StudyGuide Practice Test
for the ACT®

TAKING THE PRACTICE TEST FOR THE ACT

Assessment Breakdown
The ACT Assessment consists of four multiple-choice tests:

English	75 questions, 45 minutes
Mathematics	60 questions, 60 minutes
Reading	40 questions, 35 minutes
Science Reasoning	40 questions, 35 minutes
Optional Essay	1 question, 30 minutes

The English test covers punctuation, grammar and usage, sentence structure, strategy, organization, and style.

The Mathematics test covers pre-algebra, elementary algebra, intermediate algebra, coordinate geometry, plane geometry, and trigonometry.

The Reading test covers reading comprehension in terms of main idea and details, stated meanings, implied meanings, cause and effect, comparison and contrast, author's purpose and tone, vocabulary, and text development.

The Science Reasoning test covers analysis and interpretation, evaluation, reasoning, and problem-solving skills used in the natural sciences.

Total testing time (without the essay) is 2 hours and 55 minutes. We suggest that students take the entire assessment in one sitting with one 10-15 minute break after the first two tests. The goal is to create as realistic a testing situation as possible since endurance is an important aspect of this lengthy exam.

Answering the Questions
Be sure to read the directions carefully at the beginning of the four sections. You may move around within a section, but you may NOT move between sections or return to an earlier section to change an answer. If you finish early, go back and check your work within that section only.

Since you are not penalized for incorrect answers, it is to your advantage to answer every question, even if you have to guess. You should make every effort to eliminate any incorrect answers before making your selection. If you can narrow your choice to two, you have a 50-50 chance.

Do not spend too much time on any one question. Be sure to read each question carefully. After you have marked your answer choice, go back and reread the question to make sure you have not missed anything. If you are not sure about a question, circle it in your test booklet, go on to the next question, and then come back to it later.

Calculators
You may use any four-function, scientific, or graphing calculator on the Mathematics test only. You may NOT use a calculator on the other three tests. Go to the ACT, Inc. website www.act.org to see complete rules on calculator use.

ENGLISH TEST
45 Minutes—75 Questions

DIRECTIONS: The following five passages contain underlined and numbered words or phrases with alternatives in the right-hand column. Choose the answer that fits best, paying attention to the rules of standard written English and the tone and style of the passage. In some instances, a number in a box will refer to a section of a paragraph or to an entire paragraph. If you think the original version is best, select "NO CHANGE." Be sure to read through the entire passage before answering the questions about it.

PASSAGE I

This passage was adapted from the JohnShepler.com essay "Handy Guide to What's Coming in Our Careers," written by John Shepler.

Pick up a <u>newspaper. Any paper, any edition.</u>
₁ Somewhere in the national or business section, you'll see two stories that seem to conflict. The first <u>talks</u> of an
₂ unprecedented business expansion with an ever rising stock market and the lowest unemployment in twenty or thirty years. Just inches away you'll find a report that such and such company is laying off two or three thousand workers. There they sit, side by side, with no editorial comment. Yet something seems amiss. Does this really make sense? [3]

<u>It makes no sense in the expectations most of us grew</u>
₄ <u>up with.</u> You stayed in school to get a good job. Only dropouts bounced around from job to job, never knowing what they'd be doing next. You picked what you wanted to be early in <u>life and</u> were told to choose carefully because that
₅ was what you would be doing the rest of your life. High

1. **A.** No Change
   B. newspaper–any paper, any edition.
   C. newspaper; any paper, any edition.
   D. newspaper: any paper; any edition.

2. **F.** No Change
   G. is talking
   H. talk
   J. was talking

3. The purpose of this paragraph is to:
   A. give reasons for low unemployment.
   B. highlight the differences between the stock market and unemployment.
   C. prove that editorials are not fair.
   D. emphasize the conflicts in business expansion and unemployment.

4. **F.** No Change
   G. Most of us grew up knowing something was wrong.
   H. This inconsistency between industry and unemployment does not meet the expectations of most of us.
   J. The inconsistency between industry and unemployment is not what we are used to.

5. **A.** No Change
   B. life, and
   C. life; and
   D. life. And

GO ON TO THE NEXT PAGE.

school was preparation for c<u>ollege. College</u> was preparation
₆

for a <u>lifes </u>work. You picked a good profession and went to
₇

work for a good company, so you'd be "set for life." If you

didn't or couldn't go the college route, you went to junior

college or nursing school, joined a trade union or perhaps went

into the family business.   Whatever the choice, you were

setting up for your future. It was a future that might be clearly

seen.

What nobody told you, because nobody knew, is that

the world would change right before your eyes. You can't tell

where a car is built anymore because the parts come <u>by all</u>

<u>over</u> the world. One of the "big three" automakers is soon to
₈

be a foreign company. Banks seem to change names every

few weeks, not that there is any reason to set foot in one since

your check is handled electronically, loans and certificates of

deposit can be had in the grocery store, and the gas station

gives you cash advances. [9]

You might smile at this, but <u>its</u> a nervous smile, isn't
₁₀

it? You know that you and I have been affected by whatever

is changing in business. The certainty that we <u>may have felt</u> in
₁₁

our careers isn't quite there anymore. [12]

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6. Which choice most effectively combines the
   sentences?
   F.   No Change
   G.   college: college
   H.   college; college
   J.   college—college

7. A.   No Change
   B.   life's work
   C.   work of life
   D.   lifes' work

8. F.   No Change
   G.   from all over
   H.   in all over
   J.   out all over

9. If the writer were to delete the last sentence, this
   paragraph would primarily lose a statement that:
   A.   provides descriptions of "automakers"
   B.   supports the opening sentence in the essay
   C.   gives an explanation for the writer's actions
   D.   provides the necessary support that money has
        become an impersonal matter

10. F.   No Change
    G.   it's
    H.   that's
    J.   it would be

11. A.   No Change
    B.   we do feel
    C.   feel
    D.   did feel

12. Suppose the writer had intended to write a brief essay
    persuading readers that college was the only option
    after high school. Would this essay fulfill the writer's
    goal?
    F.   Yes, because the essay supplies evidence that
         there are no other alternatives.
    G.   Yes, because the essay describes the different
         educational options for high school graduates.
    H.   No, because the essay focuses on the changes
         taking place in today's workforce.
    J.   No, because the essay focuses on the writer's
         experiences as a college student.

PASSAGE II

This passage was adapted from the JohnShepler.com essay "As the Crow Flies: The Mysterious and Intelligent Corvids Pondered by Edgar Allan Poe," written by John Shepler.

In groups they are a conspiracy of ravens, an unkindness of ravens or a murder of crows. They are the dark, foreboding birds of Poe's lament, the "black bandits" vilified for stealing the nation's precious grain during World War II and the scourge of farmers through the centuries. We may fear them, curse them or merely consider them occasional pests, yet these are <u>highly, intelligent</u> creatures.
                                    13

Perhaps you <u>had heard</u> the expression "counting
                  14
crows." For centuries this practice, called crow or magpie augury, <u>was said</u> to predict the future. If you see one crow,
              15
it foretells an unhappy event. Two means a change for the better. A trio signifies a marriage, four a birth. Five at once is a positive transaction or silver. Six signifies gold in the form of wealth or greed. Seven is something of spiritual significance, perhaps a secret. Eight foretells a life altering <u>experience, while</u> nine means something sensual. Ten
  16
signifies an overwhelming sensation. Eleven is uncertainty. A dozen crows is best of <u>all, for</u> they foretell fulfillment and
                          17
riches, an end to a <u>problem or</u> the answer to a question.
                      18

But did you know that crows also count? <u>A close eye</u>
                                                          19
<u>is kept on hunters,</u> knowing the difference between a hunter with a gun and a farmer with a rake. If three hunters enter a blind and only two emerge, the crows will keep <u>one's</u> distance,
                                                            20
knowing full well that one still lurks inside.

13. A. No Change
    B. highly and intelligent
    C highly intelligent
    D. high intelligent

14. F. No Change
    G. will have heard
    H. would have heard
    J. have heard

15. A. No Change
    B. have been said
    C. has been said
    D. will have been said

16. Which of the following choices
    is NOT acceptable?
    F. No Change
    G. experience; nine means
    H. experience and nine
    J. experience. Nine

17. A. No Change
    B. all; for
    C. all. Or
    D. all: for

18. F. No Change
    G. problem; or
    H. problem. Or
    J. problem, or

19. A. No Change
    B. Hunters watch them with a close eye,
    C. They kept a close eye on hunters,
    D. They keep a close eye on hunters,

20. F. No Change
    G. his
    H. there
    J. their

The scarecrows that farmers prop up among the corn stalks are almost laughable to the lying crows. Seldom does a scarecrow last more than a week next it becomes a handy perch for crows to rest upon between dives to the corn field. Those cartoon crows, Heckel and Jeckel, were not that far from true crow behavior as they mocked the simpleminded humans who tried to foil them. Perhaps it is fortunate that the farmer's scarecrows are so ineffective, because the crows who are being blamed for taking corn kernels may often be attacking cutworms and white grubs instead. Woe has been the lot of the irate farmer who exterminated the crows only to find his crops destroyed by marauding cutworms instead.

So, are crows our friends or foes? Who knows? The English monarchy is taking no chances. It has been prophesied that if the ravens who occupy the Tower of London ever leave, the Tower will fall and with it the crown of England. The appointed RavenMaster is there to care for them just to make sure they feel welcome. 26

21.
A. No Change
B. intelligent
C. scheming
D. wily

22.
F. No Change
G. week before it
H. week while it
J. week and it

23.
A. No Change
B. farmers scarecrows
C. farmers' scarecrows
D. farmers' scarecrow

24.
F. No Change
G. ineffective because
H. ineffective; because
J. ineffective—because

25. Which of the following alternatives to the underlined portion is acceptable?
A. No Change
B. cutworms and white grubs are being blamed for attacking the kernels, not the crows
C. crows are taking the kernels and attacking the white grubs and the cutworms
D. crows who are taking the corn kernels are also destroying the scarecrows

26. Why does the author conclude the passage with the details of the English monarchy and the Tower of London?
F. because he wishes to emphasize the role of the British in caring for the crows
G. because he wants the reader to travel to England
H. because he is emphasizing the legends and the mystery surrounding the crows throughout history
J. because he is emphasizing the job the crows maintain in the Tower of London

PASSAGE III

This passage was adapted from the JohnShepler.com essay "The Golden Age of the Circus: The Era of Barnum & Bailey and the Ringling Brothers," written by John Shepler.

Imagine yourself taken back in time. It's the late 1800's and your just ten years old and living in one of the small towns in the midwestern USA. The most exciting thing

27.
A. No Change
B. youre
C. you was
D. you're

in your life comes once a year. This is something that gets

your heart pounding with anticipation. Down the street come

huge wagons, painted in bright colors. There are strange

animals. A gigantic huge trumpeting elephant, a growling
___
28   29

lion, beautiful parading horses. Yes, it is the day the circus

comes to town.

The circus has been around since the time of the
___
30

Romans,who held their Circus Maximus in open-air arenas.

They had chariot races acrobatics wrestling horsemanship and
___
31

wild beasts. After the fall of the Roman Empire, wandering

troupes of performers and clowns helped keep the spirit of the

circus alive until it reached Philadelphia in the 18th century. It

then spread to the American frontier, the frontier and the
___
32

circus were made for each other. It was a situation that was

ripe for the golden age of the circus. Enter Barnum and Bailey

and the Ringling Brothers, and the stage, as they say, is set. 34
___
33

P. T. Barnum had a natural gift for showmanship. He

started his career selling tickets and performing as a clown in a

small circus. He expanded his act with sideshow attractions

that included faked mermaids and bearded ladies. In the

1880's James A. Bailey formed a partnership with Barnum and
___
35

together they fielded Barnum & Bailey's "Greatest Show on

28. How is the following sentence best punctuated?
    F.   No Change
    G.   animals: a
    H.   animals; a
    J.   animals, a

29. Which word can be omitted?
    A.   No Change
    B.   huge
    C.   trumpeting
    D.   elephant

30.   **F.**   No Change
    G.   had been around
    H.   was around
    J.   will have been around

31.   **A.**   No Change
    B.   chariot races; acrobatics; wrestling; horsemanship; and wild beasts
    C.   chariot races, acrobatics, wrestling, horsemanship, and wild beasts
    D.   chariot races—acrobatics—wrestling—horsemanship—and wild beasts

32.   **F.**   No Change
    G.   frontier; the frontier
    H.   frontier, and,
    J.   frontier; and

33.   **A.**   No Change
    B.   stage as they say,
    C.   stage, as they say
    D.   stage as they say

34. Which of the following offers the best introduction to the paragraph?
    F.   P. T. Barnum was an entrepreneur.
    G.   The circus was a new event in the United States of America.
    H.   Entertainment was something to think about while on the American frontier.
    J.   Barnum and Bailey and the Ringling Brothers established themselves as the original inventors of the circus life.

