Form C02
(June 2020)

Math/Science

The ACT®

2019 | 2020

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

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

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MATHEMATICS TEST

60 Minutes—60 Questions

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

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

You are permitted to use a calculator on this test. You may use your calculator for any problems you choose, but some of the problems may best be done without using a calculator.

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

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

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1. What is the greatest common factor of 60, 84, and 126 ?
   - A. 12
   - B. 6
   - C. 3
   - D. 2
   - E. 1

2. $4n^7 \cdot 3n^5$ is equivalent to:
   - F. $7n^2$
   - G. $7n^{12}$
   - H. $7n^{35}$
   - J. $12n^{12}$
   - K. $12n^{35}$

3. Devon bought running shoes at a price that was $\frac{1}{4}$ off the original price of $88. He paid a sales tax of 7% on the discounted price and gave the clerk four $20 bills. How much change should he receive?
   - A. $ 4.62
   - B. $ 7.84
   - C. $ 9.38
   - D. $12.46
   - E. $18.62

4. Brandon is having a bake sale at school to raise $140.00 to donate to the local animal shelter. He sells brownies for $1.00 each and cookies for $0.50 each. Given that Brandon sells 82 brownies, and all sales go to the donation, how many cookies does he need to sell to reach his goal?
   - F. 29
   - G. 58
   - H. 111
   - J. 116
   - K. 444

DO YOUR FIGURING HERE.

5. In the figure below, $\overline{AB}$ is congruent to $\overline{BC}$, and $\overline{AE}$ intersects $\overline{BF}$ at C. What is the measure of $\angle B$?
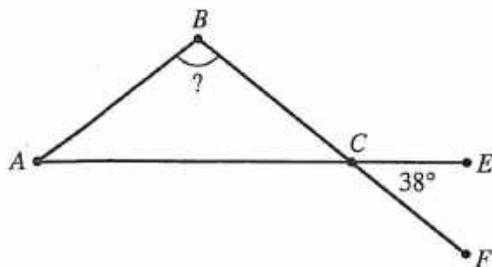
- **A.** 14°
- **B.** 38°
- **C.** 76°
- **D.** 104°
- **E.** 142°

6. Patty, Carla, Shada, and Ling ran a race. The bar graph below gives each girl's running time, in seconds. How many of the girls ran the race in less time than the average of the 4 running times?
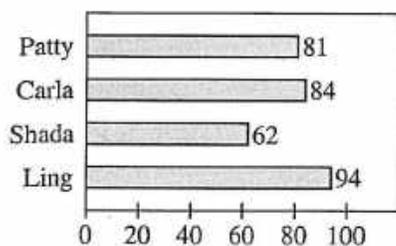
- **F.** 0
- **G.** 1
- **H.** 2
- **J.** 3
- **K.** 4

7. Between 9:00 a.m. and 10:20 a.m., 18,000 visitors entered the Family Fun Amusement Park. Between 9:00 a.m. and 10:20 a.m., an average of how many visitors per minute entered the park?

- **A.** 20
- **B.** 25
- **C.** 150
- **D.** 225
- **E.** 300

8. Given that u and v are vectors such that $\mathbf{u} = \langle -1, 3 \rangle$ and $\mathbf{v} = \langle 5, 8 \rangle$, what is the component form of the vector $\mathbf{u} + \mathbf{v}$?

- **F.** $\langle 2, 13 \rangle$
- **G.** $\langle 4, 5 \rangle$
- **H.** $\langle 4, 11 \rangle$
- **J.** $\langle 6, 5 \rangle$
- **K.** $\langle 6, 11 \rangle$

9. Juan and Xie are painting a room in the city recreation center. They started with 5 gallons of paint. On the first day, Juan used $\frac{1}{2}$ gallon of paint and Xie used $1\frac{3}{4}$ gallons of paint. How many gallons of paint were left after the first day?

