-7	1	2	—	—
3	4-5	—	—	1	—
2	2-3	—	1	—	—
1	0-1	0	0	0	8