35.   **A.**   No Change
    B.   Barnum and, together
    C.   Barnum, and together
    D.   Barnum, and, together

Earth," with more people, horses, elephants and larger tents than other <u>circuses, nor</u> competition awaited Barnum & Bailey in the tents of the Ringling Brothers.
³⁶

Thanks partly to the influence of the Ringlings, the state of Wisconsin became known as "The Mother of Circuses." It was home to 26 different circus companies. After the deaths of Barnum and Bailey, the Ringlings had begun acquiring some of Bailey's circus properties. The Barnum & Bailey Circus <u>will have been bought</u> by the Ringling <u>Brothers, but</u>
³⁷ ³⁸
<u>kept</u> as a separate circus until 1919. <u>When merged, the</u>
<u>"Ringling Bros. and Barnum & Bailey Combined Shows, The</u>
³⁹
<u>Greatest Show on Earth."</u> It was the pinnacle of the circus' golden age and ushered in the twilight of the traveling circus.

<u>Today, you</u> can still see the circus perform, as smaller
⁴⁰
shows come to your town. You can also visit the Circus World Museum in Wisconsin to see shows, circus memorabilia, and 200 colorful <u>wagons, which</u> also parade
⁴¹
through the streets of Milwaukee every year! [42]

36.
F. No Change
G. circuses. However,
H. circuses, nevertheless,
J. circuses. In addition,

37.
A. No Change
B. was buying
C. would have bought
D. was bought

38.
F. No Change
G. Brothers but kept
H. Brothers. But kept
J. Brothers kept

39.
A. No Change
B. When merged, the company became the "Ringling Bros. and Barnum & Bailey Combined Shows, The Greatest Show on Earth."
C. The company became the "Ringling Bros. and Barnum & Bailey Combined Shows, The Greatest Show on Earth."
D. When merged the company became the "Ringling Bros. and Barnum & Bailey Combined Shows, The Greatest Show on Earth."

40.
F. No Change
G. In fact you
H. Nevertheless, today you
J. On the other hand, today you

41.
A. No Change
B. wagons which
C. wagons; which
D. wagons—which

42. In reviewing notes, the writer discovers that the following information has been left out of the essay:
The major cities supported theater and opera, but professional entertainment was a rare treat for the people who lived on farms and in the small towns that dotted a country that was still being settled.
If added to the essay, the sentence would most logically be placed in Paragraph:
F. 1
G. 2
H. 3
J. 4

PASSAGE IV

This passage was adapted from the JohnShepler.com essay "Lance Armstrong's Tour de Force: Amazing story of America's premier bicycle racer," written by John Shepler.

The Tour de France is the supreme test of strength and endurance. For 22 days, 20 different stages and 2, 286 miles, some of the world conditioned athletes compete literally head to head as they work the pedals of <u>there</u> racing bicycles against hills and valleys, city streets and always the onset of exhaustion. As in all sports, there sometimes arises a champion of champions. Lance Armstrong was not supposed to be that champion of this year's Tour de France.

Lance Armstrong appeared to be on the threshold <u>of a</u> <u>life.</u> Young, strong, and talented, his career started taking on the appearance of superstardom. ❝ <u>He joined the U.S.</u> <u>cycling team and helped one's teammates</u> reach number five in the world by 1993. Three years later Armstrong won the Tour de France itself. The stars and planets were lining up his way. He was the number one ranked cyclist in the <u>world. a new</u> American cyclist would arise to become known the world over.

Then there <u>was</u> symptoms. The headaches, blurry vision, soreness in the groin area, overall ill feeling and even coughing up blood were enough to get him into the doctor's office. Then, his future came crashing down all at once; the diagnosis had come back as cancer, massive cancer.

What Lance didn't know was that spreading <u>like</u> <u>crazy throughout his body</u> was an especially aggressive form of testicular cancer. His cancer had established itself in his

43. A. No Change
     B. worlds most conditioned athletes
     C. worlds more conditioned athletes
     D. world's most conditioned athletes

44. F. No Change
     G. their
     H. them
     J. they're

45. A. No Change
     B. of an enamored life
     C. of a captivated life
     D. of a charmed life

46. Which of the following sentences offers the best introduction for Paragraph 2?
     F. The Tour de France is the famous cycling event in Paris.
     G. Many champions emerge from the Tour de France.
     H. Life circumstances would challenge Armstrong and his determination.
     J. Satisfaction is something to think about when entering competitions.

47. A. No Change
     B. He joins the U.S. cycling team and helps one's teammates.
     C. He joined the U.S. cycling team and helped his teammates.
     D. One joined the U.S. cycling team and helped one's teammates.

48. F. No Change
     G. world a new
     H. world. A new
     J. world; A new

49. A. No Change
     B. were
     C. would have been
     D. might have been

50. F. No Change
     G. like fanatical through his body
     H. like mad through his body
     J. like wildfire through his body

GO ON TO THE NEXT PAGE.

abdomen, his lungs and even his brain. There were eleven

masses in his lungs alone, some the size of golf balls. <u>The</u>
₅₁

brain was invaded by two malignancies. Best estimate of

survival? <u>Only 50/50.</u>
₅₂

It is said that the mind and the body are linked inextricably

and that how <u>you think</u> can promote or hinder the healing
₅₃

process. Perhaps that as much as anything else explains the

miraculous recovery of Lance Armstrong. He underwent

brain surgery and intense chemotherapy, but he never resigned

to failure or depression. Lance was declared, incredibly,

cancer-free. He had fought through the darkness, and <u>now the</u>

<u>brightness and luminating success had returned.</u>
₅₄

51. **A.** No Change
    B. Its
    C. His
    D. It's

52. Why would the author choose to set "Only 50/50"
apart from the rest of the sentence?
    F. to indicate that Armstrong was a true champion
    G. to indicate the importance of survival
    H. to stress the seriousness of Armstrong's prognosis
    J. to emphasize the strength and determination Armstrong had in order to overcome his obstacles

53. **A.** No Change
    B. your thinking
    C. you're thinking
    D. omit the word "you"

54. **F.** No Change
    G. now the brightness of success had returned
    H. now, today, the failures of yesterday were turned into success
    J. now returning were the successes of yesterday in place of the darkness of today

GO ON TO THE NEXT PAGE.

In 1999 Lance Armstrong led his team to victory

once again <u>around the streets on Paris.</u> He's won the Tour de
₅₅

France and established his own foundation to fund testicular

cancer. <u>Hes a champion</u> athlete, husband, and soon to be
₅₆

father in the prime of health again. ☐57 He is the best example

of what a second chance in life can really become. ☐58

55. **A.** No Change
     B. in the streets on Paris
     C. on the streets of Paris
     D. about the streets in Paris

56. **F.** No Change
     G. His is a champion
     H. One is a champion
     J. He's a champion

57. How would the last sentence in the paragraph best be reworded?
     A. No Change
     B. He is the best example of a second chance in life.
     C. He is the best example of what a second chance in life can grant for those who are optimistic and determined.
     D. A second chance in life can really be becoming.

58. What function does the paragraph serve in relation to the rest of the essay?
     F. It suggests that the author has yet to learn the significance of the Tour de France.
     G. It suggests that the author is satisfied with Armstrong not being a champion.
     H. It summarizes the main point that France is the host of the Tour de France.
     J. It refers back to the opening sentences of the essay, suggesting that Lance Armstrong was destined to be the winner of the Tour de France.

GO ON TO THE NEXT PAGE.

PASSAGE V

This passage was adapted from the JohnShepler.com essay "Cringely's Computer Chronicles: Robert X. Cringely Looks at Silicon Valley," written by John Shepler.

Robert X. Cringely writes what will be tomorrow's history. He's a journalist immersed <u>on the accelerated world</u> [59] of computers and high technology in Silicon Valley. It's a business in a time warp, where garages transform into <u>empires</u> [60] <u>and</u> hobbyists change the world. <u>If there is a battle raging for who will dominate the Internet, the personal computer, and</u> [61] <u>even the information age;</u> then Robert X. Cringely is the premier war correspondent. [62]

Almost <u>things we take for granted</u>, [63] the hardware, the software, the big names, nothing was preordained or even worked out on paper. Cringely was there to watch it, <u>write about</u> [64] and perhaps even influence it a bit himself. He was an Apple Computer employee and claims to have helped clean out the garage where the Apple empire began. Today the iMac computer from Apple <u>is one of the hottest</u> [65] selling products you'll find, and Apple is flying high in the computer industry.

59.
- **A.** No Change
- **B.** in the accelerated world
- **C.** about the accelerated world
- **D.** around the accelerated world

60.
- **F.** No Change
- **G.** empires, and
- **H.** empires and,
- **J.** empires. And

61.
- **A.** No Change
- **B.** If there is a battle raging for who will dominate the Internet, the personal computer, and even the information age:
- **C.** If there is a battle raging for: who will dominate the Internet, the personal computer, and even the information age,
- **D.** If there is a battle raging for who will dominate the Internet, the personal computer, and even the information age,

62. Which of the following sentences (assuming all are true), if added here, would best introduce the new subject of Paragraph 2?
- **F.** Cringely reported on the economic impact of the computer and its software.
- **G.** Billions of dollars were spent on personal computers and software.
- **H.** Cringely had a position of importance in the early days of the computer world.
- **J.** Cringely is an influential author.

63.
- **A.** No Change
- **B.** nothing we take for granted
- **C.** anything we take for granted
- **D.** most items we take for granted

64.
- **F.** No Change
- **G.** write about computers,
- **H.** write about some,
- **J.** write about it,

65.
- **A.** No Change
- **B.** was one of the hottest
- **C.** was one of the hotter
- **D.** is one of the hotter

12

GO ON TO THE NEXT PAGE.

Cringely made his own name in writing an influential weekly column in a top computer trade publication, InfoWorld, from 1987 to 1995. [66] He has also moved on to PBS to continue his writing and expand into video reporting. His latest production is appropriately titled "Nerds 2.0.1: A Brief History of the Internet;" It's a three-hour documentary in that shows how college students become billionaires and create the world of cyberspace out of, well, garages. In fact, the group that created the Excite search engine have a new multi-million dollar corporate palace with a conference room that looks just like the garage they started in six years ago. In addition, Cringely has produced and starred in "Triumph of the Nerds," which is a similar documentary about the history of the PC industry. [70]

66. For the sake of the unity and coherence of the essay, Paragraph 3 should be placed:
F. where it is now
G. after Paragraph 2
H. omit Paragraph 3 completely
J. after Paragraph 4

67. A. No Change
B. Internet," it's
C. Internet." It's
D. Internet. It's

68. F. No Change
G. in which shows how college students
H. that shows how college students
J. where it shows how college students

69. A. No Change
B. Whereas,
C. Nevertheless,
D. On the other hand,

70. The writer wishes to include another example of Cringely's knowledge and expertise in the world of technology. Which of the following true sentences, if inserted here, would best fulfill that goal?
F. Cringely became financially independent because of his career.
G. The technology world was forever changed by Cringely's revelations.
H. Cringely used to sneak around the back alleys of Silicon Valley computer companies with budding entrepreneurs, diving through dumpsters to find parts for their next project.
J. Robert Cringely wrote it all; Bill Gates didn't invent MS-DOS.

You've gotta love this guy, character that he is. He sticks pins in the overinflated egos and overhyped products of the industry <u>giants and</u> he celebrates the <u>lesser known</u> geeks
_71_ _72_
and nerds <u>who </u>create the real value in the products from <u>which</u>
_73_ _74_
cubicles and dorm rooms. [75]

71.
- **A.** No Change
- **B.** giants, and
- **C.** giants, and,
- **D.** , giants, and

72.
- **F.** No Change
- **G.** least known
- **H.** least to know
- **J.** lesser to know

73.
- **A.** No Change
- **B.** to whom
- **C.** whom
- **D.** which

74.
- **F.** No Change
- **G.** their
- **H.** they're
- **J.** there

75. Suppose the writer had intended to write a brief essay persuading readers to boycott modern technology. Would this essay fulfill the writer's goal?
- **A.** Yes, because the essay supplies plenty of examples of the corruption in the technology field.
- **B.** Yes, because the essay describes many people whose careers were destroyed in the early years of the computer.
- **C.** No, because the essay focuses on the kinds of people who work in the computer field.
- **D.** No, because the essay focuses on the experiences and opinions of one man, Robert Cringely.

END OF TEST 1
STOP! DO NOT GO ON UNTIL TOLD TO DO SO.

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intentionally.

MATHEMATICS TEST
60 Minutes—60 Questions

DIRECTIONS: After you solve each problem, mark the correct answer on your answer sheet. You should not spend too much time on any one problem. Solve the problems that you can and then go back to the others if you have time left for this section. You may use a calculator for this portion of the test. Keep in mind that the word *line* means "straight line" and that all geometric figures lie in a plane and are not necessarily drawn to scale.

DO YOUR FIGURING HERE.

1. If a system of 2 linear equations has *no* solution and one of the equations is $2x + y = 9$, which of the following could be the equation of the other line?