A. $2\frac{1}{4}$

B. $2\frac{3}{4}$

C. $3\frac{1}{4}$

D. $3\frac{3}{4}$

E. $4\frac{1}{2}$

10. The point $(4,r)$ lies on the graph of $y = -3x + 2$ in the standard (x,y) coordinate plane. What is the value of r ?
   F. -4
   G. -10
   H. -14
   J. -18
   K. -24

11. Sebastian programs his calculator to evaluate a linear function, but he doesn't say what the function is. When 8 is entered, the calculator displays the value 6. When 12 is entered, the calculator displays the value 9. Which of the following expressions explains what the calculator will display when any number, n, is entered?

A. $\frac{3}{4}n$

B. $\frac{4}{3}n$

C. $n - 2$

D. $n - 3$

E. $\frac{4}{3}n - \frac{14}{3}$

12. A function $f(x)$ is defined as $f(x) = -4x^2$. What is $f(-5)$?
   F. -400
   G. -100
   H. 80
   J. 100
   K. 400

13. When $x = -1$, what is the value of $4x^3 - 2x^2$?
   A. -8
   B. -6
   C. -2
   D. 2
   E. 6

DO YOUR FIGURING HERE.
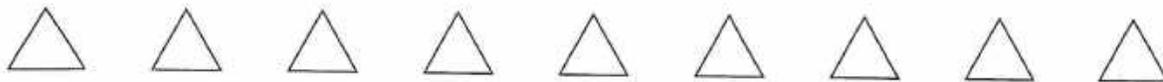
**14.** In the figure shown below, all angles are right angles, and the side lengths given are in yards. What is the area, in square yards, of the figure?

F. 12
G. 74
H. 98
J. 110
K. 134
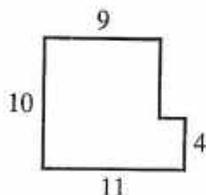
15. A certain fraternity had its freshmen members keep a log of their hours spent playing video games. When midterm grades were known, the fraternity president plotted the data in the standard (x,y) coordinate plane with average hours per week spent playing video games on the x-axis and midterm grade point average (GPA) on the y-axis as shown in the figure below. He then performed a linear regression on the data. Which of the following statements is true of the regression equation?
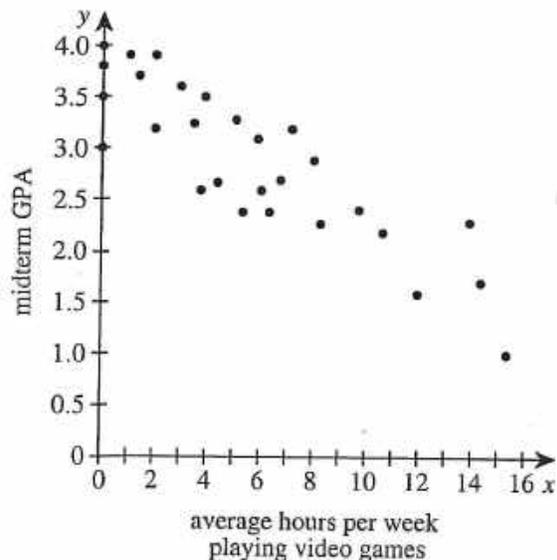
A. The slope and the y-intercept are both negative.
B. The slope and the y-intercept are both positive.
C. The slope is negative, and the y-intercept is positive.
D. The slope is positive, and the y-intercept is negative.
E. The slope is 0, and the y-intercept is positive.

**16.** Given $4x + 2 = -10$, then $|5 - x^2| = ?$

F. 1
G. 4
H. 9
J. 11
K. 14

17. The graph of $y = 3 \sin(x + 2)$ is shown in the standard (x,y) coordinate plane below. What is the maximum value of this function?

A. 2
B. 3
C. 6
D. π
E. 2π
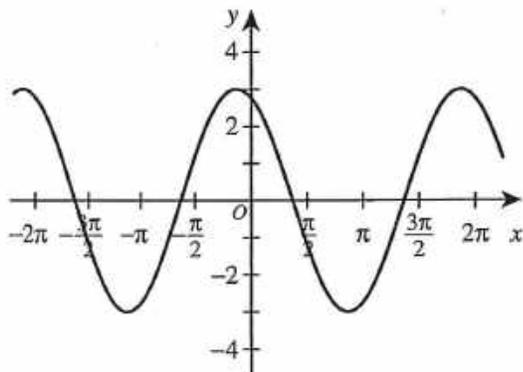
18. Renata took 9 quizzes in German class. Her scores, in order, were 6, 7, 7, 6, 8, 7, 8, 10, and 9. She discovered a scoring error on the 9th quiz, and her score on that quiz was corrected to 10. Which of the following measures of central tendency changed as a result of the correction?