   A. $y = -2x + 9$

   B. $y = 2x + 9$

   C. $y = -2x + 3$

   D. $y = \frac{1}{2}x - 6$

   E. $y = 9$

2. In the standard (x, y) coordinate plane, what is the center of the circle $x^2 + (y - 1)^2 = 100$?

   F. (0,-1)

   G. (0,1)

   H. (1,0)

   J. (1,1)

   K. (0,0)

3. What is the area, in square centimeters, of a rectangle that has a perimeter of 20 cm and is 4 cm wide?
   A. 6
   B. 10
   C. 24
   D. 64
   E. 80

16

GO ON TO THE NEXT PAGE.

DO YOUR FIGURING HERE.

4. If x = -5, then $-x^2 + 3x + 9 = ?$

    F. -31

    G. -1

    H.   4

    J.   19

    K.   49

5. Which of the following is equivalent to $12x^2 - 5x - 2$?
    A. $(x - 8)(x + 3)$
    B. $(3x - 2)(4x + 1)$
    C. $(3x + 2)(4x - 1)$
    D. $(6x - 1)(2x + 2)$
    E. $(6x + 1)(2x - 2)$

6. At a dinner each person was given a choice of chicken or steak. Of the 200 people in attendance, 54 chose the chicken. What percentage of the people chose the chicken dinner?

    F.   12%

    G.   27%

    H.   37%

    J.   54%

    K.   73%

7. For $\triangle ABC$ shown below, $\angle A$ is given in degrees. What is the measure of $\angle C$?

    A.   15°
    B.   30°
    C.   60°
    D.   75°
    E.   150°
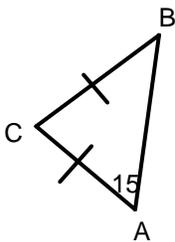
DO YOUR FIGURING HERE.

8. If $A = x^2 + 2x + 3$ and $B = 3x - 7$, then what is the value of $A - B$?

    F. $x^2 + 5x - 4$
    G. $-x^2 + x - 10$
    H. $x^2 - x - 4$
    J. $x^2 - x + 10$
    K. $3x^3 - x^2 - 5x - 21$

9. If $3 + 2(5 - x) = 9$, then $x = ?$

    A.   4
    B.   2
    C. $\dfrac{16}{5}$
    D. -2
    E. -4

10. Suppose an empty box that is a cube with all sides measuring 8 ft is to be filled with identical plastic cubes as shown below. How many cubes will fit inside the box?
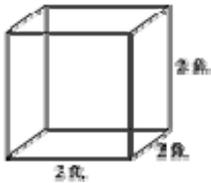
    F.   16
    G.   32
    H.   36
    J.   48
    K.   64

11. In the complex number system $i^2 = -1$, what does $2i(i^3 + i)$ equal?

    A. -2
    B. -1
    C.   0
    D.   1
    E.   2

12. Which of the following gives all the solutions of $x^2 + 5x - 24 = 0$?

    F. -8 and 3
    G.   8 and 3
    H. -12 and 2
    J.   12 and -2
    K.   5 and 24

DO YOUR FIGURING HERE.

13. In the figure below, lines ℓ and m are parallel and intersected by lines n and t at point A. What is the measure of $\angle x$?
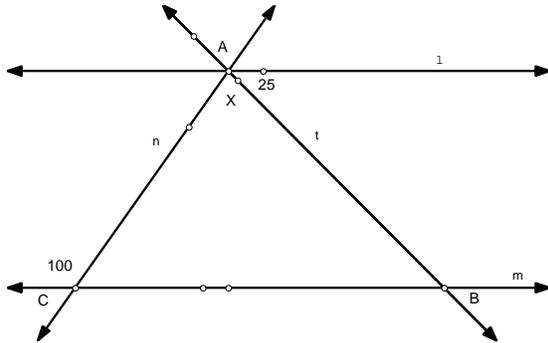
A. 25°

B. 75°

C. 80°

D. 100°

E. Cannot be determined from the information given.

14. An artist has a square canvas that is to be covered with a piece of fabric. The square is such that one side measures $(3x - 1)$ inches. Which of the following expressions in terms of x gives the number of square inches of fabric needed to cover the picture?

F. $6x - 2$

G. $12x - 4$

H. $9x^2 + 1$
J. $9x^2 - 6x + 1$
K. $18x^2 - 12x + 2$

15. What is the eighth term of the following geometric sequence?

$$27, 9, 3, 1, \ldots$$

A. $\dfrac{1}{3}$

B. $\dfrac{1}{9}$

C. $\dfrac{1}{27}$

D. $\dfrac{1}{81}$

E. $\dfrac{1}{243}$

GO ON TO THE NEXT PAGE.

DO YOUR FIGURING HERE.

16. What is the value of $|4 - a| + 2b$ if $a = 9$ and $b = \frac{1}{2}$?

   F.   14

   G.   6

   H.   3.5

   J.   −1.5

   K.   4

17. Tonya bought 3 pounds of candy at the mall. The first day she ate $\frac{2}{5}$ pounds of the candy. The next day she and her friends ate $1\frac{1}{5}$ pounds of the candy. How many pounds of the candy were left after the second day?

   A. $1\frac{2}{5}$

   B. $1\frac{3}{5}$

   C. $1\frac{7}{10}$

   D. $2\frac{2}{5}$

   E. $2\frac{3}{5}$

18. The diameter of a circle is 20 cm long. What is the area of the circle, in square centimeters?

   F. 20π

   G. 40π

   H. 100π

   J. 400π

   K. 1600π

19. If $y = 5x - 9$, what is the x coordinate where $y = 1$?

   A.   −2

   B.   −1

   C.   0

   D.   1

   E.   2

DO YOUR FIGURING HERE.

20. In the standard (x, y) coordinate plane, which of the following lines has a slope of -3?

   F. $y = 2x - 3$

   G. $2y = -6x + 4$

   H. $y = x + 3$

   J. $2y = -3x + 1$

   K. $y = -3$

21. Walter is on a bowling team. One night, he bowled 200, 192, 186, and 200 in the first four games. For his team to win he must bowl 5 games and have an average of 190. What is the lowest score he can get in the fifth game for his team to win?

   A.   168

   B.   172

   C.   184

   D.   195

   E.   216

22. In the standard (x, y) coordinate plane, what is the slope of the line that passes through $(-1, 4)$ and $(-3, 7)$?

   F. $\dfrac{3}{4}$

   G. $-\dfrac{3}{4}$

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

   J. $-\dfrac{3}{2}$

   K. $\dfrac{4}{3}$

23. What is the area, in square centimeters, of the parallelogram shown below?

   A.   20

   B.   21

   C.   24

   D.   28

   E.   42
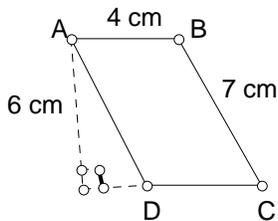
DO YOUR FIGURING HERE.

24. For all non-zero values of r, s, and t, $\dfrac{(4rs^2t^4)(2s^3)^2}{8r^5t^2} = ?$

F. r^4s^7

G. $2r^4s^8t^2$

H. $\dfrac{t^2s^{12}}{r^4}$

J. $\dfrac{2s^8t^2}{r^4}$

K. $\dfrac{2s^7t^2}{r^4}$

25. From a point 20 feet from the base of a building, the angle of elevation to the top of the building is 50°, as shown below. Which of the following equations could be used to find the height of the building h, in feet?

50

20 ft

h
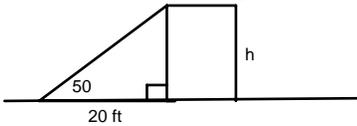
A. $\sin 50° = \dfrac{h}{20}$

B. $\cos 50° = \dfrac{h}{20}$

C. $\tan 50° = \dfrac{h}{20}$

D. $\sec 50° = \dfrac{h}{20}$

E. $\csc 50° = \dfrac{h}{20}$

26. The equation for the volume of a right circular cylinder is $V = \pi r^2 h$ where V is the volume, r is the radius, and h is the height. If you know the volume and radius of the cylinder, which of the following allows you to find the height of the cylinder?

F. divide V by the product of πr^2

G. divide the product of πr^2 by V

H. divide the product of $V\pi$ by r^2

J. multiply V by πr^2

K. subtract the product of πr^2 from V

DO YOUR FIGURING HERE.

27. In the standard (x, y) coordinate plane, what is the slope of any line perpendicular to $2x - 3y = 15$?

A. $-\dfrac{1}{2}$

B. 2

C. $\dfrac{2}{3}$

D. $\dfrac{1}{5}$

E. $-\dfrac{3}{2}$

28. For all non-zero a and b, $a^{-1} - b^{-1} = ?$

F. ab

G. $\dfrac{1}{ab}$

H. $\dfrac{1}{a-b}$

J. $\dfrac{b-a}{ab}$

K. $\dfrac{ab}{b-a}$

29. In the standard (x,y) coordinate plane, the midpoint of line segment $\overline{AB}$ is (2,-3). If the coordinates of A are (5,4), what are the coordinates of B?

A. (7,-2)
B. (-1,-10)
C. (0,0)
D. (3,7)
E. (-3,-7)

30. What is the smallest positive whole number that both 25 and 30 will divide into leaving a remainder of zero?

F. 5
G. 30
H. 55
J. 150
K. 750

DO YOUR FIGURING HERE.

31. For all b, $4(-3b)^3 = ?$

    A. $-108b^3$

    B. $-36b^3$

    C. $-12b^3$

    D. $36b^3$

    E. $108b^3$

32. Suzanne has 30 yards of fabric to use to make t-shirts. Each t-shirt requires 1.25 yards of fabric. She has enough fabric to make how many t-shirts?

    F. 15
    G. 18
    H. 24
    J. 30
    K. 38

33. If n is an integer which of the following will yield a positive integer for any integer n?

    A. $n^2 - 2$
    B. $n^2 + 2$
    C. $n(n + 1)$
    D. $2n^3$
    E. $4n + 3$

34. Find the perimeter in centimeters of the figure shown below. All lengths are given in centimeters.
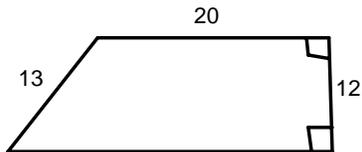
    F. 45
    G. 50
    H. 70
    J. 82
    K. 240

35. For what values of x is it true that $x^2 < 25$?

    A. $x < -5$ or $x > 5$
    B. $-5 < x < 5$
    C. $x < 5$
    D. $x > 5$
    E. $x > 0$

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DO YOUR FIGURING HERE.

36. Using the triangle below, which ratio is equal to $\cos\theta$?
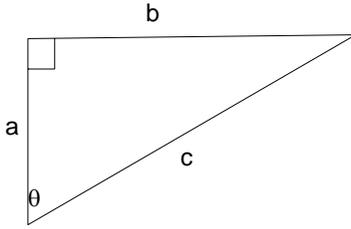
F. $\dfrac{a}{c}$

G. $\dfrac{b}{c}$

H. $\dfrac{a}{b}$

J. $\dfrac{b}{a}$

K. $\dfrac{c}{b}$

37. The volume of a sphere is given by the formula $V = \dfrac{4}{3}\pi r^3$ and the surface area of a sphere is given by the formula $S = 4\pi r^2$ where r is the radius of the sphere. What is the surface area of a sphere, in square meters, if its volume is 36π cubic meters?

    A. 4π
    B. 16π
    C. 36π
    D. 64π
    E. 100π

38. A wheelchair ramp is to be built that must rise to a height 3 feet above the ground and must start exactly 4 feet from the base of the wall. Assuming that the ramp is straight and that the wall is perpendicular to the ground, how long, in feet, will the ramp be?

    F. $\sqrt{7}$

    G.   1

    H.   5

    J.   7

    K.   25

GO ON TO THE NEXT PAGE.

DO YOUR FIGURING HERE.

39. Using $\triangle ABC$ shown below, which of the following angles *could be* the largest angle in the triangle? Note, figure not drawn to scale.

```
           B
          / \
      9  /   \  12
        /     \
       /       \
      A---------C
          15
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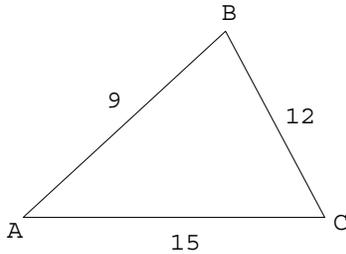
      I. $\angle$ A
     II. $\angle$ B
    III. $\angle$ C

A. I or II
B. II or III
C. I only
D. II only
E. I, II, or III

40. Raul can bicycle 5 miles in m minutes. Which expression describes his speed in miles per hour?

F. $\dfrac{1}{12m}$

G. $12m$

H. $\dfrac{5}{m}$

J. $\dfrac{m}{300}$

K. $\dfrac{300}{m}$

41. A survey is conducted asking Americans how often they wear a seatbelt when in an automobile. The table below shows the results.

Always	60%
Sometimes	20%
Seldom	15%
Never	5%

If 600 people responded that they always wear a seatbelt, how many responded that they never wear a seatbelt?

A. 5
B. 10
C. 50
D. 100
E. 500

DO YOUR FIGURING HERE.

42. A bag of marbles contains 3 red marbles, 5 green marbles, and 7 blue marbles. If Joseph reaches in and pulls out one marble, what is the probability that the marble will *not* be red?

F. $\dfrac{1}{3}$

G. $\dfrac{1}{5}$

H. $\dfrac{1}{7}$

J. $\dfrac{4}{5}$

K. $\dfrac{7}{15}$

43. If $x = \dfrac{2y-3}{4}$, then y=?

A. $2x + 12$

B. $2x - 3$

C. $2x + 3$

D. $\dfrac{4x-3}{2}$

E. $\dfrac{4x+3}{2}$

44. A local phone company charges x cents for the first 5 minutes of a long distance phone call and y cents per minute for each additional minute. Which of the following expressions gives the cost, in cents, of a 20-minute phone call?

F. $x + 15y$

G. $5x + 15y$

H. $(x + y)20$

J. $20xy$

K. $\dfrac{x}{5} + \dfrac{y}{15}$

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DO YOUR FIGURING HERE.

45. Find the area of the following figure in square centimeters. Assume that all the angles in the figure are right angles and that all lengths are given in centimeters.
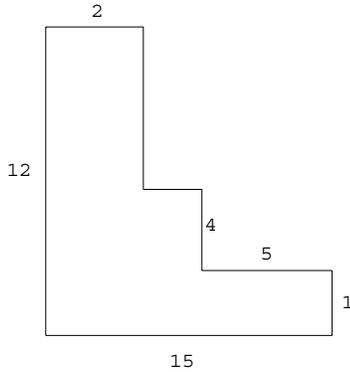
A.   180

B.   126

C.   90

D.   69

E.   54

46. Cory ran the mile every morning for a week and recorded his times, in minutes, in the table below. What was his average time, in minutes, for the mile run for that week?

Sunday	6
Monday	5.75
Tuesday	6.5
Wednesday	6.2
Thursday	5.8
Friday	6.6
Saturday	5.5

F.   6

G.   6.05

H.   6.1

J.   6.15

K.   6.2

DO YOUR FIGURING HERE.

47. Shana is going on a school trip to Canada and wants to know what type of clothes to pack. She finds out that the low temperature for while she is there is expected to be -5°C. If the conversion between degrees Fahrenheit and degrees Celsius is $F = \dfrac{9}{5}C + 32$, what is the low temperature expected to be in degrees Fahrenheit?

   A.   –21
   B.   –2.6
   C.   0
   D.   23
   E.   41

48. Which of the following expressions represents the distance between A and B on the number line below?
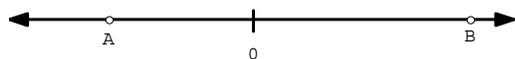
   F. $A - B$
   G. $|A - B|$
   H. $A + B$
   J. $|A + B|$
   K. $\dfrac{B}{A}$

49. The figure below shows a circle with center C and $\triangle ABC$ where A and B are points on the circle. Which of the following must be true?
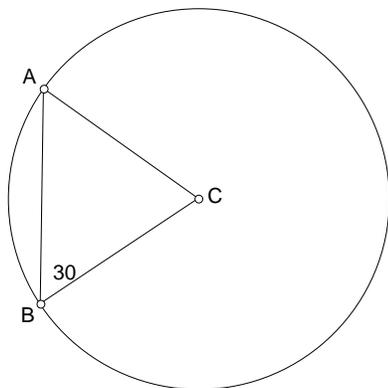
   A. $\triangle ABC$ is an equilateral triangle.
   B. $\triangle ABC$ is an equiangular triangle.
   C. $\triangle ABC$ is a right triangle.
   D. $\triangle ABC$ is an isosceles triangle.
   E. $\triangle ABC$ is a scalene triangle.

DO YOUR FIGURING HERE.

50. Anita currently brings home $1500 per month and puts $250 in a savings account each month. She is getting a raise at the first of the year and will then bring home $1800 per month. If she wants to increase the amount that she puts in savings proportionately, how much should she put in savings each month after her raise?

F. $275
G. $300
H. $325
J. $350
K. $375

51. Which of the following inequalities is graphed on the number line below?
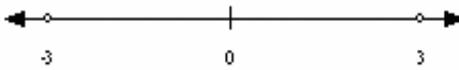
A. $|x| > 3$
B. $|x| \geq 3$
C. $|x| < 3$
D. $|x| \leq 3$
E. $|x| \leq -3$

52. The statement "If not Q, then not P." is the contrapositive to "If P, then Q." The contrapositive of a true statement is always true.

For example:
If a number is divisible by two, then it is even.
If a number is not even, then it is not divisible by two.
Which of the following statements illustrates a statement and its contrapositive?

F. If it is Friday, then I will go to the mall. If it is not Friday, then I will not go to the mall.
G. If I go to work, then I will get paid. If I get paid, then I can buy new shoes.
H. If the sun is out, then it is daytime. If it is not daytime, then the sun is not out.
J. If George is hungry, then he will eat. If George is not hungry, then he will not eat.
K. If I do my homework, then I will get a good grade. If I get a good grade, then I did my homework.

53. Suppose that 1% of a number is equal to 9 more than the product of 0.1 and the number. Find the number.

A. −100
B. 100
C. −10
D. 10
E. No solution

DO YOUR FIGURING HERE.

54. Samuel gets paid $0.30 per mile when he uses his car on a business trip. On a recent trip, his mileage went from 15,737 to 15,861. His boss decided to give him a bonus and Samuel received a check for $100. How much was the bonus that Samuel received?

F. $61.00

G. $61.75

H. $62.30

J. $62.80

K. $75.00

55. Suppose the radius of a certain circle is doubled. How many times larger is the area of the new circle than the area of the original circle?
A. 2
B. 4
C. 6
D. 8
E. 16

56. If x < 0 and y < 0, then which of the following *must* be a non-real number?
F. $\sqrt{xy}$
G. $\sqrt{\dfrac{x}{y}}$
H. $\sqrt{x-y}$
J. $\sqrt{y-x}$
K. $\sqrt{x+y}$

57. A parabola with an equation in the form $y = ax^2 + bx + c$ has a vertex of (0,3) and passes through the point (2, 5). Which of the following statements *must* be true?
A. The parabola opens down.
B. The parabola opens right.
C. The parabola has two x-intercepts.
D. The parabola passes through the point (-2,5).
E. The parabola passes through the point (-2,-5).

GO ON TO THE NEXT PAGE.

DO YOUR FIGURING HERE.

58. The figure below shows two angles A and B. What is $\cos(A + B)$?

[note: $\cos(A + B)=\cos A\cos B - \sin A\sin B$ for all angles A and B.]
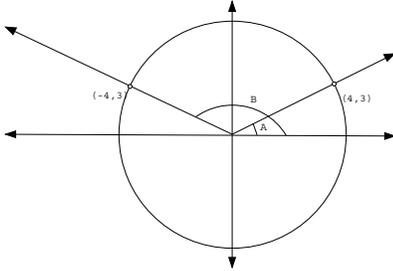
F. 1

G. 0

H. $-\dfrac{7}{25}$

J. -1

K. $-\dfrac{8}{5}$

59. Two cars leave from the same point. One car travels due south at 60 mph and the other car travels due east at 40 mph. What is the approximate distance, in miles, between the two cars after one hour?

A. 44.7

B. 64.8

C. 72.1

D. 100

E. 5200

60. If x and y are real numbers, $x = \sqrt{y}$, and $x = 2y$, then which of the following represent a possible value of x?

F. 2

G. $\dfrac{1}{2}$

H. 1

J. $-\dfrac{1}{2}$

K. -2

END OF TEST 2
STOP! DO NOT GO ON UNTIL TOLD TO DO SO.
DO NOT RETURN TO THE FIRST SECTION OF THE TEST.

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READING TEST
35 Minutes—40 Questions

DIRECTIONS: This test consists of four passages. Each passage is followed by ten multiple-choice questions. Read the passage, select the best answer, and then mark it on your answer sheet. You may refer to the passages as many times as necessary.

PASSAGE I

The Seven Wonders of the Ancient World have all vanished from modern sight with the significant exception of one: the Great Pyramid of Giza. It alone remains as mute testimony to the amazing accomplishments of its builders and the advanced civilization that produced it. The Great Pyramid is much more than a massive pile of carefully carved stone.

The Seven Wonders of the Ancient World were required stops on the itinerary of ancient globetrotters. Created by master artisans from Greece, Egypt, Asia Minor, and Babylon, these monuments attested to the
5   high level of mathematical, architectural, and artistic expertise inherent in those cultures that nurtured their development. Not only was building on a colossal scale significant, but their individual intended purposes were a clear indication of the aesthetic values at the core of each
10 civilization.
        Today, only the Great Pyramid at Giza remains; the other six long ago succumbed to the ravages of time, natural disasters, and man. Located on the outskirts of present day Cairo, the Great Pyramid sits in stoic grace,
15 surrounded by its two other companion pyramids and watched over by the unblinking gaze of the Great Sphinx.
        Modern scholarship and archeological evidence attribute the idea of building the Great Pyramid to the Pharaoh Khufu during the period of Egyptian civilization
20 known as the Old Kingdom, which dates to c. 3000-2200 B.C. Intended for use as his final resting place on Earth until his spirit went to join the gods, the pyramid rose over and around a red granite sarcophagus positioned in a room whose walls were also constructed of red granite.
25 A series of narrow passageways led from the outside down deep within the pyramid, eventually ending at the "Kings Chamber," as the burial site is called. Also found in the chamber are tiny openings which lead directly upward at a steep angle to the outside. For years these
30 so-called vents were thought to be simply passages for the flow of air into the chamber. Only recently has a fascinating discovery concerning these vents led

archaeologists to put forth a new theory concerning their use. When fully researched, this theory could
35 revolutionize how we think about the remarkable scientific and mathematical accomplishments of the ancient Egyptians.
        What scientists discovered was that these tiny passages pointed directly to the constellation we call
40 Orion. What could be the significance of such a connection? From ancient hieroglyphic texts, Egyptologists know that Horus, the Egyptian god of light, son of Osiris and Isis, was believed to reside in this region of the sky. Consequently, it is easy to see how a
45 well-established belief in the afterlife so fundamental to ancient Egyptian religion would expect the spirit of the dead Pharaoh to ascend to the stars and join the light of Horus.
        But there is an even more remarkable
50 connection between the Great Pyramid and the constellation of Orion. When astronomers reconstructed a picture of the night sky of some 5,000 years ago, they discovered to their amazement that the pyramid and its other two companions are positioned on Earth to
55 duplicate the location of the stars in Orion's belt in the sky. Consider the mastery of highly evolved principles of geometry and astronomy required to make such calculations. Clearly, the ancient Egyptians were far more than a people who believed in what many would
60 call the pseudoscience of astrology. And so the Great Pyramid continues to present us with new insights to ponder gained from recent scientific and archaeological evidence.
        When completed, the Great Pyramid rose to a
65 staggering height of 481 feet, remaining the tallest man-made structure anywhere in the world until the building of the Eiffel Tower in the nineteenth century. It can also lay claim to another astounding record: Of the seven Ancient Wonders, it, alone, still exists today. As an Arab
70 proverb states, "Man fears Time, yet Time fears the Pyramids." Who knows what other revelations it has yet to share.

1. According to the passage, the Great Pyramid of Giza stands as a testimony to:
   A. the remarkable monuments on the Earth today.
   B. the ancient world and its amazing history.
   C. the many secrets the pyramid holds as a result of its amazing construction.
   D. Pharaoh Khufu's vision for the ancient world.

2. Which of the following best describes the way the fourth paragraph (lines 38-48) functions in the passage as a whole?
   F. It puts into historical perspective the connection between Egyptian mythology and the Egyptian pharaohs.
   G. It enables the reader to understand how the god Horus is connected to the history of the pyramids.
   H. It supplies an explanation for the construction of the mysterious passages in the pyramids.
   J. It proves that scientists are determined to find out why the ancient builders used mathematics and science.

3. Which of the following best describes the proverb in the sixth paragraph (lines 64-72), "Man fears Time, yet Time fears the Pyramids," in relation to the entire passage?
   A. Man should fear when pyramids were constructed.
   B. The world and civilization were coming to an end.
   C. The pyramids were built as a result of scientific brilliance.
   D. When the pyramids were destroyed, it would be the end of time.

4. The author's primary purpose in referencing "Pharaoh Khufu" in the passage is to:
   F. prove the scientific fact that his ideas led to the construction of the pyramids.
   G. illustrate that Khufu and his kingdom were responsible for building Giza.
   H. help scientists understand the astonishing mathematical and scientific skills involved in constructing pyramids.
   J. illustrate what a great leader Khufu was in the ancient world.

5. According to the passage, all of the following were "required stops" on a journey during ancient times EXCEPT:
   A. aesthetic values
   B. architectural questions
   C. mathematical and scientific wonders
   D. religious ponderings

6. The author's attitude toward the Great Pyramid is best described as:
   F. reverent
   G. incredulous
   H. overwhelming
   J. awe-struck

7. In line 9, the word "aesthetic" most nearly means:
   A. artistic and beautiful
   B. cultural and political
   C. spiritual and religious
   D. philosophical and idealistic

8. The ideas in the fourth paragraph (lines 38-48) imply that:
   F. hieroglyphic texts were important to the pharaohs.
   G. the tiny passages in the pyramid were not randomly placed; they proved the astronomical importance to the pharaohs.
   H. the sun god, Horus, was important to the Egyptians.
   J. the pyramids were all built for religious purposes.

9. Why does the author refer to the modern day Eiffel Tower?
   A. to prove that man can still build grand monuments that survive the test of time.
   B. to attest to the connection between the French and the Egyptians.
   C. to demonstrate how the mystery of the pyramids withstood the test of time until the modern day.
   D. to illustrate that all historical monuments have secrets to reveal.

10. The passage implies that further research on the Great Pyramid will reveal:
   F. additional hidden chambers.
   G. further revelations of the Great Pyramid's secrets.
   H. builders from another civilization.
   J. great treasures as yet undiscovered.

PASSAGE II

The author grew up on a small farm in the Midwest. As he recounts in this passage, the innocence of youth and daily experiences created memories to last a lifetime.

The world seemed to be full of endless adventures for me, a young boy growing up on a farm in central Ohio in the late 40's. Blackberry picking was one. Accompanied by my faithful dog, I would walk past
5 the barn and around the hill to a patch of thick, ancient blackberry bushes. I would pull the ripened berries from the lower stalks of these towering brambles, arching in gentle curves downward. The little silver pail would slowly fill with fat, blue-black berries that gave off a
10 sweet aroma in the summer sun. As many berries went into the picker as into the pail. It was a delicious labor carried out over many days in July.

Catching fireflies was another. On warm summer nights, jar in hand, I would roam the hills and
15 fields above the house, catching fireflies as they blinked their tiny lights over the grass. Each was placed carefully into the jar and the lid with its little air holes replaced. I would hold the jar up to the sky and watch the glow from within, and only when I was called to come in would I
20 stop my gathering and reluctantly head home toward the little yellow spots in the distance. Only much later would I come to realize the significance of both lights.

I was my father's shadow. Wherever he went, I tagged along, and although I was still too small to be of
25 much help, I tried my hand at the usual chores. Milking the cows was always an event for me. Somehow, as if by a magic signal, as dusk approached, the cows would appear at the barn ready to be milked. Each would be locked in a stanchion to wait her turn. My father would
30 sit on a low, four-legged milking stool, and with a slow and even contraction of his hands, the milk would flow into the pail. The regular rhythm and sound of the milk hitting the pail was hypnotic. Three or four barn cats always heard the milking music, and it was their cue to
35 gather around for a free drink of warm milk. Every so often, my father would aim the milk their way, and they would lap their tongues and purr in satisfaction.

Although we had an old tractor, my father would often use his team of horses to mow and rake the hay. It
40 was his way of keeping in touch with his boyhood when there were no tractors or bailers, only a good team of horses to work the fields. My "job" was to ride one of the big, sturdy draft-horses. I'd be placed on one and hold onto both hames to keep my balance. A saddle
45 couldn't be used because the team was in full work harness. Looking down, the ground seemed far away, so I would keep my eyes fixed on the view ahead, always framed by two tall, pointy ears. I could hear my father call out to them, "Gee" and "Haw," and they would
50 dutifully obey, moving one way or the other because they had mastered the language of farmers for left and right.

Yes, there was a genuine art to working with a team of horses. Both man and horse had to become one, learning the language. Which horse worked best on the left;
55 which on the right?

But the real test of a well-trained team and driver could be judged by observing the placement of the driving lines and where they touched the horse. Without a spoken word of direction, the horses would move in that
60 direction, recognizing the subtle, unspoken language packed with meaning.

To me, the endless maze of work harness pieces was always a puzzle. Hames, collars, back bands, traces, lines—all had to be connected to form one set tailor-
65 made for that horse, and then it had to be done all over again for the second horse!

11. The function of the first paragraph (lines 1-12) in relation to the passage as a whole is to:
   A. orient the reader to the setting of the story.
   B. establish that the recollections of the narrator's youth and innocence are cherished even into adulthood.
   C. illustrate how the picking of blackberries is a valuable memory.
   D. explain why the narrator is fond of the childhood memories.

12. The purpose of describing the young boy's memories of picking blackberries and of catching fireflies is:
   F. to grab the reader's attention.
   G. to demonstrate that the passage is being told from the first person point of view.
   H. to reveal the narrator's fondness for growing up on a farm in the countryside.
   J. to illustrate the fond relationship the narrator has with his father.

13. By describing himself as "my father's shadow," the narrator means that:
   A. he never left his father's side.
   B. he completed his chores in the same manner as his father.
   C. he followed his father around because he was too young to be alone.
   D. his father was an influential force in his life and in farming.

14. The narrator attributes his father's need to "mow and rake"(line 39) to his:

   F. displeasure with modern farming equipment.

   G. aspiration to complete tasks the hard way.

   H. wish to remember his own days as a boy growing up on a farm.

   J. disillusionment with completing chores easily.

15. The passage portrays the narrator as a person who:

   A. aims to please his father.

   B. is disconnected from the real world.

   C. wants to get ahead in life.

   D. values the life lessons he learned as a boy.

16. All of the following prove that working with horses is a "genuine art" EXCEPT:

   F. the team of horses being in full harness resulting in superior riding skills

   G. understanding the language barrier between man and beast

   H. placement of the driving lines

   J. using the tractor and bailers correctly

17. The tone of the author's description of his feelings as a boy may best be described as:

   A. detached and objective

   B. nostalgic and sentimental

   C. sadly regretful

   D. subjective and remote

18. According to the passage, the narrator valued watching his father milk the cows because:

   F. he was allowed to feel a part of the process although he was too young to perform the task.

   G. he needed to learn how to milk the cows himself.

   H. he felt as if he could be of some help to his father.

   J. he learned that milking the cows also benefited the many cats on the farm.

19. Which of the following is the best meaning of the word "stanchion" in line 29?

   A. corral for holding.

   B. bit between the teeth.

   C. stationary device for the neck.

   D. halter for the head.

20. In the fifth paragraph (lines 56-61), the purpose of referencing the "unspoken language" is to:

   F. show that the author had a good rapport with horses.

   G. establish good communication between father and child.

   H. prove that horses can learn.

   J. confirm that memories are created without spoken language.

PASSAGE III

This passage was adapted from the JohnShepler.com essay "Like a Diamond in the Sky: Stars That Create Diamonds in the Sky Are a Wonder of Astronomy," written by John Shepler.

"Twinkle, twinkle, little star. How I wonder what you are." Ever since we first toddled outside to gaze up at the black canopy of twinkling pinpoints, we've held that thought in the back of our minds. Pick a clear dry
5   night in the woods, the desert or on the ocean and the beauty of the cosmos overhead is enough to take your breath away. So many stars, and so magnificent.

"Up above the world so high. Like a diamond in the sky." We love that nursery rhyme. But stars are
10   nuclear furnaces, we were taught. It's all about hydrogen fusing into helium a trillion, trillion miles away. They're not pinpricks in a velvet cover, beyond which is the radiance of heaven itself. No, stars are more like gas light bulbs, immense bodies on fire since before there were
15   humans or even animals. It is just our imaginations and the optical illusion of ancient photons being jostled by atmospheric ripples that make them look like diamonds twinkling in the sky.

But what if that's not so? What if man's puny
20   grasp of the universe has limited our expectations far short of what really awaits us in the distant void? What if the wonders of our imagination are just a hint of all things possible? What if there really ARE diamonds in the sky?
25   Astronomer Steve Kawaler believes he has spotted a blue green diamond the size of Earth and just seventeen light years away, almost on our doorstep in astronomical terms. From the constellation Centaurus, it is sending out a spectrum of light similar to a diamond's
30   fire. That light is being picked up and analyzed by a network of telescopes in New Zealand, Australia, South Africa, Brazil, Chile and the Hubble space telescope orbiting the Earth. Can this be true?

Diamond stars may well be scientifically
35   possible, maybe even common. Remember how you were taught that when stars use up their supply of hydrogen fuel, they either self-destruct in a massive super nova explosion or shrink into tiny white dwarfs? If the solar furnace could be thought to be like a coal
40   furnace, then the fizzled white dwarf was supposed to be nothing more than a stellar cinder littering space. Kawaler's theory is that the heavier elements created by solar fusion over the millennia condense and solidify in the center of the shrinking star. Carbon, a lighter element,
45   would crystallize, or freeze out if you will, much later. It might even form a shell of pure diamond around the star, much like water crystallizing into ice on your windshield. Imagine future space travelers landing on what appears to be Earth, yet with a surface of pure diamond. Break me
50   off a chunk!

Fanciful as this may seem, diamonds from space are likely to be here on Earth now. Tiny specks of diamond have been found in meteorites, suggesting they originated on other planets or as pieces of disintegrating
55   stars. In the 1840's, Brazilian diamond hunters came upon rare black diamonds that they called "carbonados." They look like coal, but they are over three billion years old. That's really too old for them to be products of compressed dinosaurs and ferns, which is how we were
60   taught that diamonds were made from earthly organic carbon.

Geology Professor Stephen Haggerty of the University of Massachusetts at Amherst goes a step further and suggests that star dust, in the form of carbon
65   molecules, may have formed the seed nuclei that grew nearly all of the jewelry diamonds we have today. The carbon "chondrite" meteorites came crashing to Earth when the atmosphere was much thinner and easier to survive entry. After growing into the diamond crystals