    I. Mean
    II. Median
    III. Mode

F. I only
G. II only
H. I and II only
J. II and III only
K. I, II, and III

19. Which of the following equations is that of a line parallel to the line with equation $y = \frac{2}{3}x + 4$ in the standard (x,y) coordinate plane?

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

B. $y = -\frac{3}{2}x + 7$

C. $y = -\frac{2}{3}x + 4$

D. $y = \frac{3}{2}x + 4$

E. $y = \frac{2}{3}x + 7$

GO ON TO THE NEXT PAGE.

20. For △*ABC* shown below, what is the value of tan *B* ?

F. $\sqrt{2}$

G. $\sqrt{3}$

H. $\dfrac{1}{\sqrt{2}}$

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

K. $\dfrac{1}{\sqrt{3}}$
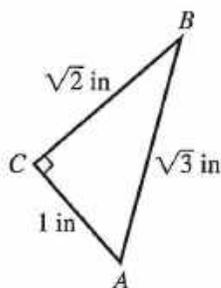
21. Given the true statement "If I live in Chicago, then I live in Illinois," which of the following statements *must* be true?

A. I live in Illinois.
B. I live in Chicago.
C. If I live in Illinois, then I live in Chicago.
D. If I don't live in Chicago, then I don't live in Illinois.
E. If I don't live in Illinois, then I don't live in Chicago.

22. Shown below, a board 3 feet 8 inches long is cut into 2 equal parts. What is the length, to the nearest inch, of each part?
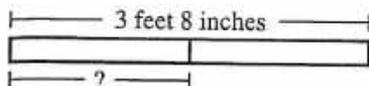
F. 1 foot 5 inches
G. 1 foot 8 inches
H. 1 foot 9 inches
J. 1 foot 10 inches
K. 2 feet 5 inches

23. What is the minimum number of square floor tiles, each 9 inches on a side, that could be used to cover the floor of a rectangular hallway 15 feet long and 6 feet wide?

A. 28
B. 56
C. 81
D. 90
E. 160

24. Graphed in the standard (x,y) coordinate plane below is line l and the circle with equation $(x - 2)^2 + y^2 = 1$. Line l passes through $O(0,0)$ and is tangent to the circle at A, and B is the center of the circle. What is the measure of $\angle AOB$?

F. 15°
G. 22.5°
H. 30°
J. 45°
K. 60°
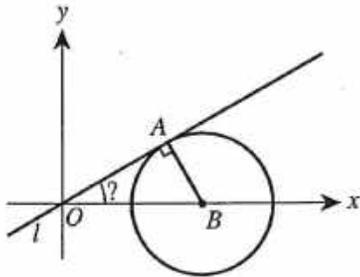
25. One square has a side whose length is x centimeters, and a second square has a side whose length is $(x - 2)$ centimeters. What expression below represents the sum of the areas of the 2 squares, in square centimeters?

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

26. When graphed in the standard (x,y) coordinate plane, the line with equation $\frac{5}{2}x + \frac{3}{4}y = -\frac{1}{2}$ has a slope of:

F. $-\frac{3}{10}$

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

H. $-\frac{10}{3}$

J. $-\frac{15}{8}$

K. $-\frac{5}{2}$

DO YOUR FIGURING HERE.

Use the following information to answer questions 27–29.

Kojo has an Internet site where his classmates can sell items in online auctions. For each item, a student pays Kojo a listing fee, based on the item's starting price, and a selling fee calculated as a percent of the selling price, as shown in the tables below.

Starting price	Listing fee
$ 0.01–$ 4.99	$0.25
$ 5.00–$19.99	$0.50
$20.00–$49.99	$1.00
$50.00 and up	$2.00

Selling price	Selling fee
$ 0.01–$49.99	5% of selling price
$50.00 and up	3% of selling price

27. Lucie sold a jacket on Kojo's site. The starting price of the jacket was $6.25, and its selling price was $34.20. What is the sum of the listing fee and selling fee Lucie paid to sell the jacket?