70   that we recognize today, volcanoes brought them back to the surface of the Earth during major eruption periods of one billion and 100 million years ago. He suggests a "safe deposit box" of diamonds still within the Earth which will open up to us every once in awhile, albeit a
75   long while.

Indeed, there may well be an entire layer of diamonds that crystallized as the Earth cooled. That layer would reside about 100 miles directly under us. The pieces that have worked their way to the surface when
80   volcanic magma pushed them up lava tubes called the kimberlite pipes (named after the Kimberly Mines in South Africa) may be just a hint at what is still down there. The stunning blue Hope Diamond at nearly 45 carats and the 41 carat Dresden Green may be just a
85   sample of the treasures still captive deep within the Earth.

What's more, if diamonds really do have an interstellar origin, our own moon, which went through a similar geological cooling process to Earth's, may also be
90   rich in diamonds somewhere deep beneath its crust. The much lower lunar gravity might also have allowed larger diamonds to form. Could they be six times the size of those on Earth?

Come to think of it, maybe the "man in the
95   moon" isn't just an optical illusion. Perhaps he's a jeweler with a cache of diamonds greater than all the jewelry stores, royal treasuries and museums on Earth.

3 THREE 3 THREE 3 THREE 3 THREE 3

21. Based on information in the passage, the scientific community is pondering:
- **A.** the theory that all stars degenerate into diamonds.
- **B.** the existence of diamonds on the moon.
- **C.** the possibility that diamonds originated in the vastness of space.
- **D.** the proximity of diamonds in space to the Earth.

22. The author's main purpose in the first paragraph (lines 1-7) is to:
- **F.** recall childhood nursery rhymes.
- **G.** emphasize how even in childhood we are fascinated by the mystery and the wonder of the cosmos.
- **H.** point out locations for star gazing.
- **J.** elaborate on the splendor of the heavens.

23. In line 14, the word "immense" most nearly means:
- **A.** colossal
- **B.** mystifying
- **C.** extreme
- **D.** moderate

24. The author of the passage refers to the Steve Kawalar's theory primarily to underscore the idea that:
- **F.** blue green diamonds really exist.
- **G.** a diamond's fire is similar to the light emitted by space.
- **H.** the Hubble Space Telescope was a good investment.
- **J.** man's questioning of the universe is understandable and does have scientific support.

25. In line 19 the word "puny" most likely means:
- **A.** frail
- **B.** minimal
- **C.** small
- **D.** stunted

26. Based on information in the fifth paragraph (lines 34-50), a diamond is formed by all of the following EXCEPT:
- **F.** a massive super nova explosion.
- **G.** condensation of heavy elements.
- **H.** solidification of elements in the star's center.
- **J.** crystallization of carbon and lighter elements.

27. Which of the following does NOT support the theory that diamonds are formed in space?
- **A.** Meteorites of carbon collided with Earth.
- **B.** Dinosaurs and ferns are too young to have led to black diamonds.
- **C.** Eruptions of volcanoes surfaced diamond pieces.
- **D.** Diamonds have been found in chunks of meteorites.

28. In the seventh paragraph, the author's main purpose in lines 62-66 is to show:
- **F.** volcanic eruptions occurred 100 million years ago.
- **G.** jewelry today is made from meteors.
- **H.** carbon meteors crashed to Earth years ago.
- **J.** nuclei of carbon may have formed diamonds.

29. In the eighth paragraph (lines 76-86), the reference to the Hope Diamond and to the Dresden Green suggests:
- **A.** the location of diamonds is in the Earth's layers.
- **B.** magma from volcanoes is responsible for diamond formation.
- **C.** the "kimberlite pipes" still have stunning diamond material to push to the Earth's surface.
- **D.** the Earth may hold grand treasures beneath its surface.

30. Why does the author reference the moon in the ninth paragraph (lines 87-97)?
- **F.** because it is a satellite to the Earth.
- **G.** because its formation is similar to that of the Earth's.
- **H.** because it may contain larger diamonds than the inner surface of the Earth.
- **J.** because it has less gravity than Earth.

PASSAGE IV

Many people are familiar with the Shakespearean play, Hamlet, *especially the famous scene with the skull in the graveyard. However, few people are aware of how closely the twentieth century tenets of existentialism parallel the life of Hamlet. This passage describes those connections.*

Perhaps the most enigmatic of all Shakespearean plays, *Hamlet* presents complex themes with subtle messages all centering around and evolving from its tragic hero, Hamlet, Prince of Denmark. To gain

5 increased insight into this atypical portrayal of an Elizabethan tragic hero while at the same time underscoring the contemporary nature of the protagonist, the character of Hamlet can be analyzed and evaluated based on the twentieth century concept of the existential

10 hero. With such characteristics in mind, the often-debated indecisiveness and melancholy demeanor of the play's central figure emerge with renewed clarity and thematic implications.

As portrayed by Albert Camus, famed French

15 novelist and essayist, and Jean-Paul Sartre, noted French philosopher, the nature of man in the twentieth century was one of deep despair and great melancholy caused by a feeling of alienation and estrangement from self and society in general. They attributed this separation of

20 spirit to the belief that an impersonal universe moves inexorably forward toward some predetermined future without regard for the individual or his needs. So strong is this belief on the part of modern man that he finds himself swept down into a paradoxical vortex of

25 inactivity. In this state, the inherent human will to struggle against life-threatening circumstances becomes overpowered by an intense sense of meaninglessness.

Now consider the specific circumstances surrounding Hamlet: his father dies unexpectedly, his

30 mother marries his uncle "before the funeral baked meats are cold," the ghost of his father tells him of his uncle's fratricide and makes him swear revenge, his best friends from the university betray him, Ophelia agrees to draw him out to help determine the cause of his deranged state,

35 and Polonius finds every opportunity to spy on him and torment him with double entendres and glib asides.

Indeed, "something is rotten in the state of Denmark." Faced with such overwhelming alterations in his life and the society in which he lives, Hamlet appears

40 to lack initiative and decisiveness, only a pawn manipulated by the vagaries of chance. Rather than take any decisive action, he ruminates on eternal questions. Does fatherly love dictate revenge? Does a wife's loyalty to her husband end immediately upon his death? Is

45 suicide an acceptable method of escaping life's difficulties? Can Truth be found by indirection? Clearly, his is a world of questions with no clear-cut answers, an existential void pulling him ever deeper into the depths of alienation and despair.

50 "Words, words, words," he tells Polonius when questioned about what he has been reading. Words added to words to make phrases and sentences devoid of any meaning he can decipher. Locked in this existential abyss, his only salvation is the requisite "Leap of Faith," that

55 single component of the philosophy that changes every meaningless negative in one momentary flash into an orderly and meaningful essence. As "Existence precedes Essence," so too does a meaningful life often begin only after a long period of great estrangement from the self. In

60 the Elizabethan world view so similar to the ancient Greek philosophical perception, Order must be restored from Chaos, for when Chaos rules, as Hamlet states, "The world is out of joint. Oh cursed sprite that ever I was born to set it right."

65 Whether or not Hamlet has a "Leap of Faith" is subject to some debate. It is ironic that after such a long period of questioning and pondering Truth, his killing of Claudius is an act of immediate, thoughtless impulse, not the result of premeditated revenge. Perhaps in that instant,

70 Hamlet realized that life is not predictable or capable of analysis as he must have learned at Wittenburg, but rather a journey fraught with danger and apparent contradictions which can be appreciated only by living each day, making meaning from meaninglessness, and believing totally that

75 no person is truly alone, because by all of us being alone, we are really together, bound by a brotherhood of mutual isolation.

31. Which of the following words best describes the author's tone?

A. determined
B. diagnostic
C. analytic
D. serious

32. As it is described in the passage, existentialism is characterized by:
- **F.** insecurity and timidity
- **G.** isolation and loneliness
- **H.** indifference and apathy
- **J.** fear and apprehension

33. It can be inferred from the passage that the comparison of Hamlet to the 20[th] century existential hero is accurate because:
- **A.** he is the indirect victim of a horrible crime.
- **B.** he is betrayed by his close friends.
- **C.** he is stricken with uncertainty.
- **D.** he is controlled by events which are not within his command.

34. It is logical to infer that the primary reason the author included the information in the third paragraph (lines 28-36) is to:
- **F.** contrast it with the information in the second paragraph (lines 14-27).
- **G.** compare it with the information in the first paragraph (lines 1-13).
- **H.** contrast it with the information in the first paragraph (lines 1-13).
- **J.** support the information in the first paragraph (lines 1-13).

35. The primary focus of lines 50-53 is to:
- **A.** explain the connection between Hamlet and the reading material.
- **B.** show that Hamlet cannot decipher the reading material.
- **C.** prove the uncertainty of Denmark and its future.
- **D.** elaborate on the fact that Hamlet cannot find meaning in his life.

36. In the second paragraph, when the author says in lines 23-25, "…he finds himself swept down into a paradoxical vortex of inactivity," he most likely means that:
- **F.** Hamlet has misunderstood his purpose in life.
- **G.** the 20[th] century hero has no concern for life.
- **H.** Hamlet's lack of initiative has contributed to his indecisiveness.
- **J.** The inability of 20[th] century man to act is caused by apparent contradictions.

37. In line 1, the word "enigmatic" most nearly means:
- **A.** mysterious
- **B.** puzzling
- **C.** unusual
- **D.** difficult

38. In the sixth paragraph (lines 65-77), what can be assumed to be true about the author's view of existentialism?
- **F.** It is more important to live life to the fullest than to contemplate the meaning of each life lesson.
- **G.** It is better to live in safety and security so decisions do not have to be made.
- **H.** Individuals will, at the end of their lives, understand fully the mysteries of the universe.
- **J.** Life can never be enjoyed because it is devoid of meaning.

39. The overall implication of the passage is that:
- **A.** the works of Sartre and Camus must be studied in order to understand the Elizabethan drama *Hamlet.*
- **B.** philosophers and literary writers agree that life cannot be understood.
- **C.** the tenets of existentialism must be applied in order to understand Hamlet's mind.
- **D.** Hamlet's life was filled with indecisiveness and uncertainty.

40. The word "ruminates" in line 42 most nearly means:
- **F.** worries
- **G.** argues
- **H.** ponders
- **J.** discards

END OF TEST 3
STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO. DO NOT RETURN TO ANY OTHER SECTION OF THE TEST.

SCIENCE REASONING TEST
35 Minutes—40 Questions

DIRECTIONS: This test consists of seven passages. Each passage is followed by several multiple-choice questions. Read the passage and then select the best answer for each question. You may refer back to the passage if necessary. You may NOT use a calculator on this test.

PASSAGE I

Students conducted experiments to measure resistance, current, and voltage in series and parallel circuits. Resistance is measured in ohms(Ω) and describes how difficult it is for electricity to move through the material. Current is measured in amperes (A) and describes how fast electricity moves through the material. Voltage is measured in volts and describes how much energy is present. In a circuit the value of a resistor that could be used to replace all the individual resistors is called the equivalent resistance (R_{eq}).

Experiment 1

Students connected 2 resistors in a series to a power supply as shown in Figure 1, so that there was only one path for the current. The power supply provided 5V of electricity to the circuit.

They used a voltage probe to measure the voltage in the circuit and a current probe to measure the current in the circuit. Then they changed the resistors and repeated the process for a total of 3 trials. The results are shown in Table 1.
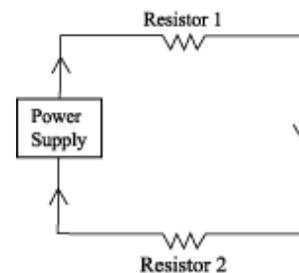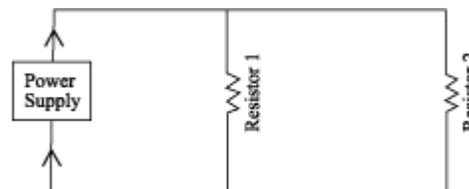

Figure 1

Table 1: Series Circuit							
	Resistor 1 (Ω)	Resistor 2 (Ω)	Equivalent Resistance (Ω)	Voltage at Resistor 1 (V)	Voltage at Resistor 2 (V)	Total Voltage (V)	Total Current (A)
Trial 1	10	10	20	2.49	2.52	5.01	0.245
Trial 2	10	50	60	0.77	4.21	4.98	0.075
Trial 3	50	50	100	2.46	2.54	5.00	0.045

Experiment 2

Students connected 2 resistors in parallel, so that there were 2 paths for the current, to a power supply as shown in Figure 2. The power supply provided 5V of electricity to the circuit.

They used a voltage probe to measure the voltage in the circuit and a current probe to measure the current in the circuit. Then they changed the resistors and repeated the process for a total of 3 trials. The results are shown in Table 2.

Figure 2

Table 2: Parallel Circuit							
	Resistor 1 (Ω)	Resistor 2 (Ω)	Equivalent Resistance (Ω)	Voltage at Resistor 1 (V)	Voltage at Resistor 2 (V)	Total Voltage (V)	Total Current (A)
Trial 1	50	50	25.6	5.02	5.03	5.02	0.201
Trial 2	50	68	28.7	5.02	5.01	5.01	0.177
Trial 3	68	68	33.5	5.01	5.02	5.01	0.153

Figure 3 shows the relationship between current and resistance for all circuits.
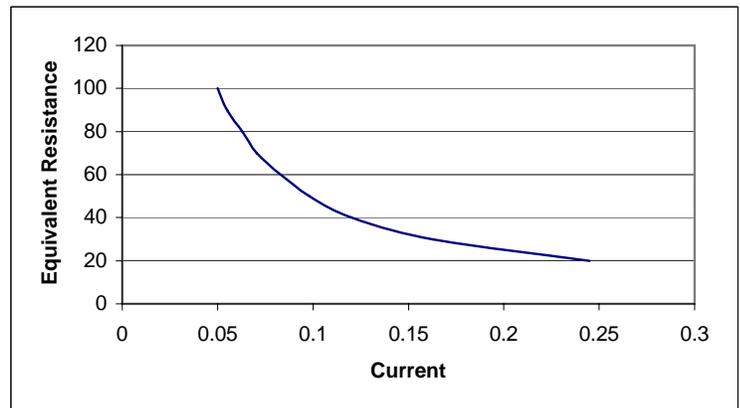

Figure 3

1. The results of the experiments support the conclusion that
   A. voltage in a series circuit is not influenced by the resistors.
   B. voltage in a parallel circuit is not influenced by the resistors.
   C. current in a series circuit is not influenced by the resistors.
   D. current in a parallel circuit is not influenced by the resistors.

2. If a 50Ω resistor and a 68Ω resistor are connected in a series circuit, the equivalent resistance in the circuit will be
   F. 28.7 Ω
   G. 100 Ω
   H. 118 Ω
   J. 136 Ω

3. Which of the following best describes the relationship shown in Figure 3?
   A. Current is directly related to voltage.
   B. Current is directly related to resistance.
   C. Current is inversely related to voltage.
   D. Current is inversely related to resistance.

4. If a circuit were constructed with an equivalent resistance of 40Ω, the current value would be closest to
   F. 0.100 A
   G. 0.125 A
   H. 0.160 A
   J. 0.185 A

5. It was determined from additional trials that in a parallel circuit the equivalent resistance can be determined using the formula: $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$. If two 10Ω resistors are connected in a parallel circuit, what would the equivalent resistance equal?
   A. 5Ω
   B. 10Ω
   C. 0.2Ω
   D. 0.1Ω

6. Which variable was kept constant throughout the tests in both circuits?
   F. current
   G. resistance provided by resistors
   H. voltage supplied by power source
   J. current and resistance

Passage II

Stars are classified according to their average surface temperature, measured in Kelvin (K). Kelvin = Celsius +273. The classes of stars are shown in Table 1.

A star's color is directly related to its surface temperature. The light from a cool star is most intense at long wavelengths, making it look red. To accurately measure a star's color, light is collected by a telescope and passed through colored filters. Scientists look at how bright the light through each color filter is to determine the color of the star.

In addition, scientists can determine the temperature of a star by looking at the star through a device called a spectroscope. At different temperatures, different elements emit light. A spectroscope shows which element is most strongly emitting light. Star temperature and the strength of light emission for common elements are shown in Figure 1.

Table 1

Star (Spectral) Class	Temperature (K)	Color
O	50,000-28,000	Blue
B	28,000-9,900	Blue White
A	9,900-7,400	White
F	7,400-6,000	Yellow White
G	6,000-4,900	Yellow
K	4,900-3,500	Orange
M	3,500-2,000	Dark Red

Figure 1.

GO ON TO THE NEXT PAGE.
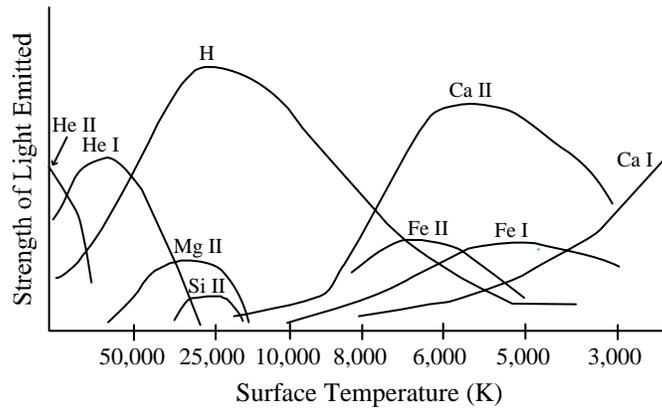
7. Which element in a bluish-white star emits the strongest wavelength of light?

    A. Fe II
    B. Mg
    C. H
    D. Ca II

8. Which of the following could be the temperature of our sun, a G class star?

    F. 3500° C
    G. 4800° C
    H. 5900° C
    J. 6100° C

9. A scientist used a spectrometer to determine the elements present in a star, but he recorded only which elements were emitting light, not how strongly they were emitting light. His data indicates that H, Fe I, and Ca II are present on the surface of the star. Which of the following conclusions could he draw?

    A. He observed an M class star.
    B. He observed a yellow star.
    C. The star he observed had a temperature of 30,000-50,000K.
    D. The star he observed had a temperature 8,000-3700K.

10. Which of the following statements is NOT true?

    F. Both star color and temperature can be determined by scientists.
    G. As temperature increases, hydrogen emits light more intensely.
    H. Hydrogen emits light at the widest range of temperatures.
    J. As temperature decreases, He II emits light less intensely.

11. As a star ages, its surface temperature increases slightly as it burns more fuel. When most of its fuel is used up, it will begin to grow rapidly, causing it to cool dramatically by several thousand Kelvin. In 5 billion years the sun, a G class star, will begin this type of expansion. What color will the sun appear when this takes place?

    A. Blue
    B. White
    C. Yellow
    D. Red

12. Scientists discovered a new star and determined that its average surface temperature is 7,560K. Which spectral class does the star belong to?

    F. spectral class B
    G. spectral class A
    H. spectral class F
    J. spectral class G

Passage III

Superconductors are elements, alloys, or compounds that conduct electricity without resistance below a certain temperature. Resistance is undesirable because it results in a loss of energy. Superconductors would allow us to transmit electricity without loss of energy. Resistance is measured in ohms (Ω).

Figure 1 shows the difference in resistance between a regular metal and a superconductive material over a temperature range.

Table 1 shows the critical transition temperature (T_c), the temperature below which the element becomes superconductive, for some common elements. Temperature is shown in Kelvin (K). Kelvin = Celsius + 273.
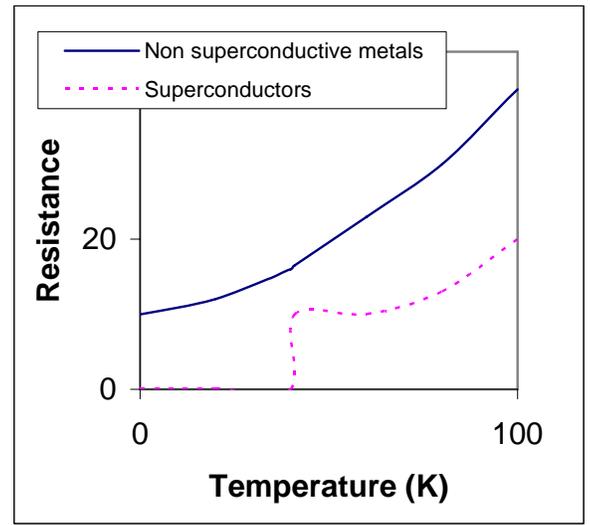
Figure 1

Table 1

Element	T_c (K)
Aluminum (Al)	1.175
Lead (Pb)	7.196
Mercury (Hg)	4.15
Titanium (Ti)	0.40
Tungsten (W)	0.0154
Uranium (U)	0.20
Zinc (Zn)	0.85

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Za	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac	104 Rf	105 Ha	106 106	107 107	108 108	109 109	110 110	111 111	112 112						

58 Ce	59 Pr	60 Nd
90 Th	91 Pa	92 U

69 Tm	70 Yb	71 Lu

| 58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cr	99 Es	100 Fm	101 Md	102 No	103 Lr

Figure 2

Figure 2 shows the periodic table of elements. The elements are numbered from lightest to heaviest (1 is the lightest). Elements that are shaded indicate elements that are superconductors. Elements that are circled are only superconductors under high pressure, not at normal pressure.

13. As the elements listed in Table 1 are cooled from room temperature (301 K), which would become superconductive first?
    A. Lead (Pb)
    B. Tungsten (W)
    C. Mercury (Hg)
    D. Hydrogen (H)

14. Which is the lightest element that is a superconductor under ambient (normal) pressure?
    F. Helium (He)
    G. Lithium (Li)
    H. Beryllium (Be)
   J. Titanium (Ti)

15. Which of the following statements best describes the behavior of non-superconductive metals?
- **A.** Non-superconductive metals have less resistance than superconductors at low temperatures.
- **B.** Superconductors have high resistance at low temperatures.
- **C.** Resistance increases with temperature in non-superconductive metals.
- **D.** There is a linear relationship between resistance and temperature in non-superconductive metals.
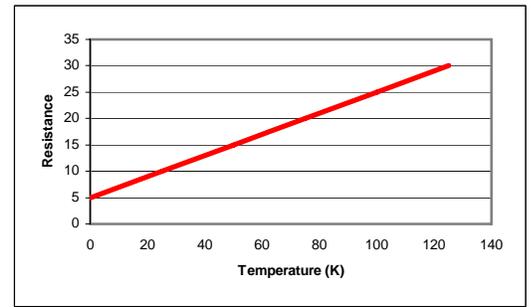
16. The same amount of energy was supplied to 10 feet of gold(Au) wire and 10 feet of tin(Sn) wire and transmitted to a receiver at the other end at a temperature just above absolute zero (0K). Which of the following statements would be supported by the given data?
- **F.** The energy would be transmitted faster through the gold.
- **G.** No energy would be lost during either transmission.
- **H.** More energy would be transmitted through the gold wire to the receiver.
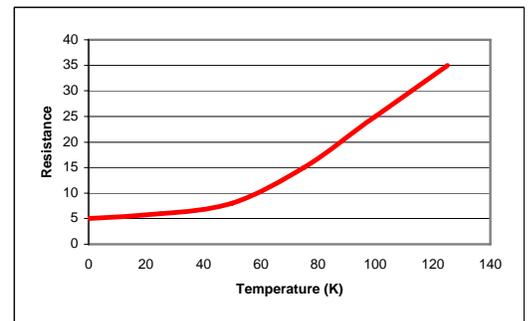- **J.** More energy would be transmitted through the tin wire to the receiver.
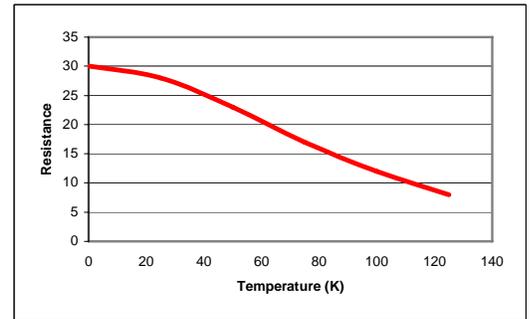
17. Which of the following graphs most likely shows the relationship between resistance and temperature in a superconductor?

A.

B.

C.

D.
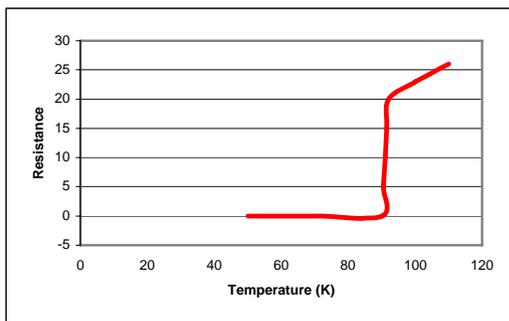
PASSAGE IV

Environmentalists recently discovered that fish populations in one area of a local stream are declining dramatically. Near the stream is a chemical plant that processes oil and a farm that uses nitrogen-based fertilizers.

Figure 1 shows a map of the stream area. The stream flows from east to west.

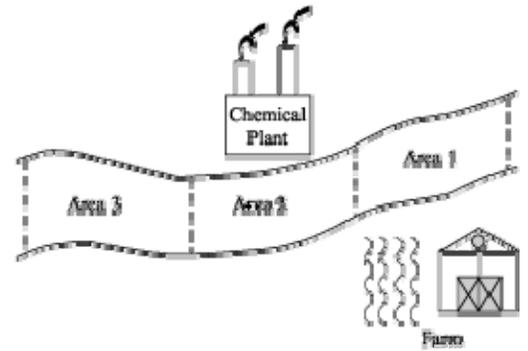Table 1 shows the fish populations for each area of the stream in 1973 when it was surrounded by forest and in 2003.

Figure 1

Table 1

Stream Area	Number of Fish 1973	Number of Fish 2003
Area 1	175	82
Area 2	230	215
Area 3	87	100

Table 2 shows the results of the tests that the environmentalists performed on the water in each area. Plus (+) indicates the stream tested positive for a significant amount of the chemical shown. Minus (-) indicates there was not a significant amount of the chemical present.

Table 2

Stream Area	pH	Chromium	Nitrate Nitrogen	Phosphorus
Area 1	7.5	-	+	+
Area 2	7.5	-	+	+
Area 3	6.5	-	-	+

Chromium is created by industrial processes and may cause cancer.

Nitrate nitrogen is associated with fertilizer and animal waste. In high amounts it can be toxic and in small amounts it can cause overgrowth of algae.

Phosphorus is associated with cleaners and fertilizers and can cause an overgrowth of algae.

pH:
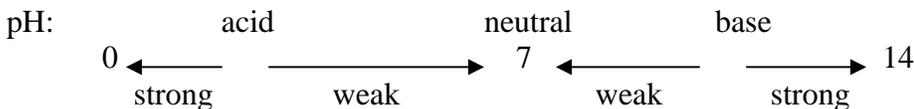
18. Based on the data shown, one can conclude that
  F. the fertilizer used on the farm is probably a base.
  G. the fertilizer used on the farm is probably an acid.
  H. the chemicals used by the chemical plant are strong acids.
  J. the water in the stream is not affected by the chemical plant or the farm.

19. Which area had the greatest change in the fish population between 1973 and 2003?
  A. Area 1
  B. Area 2
  C. Area 3
  D. All areas had the same change.

20. Which of the following best explains the presence of nitrate nitrogen and phosphorus in Area 2?

   F. The chemical plant dumps its waste into the stream.

   G. Local people are dumping garbage into the stream.

   H. The farm's fertilizer is polluting the stream.

   J. Acid rain is polluting the stream.

21. Most fish need a neutral pH to survive. Based on the stream tests, where is the best environment for the fish?

   A. Area 1 and Area 2

   B. Area 2 and Area 3

   C. Area 1 and Area 3

   D. Area 1, Area 2, and Area 3

22. Based on the information shown, one possible explanation for why the fish population in Area 1 has declined is that

   F. chromium from the chemical plant gave the fish cancer

   G. phosphorus from the farm poisoned the fish

   H. nitrate nitrogen from the chemical plant poisoned the fish

   J. overgrowth of algae from the nitrate nitrogen and the phosphorus killed the fish

PASSAGE V

Biologists use different types of media to grow bacteria. General-purpose media can be used to grow most types of bacteria. Selective media contain inhibitors which prevent the growth of unwanted organisms and are used to isolate specific groups of microorganisms. Differential media contain chemicals that cause a characteristic change in the media around the colony and are used to identify specific microorganisms within the group.

Mannitol salt agar (MSA) is both selective and differential. It contains a high salt level that is toxic to most human-related bacteria except for *Staphylococcus* and contains a pH indicator to differential between strains of *Staphylococcus*. Different strains of *Staphylococcus* will result in different colored colonies.