A. $1.50
B. $1.71
C. $2.02
D. $2.21
E. $2.52

28. For the items his classmates listed on his site last Friday, Kojo was paid listing fees that totaled $5.75. What is the maximum number of the items listed last Friday whose starting prices could have been in the range of $5.00–$19.99 ?

F. 11
G. 12
H. 23
J. 39
K. 40

29. Erick sold 2 items on Kojo's site. The sum of the selling prices for the 2 items was $116.00. The sum of the selling fees for the 2 items was $4.34. The system of equations below can be used to obtain the selling price for each item. What was the total listing fee for the 2 items given that the starting price was equal to the selling price for each of the 2 items?

$$x + y = 116.00$$
$$0.03x + 0.05y = 4.34$$

A. $2.00
B. $2.25
C. $2.50
D. $3.00
E. $4.00

30. A formula for the volume, V, of a right circular cylinder is $V = \pi r^2 h$, where r is the radius and h is the height. The cylindrical tank shown below has radius 6 meters and height 5 meters and is filled with water.
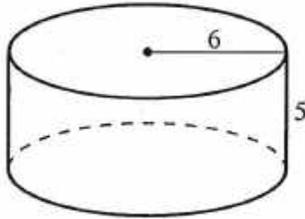
Given that the weight of 1 cubic meter of water is approximately 2,205 pounds, the weight, in pounds, of the water in the tank is:

F. less than 400,000.
G. between 400,000 and 900,000.
H. between 900,000 and 1,200,000.
J. between 1,200,000 and 1,700,000.
K. more than 1,700,000.

31. Admission to a carnival is $4 for children and $6 for adults. A group of 21 people pays $90 for admission to the carnival. What is the ratio of the number of children to the number of adults in this group?

A. 3:1
B. 4:1
C. 6:1
D. 9:1
E. 18:1

32. For all nonzero x, y, and z, which of the following is equal to $\left(\dfrac{2x^3 y^{-5} z^8}{8x^{-2} y^6 z^3} \right)^{-2}$?

F. $\dfrac{16x^{10} y^{22}}{z^{10}}$

G. $\dfrac{16y^{22} z^{10}}{x^{10}}$

H. $\dfrac{x^{10} y^{22}}{16z^{10}}$

J. $\dfrac{x^{10} z^{10}}{16y^{22}}$

K. $\dfrac{16y^{22}}{x^{10} z^{10}}$

33. The functions f and g are defined as $f(x) = 2x + 3$ and $g(x) = x^2 - 1$. What is $f(g(-1))$?

A. −1
B. 0
C. 1
D. 3
E. 5
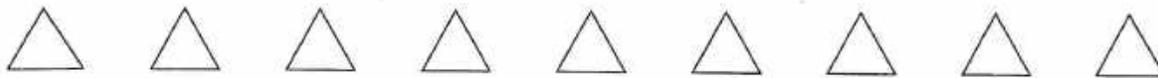
34. In a window display at a flower shop, there are 3 spots for 1 plant each. To fill these 3 spots, Adam has 7 plants to select from, each of a different type. Selecting from the 7 plants, Adam can make how many possible display arrangements with 1 plant in each spot?

(Note: The positions of the unselected plants do not matter.)

F.　3
G.　7
H.　18
J.　210
K.　343

35. In quadrilateral $ABCD$ shown below, $\overline{BC} \parallel \overline{AD}$, $BC = 20$ inches, $AD = 28$ inches, and the distance between $\overline{BC}$ and $\overline{AD}$ is 7 inches. What is the area, in square inches, of quadrilateral $ABCD$?
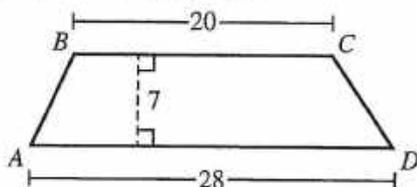
A.　140
B.　168
C.　196
D.　336
E.　560