MacConkey agar (MAC) is used to isolate Gram negative organisms. Differently shaped bacteria react differently in MAC. Gram negative bacteria include *E. coli*. Gram positive bacteria include *Staphylococcus*. Other gram positive microorganisms include yeast, a type of fungi.

Rose bengal agar (RBA) inhibits the growth of bacteria and promotes the growth of fungi.

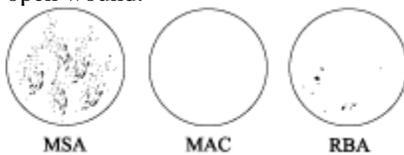Figure 1 shows microorganism growth from a swab of an open wound.

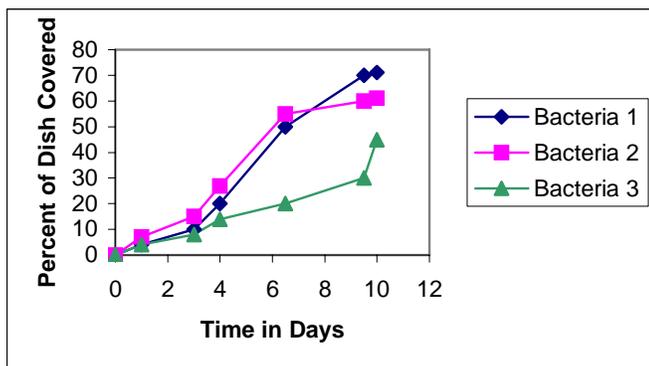MSA   MAC   RBA

Figure 1

Figure 2

Figure 2 shows the growth of bacteria on MSA over a 10-day period. All 3 types of bacteria began with a single cell that was nearly the same size.

23. Which bacteria showed the fastest growth rate over the first 4 days?
    A. Bacteria 1
    B. Bacteria 2
    C. Bacteria 3
    D. Bacteria 1 and Bacteria 3 had the same growth rate

24. Which type of microorganism is most likely present in Figure 1?
    F. *Staphylococcus*
    G. *Streptococcus*
    H. *E. coli*
    J. Yeast

25. Bacteria colonies grow exponentially. If a colony of bacteria has a generation time (doubling time) of 30 minutes, that means that the colony doubles in size every 30 minutes. If such a colony starts with 100 cells, how many will be present after 2 hours?
    A. 400 cells
    B. 800 cells
    C. 1600 cells
    D. 3200 cells

26. Students are asked to compare two MSA cultures. Both cultures show significant growth, but one has colonies that are pink in color, and the other culture has both pink and yellow colonies present. Which of the following conclusions could the student draw?
    F. Both cultures contain *E. coli*.
    G. Both cultures contain the exact same bacteria.
    H. Both cultures contain *Staphylococcus*, but one contains two different strains.
    J. Both cultures contain *Staphylococcus*, but one has been contaminated by a virus.

27. Which type of bacteria had the highest growth rate over a 10-day period?
    A. Bacteria 1
    B. Bacteria 2
    C. Bacteria 3
    D. Bacteria 1 and Bacteria 3

PASSAGE VI

A mass extinction, defined as an extinction of more than 50% of living species, took place 65 million years ago that killed all of the dinosaurs as well as many other species on the Earth. This "K-T extinction" occurred at the boundary between the Cretaceous period of the Mesozoic era and the Tertiary (T) period of the Cenozoic era. We know that dinosaurs became extinct at this time because none of their fossils have been discovered in any *strata* (rock layers) that formed after the K-T boundary.

Scientist 1

The K-T extinction was a catastrophic event, resulting from a large asteroid impacting the earth. A large crater, 180 km in diameter, is located on the Yucatan peninsula of Mexico. It is estimated that it was created by an asteroid approximately 10 km in diameter. This crater has been dated to 65 million years old, corresponding precisely to the accepted time of dinosaur extinction. Further, there is a clay layer in the strata marking the K-T boundary with an unusually high amount of iridium, a rare element more common in asteroids than in the earth's crust. Also, the presence of a layer of *shocked quartz* (quartz rock altered by extreme temperatures and pressures) in the K-T boundary strata supports the theory of a single catastrophic event. The asteroid's impact would have hurled trillions of tons of debris and dust into the atmosphere, temporarily blocking the sun's light and heat, and initiated shockwaves that would have caused large fires and tidal waves. Large numbers of plants would have died, along with the *herbivorous* (plant-eating) dinosaurs dependent on them. *Carnivorous* (meat-eating) dinosaurs that fed on herbivores also would have starved.

Scientist 2

The K-T extinction occurred as a result of gradual climatic change over millions of years. The incomplete nature of the fossil record makes it impossible to determine the exact timing of dinosaur extinction. At the end of the Cretaceous period, there was a large increase in volcanic activity. Evidence of this can be found in rocks created by massive lava flows that are located in the strata of the K-T boundary. The earth's molten *mantle* (layer of melted rock beneath the earth's crust) is high in iridium, and its deposition on the earth's surface as lava would explain the observed layer of this rare element. The soot from fires started by the lava flows gradually accumulated in the Earth's atmosphere, blocking out increasing amounts of sunlight. Also at this time, great shifts in the continental plates caused oceans to recede from the land. The resulting change in global climate from warm and mild in the Mesozoic era to cooler and more extreme in the Cenozoic era killed many species, including the dinosaurs.

28. Which of the following phrases best describes the major point of difference between the two scientists' hypotheses?
    F. the magnitude of the K-T extinction
    G. the presence of iridium in the K-T boundary stratum
    H. the cause of the K-T extinction
    J. the blocking of sunlight prior to the K-T extinction

29. What is the most likely cause of large numbers of plant deaths during the K-T extinction according to Scientist 1's hypothesis?
    A. The plants were trampled by dinosaurs fleeing the asteroid impact zone.
    B. The plants were buried under lava flows.
    C. The plants were eaten by herbivorous dinosaurs.
    D. The plants were deprived of the sunlight needed to produce food.

30. If new methods were used to date the crater on the Yucatan peninsula to be 40 million years old, which scientist's argument would be weakened?
    F. Scientist 1
    G. Scientist 2
    H. Both scientists
    J. Neither scientist

31. Which of the following statements best describes how Scientist 1 would explain the layer of shocked quartz located at the K-T boundary?
    A. Volcanic activity brought the shocked quartz to the Earth's surface.
    B. Shocked quartz was present in the asteroid.
    C. The violent asteroid impact created the shocked quartz.
    D. Shocked quartz is a type of dinosaur fossil.

32. How does Scientist 2's hypothesis of the timing of the K-T extinction differ from Scientist 1's hypothesis?
    F. Scientist 2 argues that the K-T extinction occurred millions of years before Scientist 1 states that it did.
    G. Scientist 2 argues that the K-T extinction did not occur.
    H. Scientist 2 argues that the K-T extinction occurred over a shorter period of time than Scientist 1 states that it did.
    J. Scientist 2 argues that the K-T extinction occurred over a longer period of time than Scientist 1 states that it did.

33. How does Scientist 2 explain the layer of soot found at the K-T boundary?
- **A.** The soot was present in the asteroid.
- **B.** The soot was produced by fires started by massive lava flows.
- **C.** The soot was present in the Earth's atmosphere millions of years before the K-T extinction.
- **D.** The soot was released by the shifting continental plates.

34. On which of the following statements would both scientists likely agree?
- **F.** Dinosaurs were equally adapted for climatic conditions in both the Mesozoic and Cenozoic eras.
- **G.** Global atmospheric changes were a primary cause of the K-T extinction.
- **H.** A catastrophic event changed climatic conditions at the K-T boundary.
- **J.** High levels of iridium caused the K-T extinction.

GO ON TO THE NEXT PAGE.

PASSAGE VII

The southern pine beetle is a major pest of pine forests in the southeastern United States. Large numbers of this small insect feed beneath the bark of pine trees, disrupting nutrient transport within the trees and ultimately killing them. When southern pine beetle populations reach epidemic (extremely high) levels in a particular area every 7-10 years, millions of dollars worth of timber may be lost. Several insect natural enemies (predators and parasites) that prey upon southern pine beetles may reduce their numbers during epidemics and maintain their populations at low levels between epidemics. These experiments were conducted to test the predation effects of three predator species on southern pine beetle larvae (developing insects).

Experiment 1

Three different numbers (0, 4, and 8) of three predator species (A, B, and C) were released onto 9 pine logs infested with similar numbers of southern pine beetles. **No other prey species were present.** The logs were then individually sealed inside metal drums in the laboratory to prevent additional insects from entering each log. Four weeks later, all adult southern pine beetles emerging (leaving) the logs were collected and counted. Lower southern pine beetle emergence was attributed to larva mortality (number killed) caused by the predators.

		Table 1	
Log	Predator species	Number of predators released	Number of southern pine beetles emerged
1	A	0	302
2	A	4	244
3	A	8	180
4	B	0	299
5	B	4	284
6	B	8	270
7	C	0	306
8	C	4	212
9	C	8	104

Experiment 2

Each of the three predator species may eat other insect species (including other predators) in addition to southern pine beetles beneath the bark of pine trees. Predators that are less specific in preying upon southern pine beetles may have a smaller impact on that pest's mortality. In order to determine prey preferences, four different insect species (including the southern pine beetle) that are commonly found under southern pine beetle-infested pine bark were offered as potential prey to 25 individuals of each predator species in the laboratory. Two of the potential prey species were dolichopodid flies and pteromalid wasps, which are beneficial insects that also eat southern pine beetles. The graph to the right shows the average number of prey eaten by each predator species:
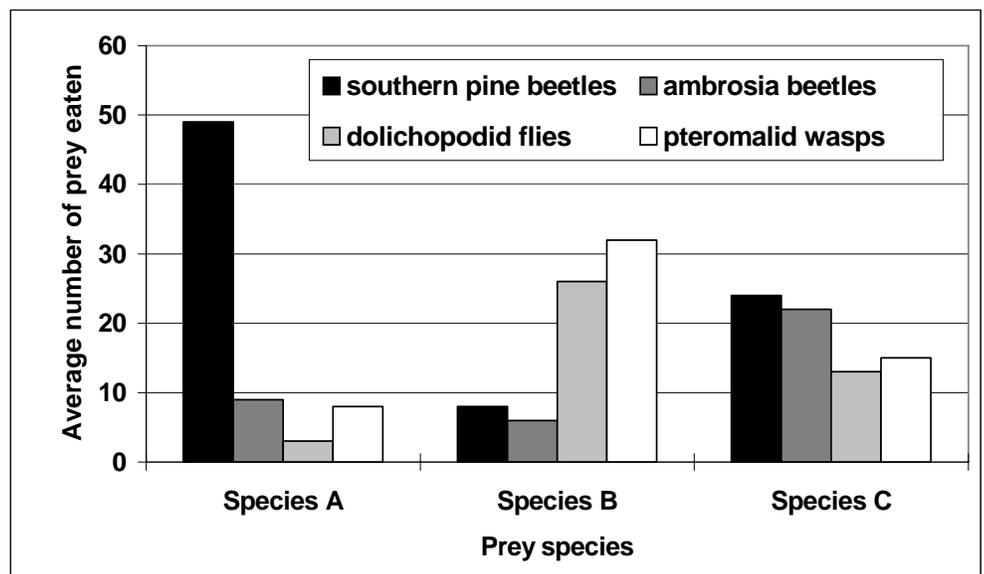

Figure 1

35. Which of the following statements best explains the number of southern pine beetles that were observed emerging from the pine logs in Experiment 1?
   A. Overall, more southern pine beetles emerged from logs containing greater numbers of predators.
   B. Overall, fewer southern pine beetles emerged from logs containing greater numbers of predators.
   C. The number of predators released affected the number of emerging southern pine beetles for only one predator species.
   D. The number of predators released onto a log had no effect on the number of emerging southern pine beetles.

36. If 12 Species A predators had been released onto an additional log in Experiment 1 initially infested with the same number of southern pine beetles as the other nine logs, what is a reasonable number of southern pine beetles you would expect to emerge from those logs four weeks later?
   F. 0
   G. 122
   H. 267
   J. 349

37. In Experiment 1, which predator species caused the highest southern pine beetle mortality?
   A. Species A
   B. Species B
   C. Species C
   D. All of the predator species caused the same amount of mortality.

38. If a predator eats many beneficial insects, it may actually cause an increase in southern pine beetle numbers. Which predator species ate the most beneficial insects?
   F. Species A
   G. Species B
   H. Species C
   J. All of the predator species ate the same number of beneficial insects.

39. Based on the results of Experiments 1 and 2, what would you expect to observe if large numbers of Species A and Species B were each released onto different trees infested with similar numbers of southern pine beetles and containing several other associated insect species?
   A. Fewer southern pine beetles would emerge from the tree with predator Species A.
   B. Fewer southern pine beetles would emerge from the tree with predator Species B.
   C. The same number of southern pine beetles would emerge from each tree.
   D. The number of emerging southern pine beetles will be lower in the tree containing the lower number of ambrosia beetles.

40. If you were redesigning Experiment 2, what would you change to obtain data more directly applicable to naturally occurring southern pine beetle infestations?
   F. Test only predator Species A and C.
   G. Test fewer numbers of each predator species to determine the average number of prey eaten.
   H. Test insect predators that are not found in naturally occurring southern pine beetle infestations.
   J. Offer a greater variety of potential prey species that are commonly found in trees infested with southern pine beetles.

END OF TEST 4
STOP! DO NOT RETURN TO ANY OTHER SECTION OF THE TEST.

IF YOU ARE WRITING THE OPTIONAL ESSAY, TURN TO THE NEXT PAGE TO BEGIN.