36. The figure below shows a solid concrete ramp for skateboarding. The length is 10 feet, the width is 6 feet, and the height is 3 feet. Which of the following values is closest to the volume, in cubic feet, of the concrete used to construct the ramp?
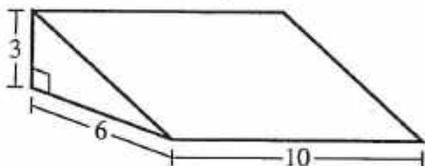
F.　32
G.　76
H.　90
J.　115
K.　180

37. A rectangle that is c inches by d inches is in the interior of a rectangle that is a inches by b inches, as shown below. The area of the shaded region is what fraction of the area of the large rectangle, in terms of $a, b, c,$ and d ?
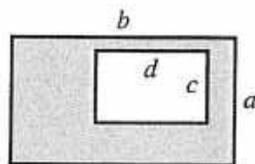
A.　$\dfrac{ab - cd}{ab}$

B.　$\dfrac{ab + cd}{ab}$

C.　$\dfrac{ab - cd}{cd}$

D.　$\dfrac{ab + cd}{cd}$

E.　$\dfrac{(a - c)(b - d)}{ab}$

38. A company prints contest codes on its fun-size bags of candy. Each 6-character code consists of the letter A followed by the letter H followed by 4 of the digits 0 through 9. The digits may repeat. Which of the following expressions gives the number of different 6-character codes that are possible?

F. 1(1)(10)(10)(10)(10)
G. 2(1)(10)(9)(8)(7)
H. 2(1)(10)(10)(10)(10)
J. 2(2)(10)(9)(8)(7)
K. 2(2)(10)(10)(10)(10)

39. The mean of the daily high temperatures for a 5-day period in a certain city was recorded as being 4.0°F. It was later determined that the high temperature for 1 of these 5 days was recorded incorrectly. If that day's high temperature was 2°F higher than originally recorded, what is the difference between. the incorrectly recorded mean and the correct mean?

A. 0.4°F
B. 1.2°F
C. 2.0°F
D. 4.0°F
E. 4.4°F

40. A box contains 6 objects. Of those, 3 are disks (2 blue and 1 red) and 3 are triangles (1 blue, 1 red, and 1 yellow). If the probability of drawing each object is the same, what is the probability that an object drawn from the box is a blue object or a triangle?

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

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

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

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

K. $\frac{5}{6}$

41. When $\log_4 x = -3$, what is x ?

A. $\frac{1}{64}$

B. $\frac{1}{12}$

C. −12

D. −64

E. There is no such value of x.

DO YOUR FIGURING HERE.

DO YOUR FIGURING HERE.

Use the following information to answer questions 42–44.

The whole number test scores of all 30 students in Ms. Smith's science class are represented in the cumulative frequency bar graph below.

Ms. Smith's Science Test Scores
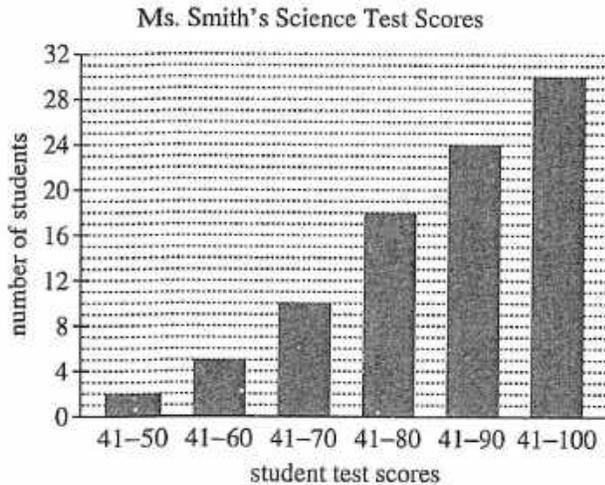
42. How many students in Ms. Smith's science class had a score greater than 70 on the test?

   F. 13
   G. 17
   H. 18
   J. 20
   K. 72

43. Which of the following intervals *must* contain the median score of the students' test scores in Ms. Smith's science class?

   A. 56–65
   B. 61–70
   C. 66–75
   D. 71–80
   E. 76–85

44. The students in Mr. Cho's class took the same test as those in Ms. Smith's class. The number of students in Mr. Cho's class with a score in the range 41–50 was 3 less than 4 times the number of students in Ms. Smith's class with a score in the range 41–50. How many students in Mr. Cho's class had a score in the range 41–50 on this test?

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

45. The solution set of the equation $|x - 1| = x - 1$ is the set of all values of x such that:

- **A.** $x \le 1$
- **B.** $x \ge 1$
- **C.** $x \le 0$
- **D.** $x \ge 0$
- **E.** x is a real number.

46. A surveyor needs to find the length from point A to point C across a lake as shown in the figure below. The measurements of which of the following angles and side lengths are sufficient for the surveyor to determine the length of $\overline{AC}$ using only the law of sines?
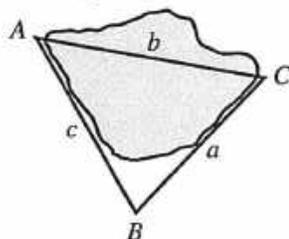
(Note: The law of sines says $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$.)

	angle	side length
F.	A, B	a
G.	A	c
H.	B	a, c
J.	B	c
K.	C	a

47. Which of the following equations determines the ellipse shown in the standard (x,y) coordinate plane below?
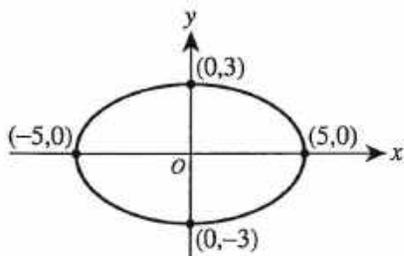
- **A.** $3x^2 + 5y^2 = 15$
- **B.** $6x^2 + 10y^2 = 60$
- **C.** $9x^2 + 25y^2 = 225$
- **D.** $36x^2 + 100y^2 = 3,600$
- **E.** $\dfrac{x^2}{5} + \dfrac{y^2}{3} = 1$

48. Given that $x = -2$ is a solution to $x^2 + bx - 6 = 0$, which of the following polynomials is a factor of $x^2 + bx - 6$?

- **F.** $x - 3$
- **G.** $x - 2$
- **H.** $x - 1$
- **J.** $x + 1$
- **K.** $x + 3$

DO YOUR FIGURING HERE.
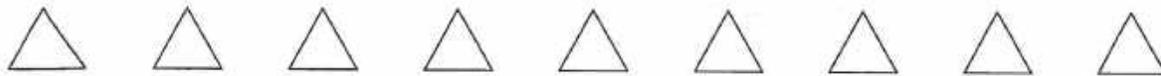
49. Square *ABCE*, shown below, has a side length of 10 inches. Point *D* is the midpoint of $\overline{CE}$, and *F* is the midpoint of $\overline{AE}$. What is the ratio of the area of $\triangle DEF$, shown shaded, to the area of pentagon *ABCDF* ?
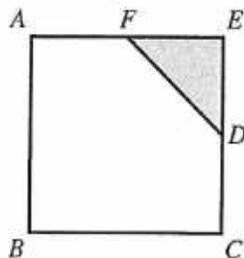
A. 1:3
B. 1:4
C. 1:7
D. 1:8
E. 1:10

50. For some positive integer *k*, the sum of the absolute values of all the integers from −*k* through *k* is 12. What is the value of *k* ?

F. 2
G. 3
H. 4
J. 6
K. Cannot be determined from the given information

51. Two real-valued functions are defined by $f(x) = \sqrt{x} + 1$ and $g(x) = (x-3)^3$. What is the domain of $f(g(x))$?

A. $[0,\infty)$
B. $[1,\infty)$
C. $[3,\infty)$
D. $[4,\infty)$
E. $(-\infty,\infty)$

52. A highway engineer is using a road map to lay out a detour for the westbound lane of a section of highway that, on the map, is a straight line going east and west. On the map, the detour goes 4 miles straight north, 1 mile straight west, 2 miles straight north, 6 miles straight west, 3 miles straight south, 1 mile straight east, and finally 3 miles straight south, back to the highway. According to the map, how many more miles will a westbound driver travel by taking the detour than he would if he could stay on the highway?

F. 20
G. 14
H. 13
J. 12
K. 6

53. The solution to the equation $3d + 17 = 13$ is which of the types of numbers listed below?

    I. Rational
   II. Irrational
  III. Positive
  IV. Negative
   V. Integer

A. I and III only
B. I and IV only
C. II and III only
D. II and IV only
E. I, III, and V only

54. For all real values of x such that $-1 < x < 0$, which of the following expressions has the greatest value?

F. x

G. $2x$

H. $x + 1$

J. $\dfrac{1}{x}$

K. $-\dfrac{1}{x}$

DO YOUR FIGURING HERE.

55. A 6-foot awning that extended 2 feet horizontally from a vertical building at 8:00 a.m. was adjusted to extend 3 feet horizontally from the building at 12:00 p.m., as shown below. Which of the following expressions equals the positive difference in the measures of the angle between the awning and the building at 8:00 a.m. and at 12:00 p.m. ?

8:00 a.m.   12:00 p.m.
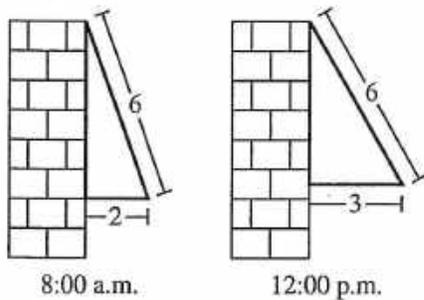
A. $\cos^{-1}\left(\dfrac{3-2}{6}\right)$

B. $\sin^{-1}\left(\dfrac{3-2}{6}\right)$

C. $\tan^{-1}\left(\dfrac{3-2}{6}\right)$

D. $\cos^{-1}\left(\dfrac{3}{6}\right) - \cos^{-1}\left(\dfrac{2}{6}\right)$

E. $\sin^{-1}\left(\dfrac{3}{6}\right) - \sin^{-1}\left(\dfrac{2}{6}\right)$

56. In the complex numbers, where $i^2 = -1$, $\dfrac{2-i}{-3+i} = ?$

F. $-\dfrac{2}{3} - i$

G. $-\dfrac{5}{8} + \dfrac{1}{8}i$

H. $-\dfrac{7}{8} + \dfrac{1}{8}i$

J. $-\dfrac{5}{10} + \dfrac{1}{10}i$

K. $-\dfrac{7}{10} + \dfrac{1}{10}i$
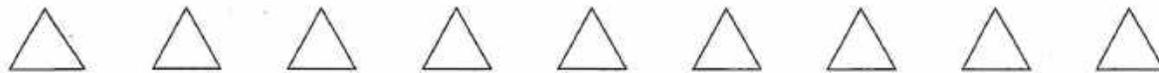
57. The degree measures of the interior angles of a certain pentagon are in the ratio 2:3:4:4:5. What is the measure of the largest interior angle of this pentagon?

A. 30°
B. 60°
C. 90°
D. 120°
E. 150°

58. The function $y = f(x)$ is graphed in the standard (x,y) coordinate plane below. The domain of f is the set of all positive real numbers. One of the following graphs is the graph of $y = -|f(x)|$. Which one is it?

F.

J.

G.

K.

H.
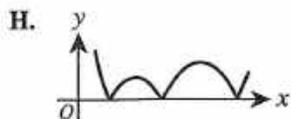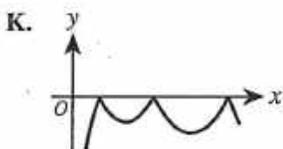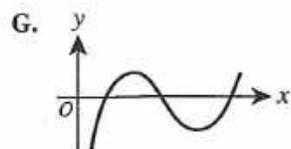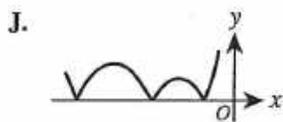
59. The sale price of a jacket is 10% off the original price. The clearance price of the jacket is 30% off the sale price. The clearance price is what percent off the original price?

A. 20%
B. 27%
C. 33%
D. 37%
E. 40%

60. How long, in centimeters, is 1 side of a square whose perimeter is equal to the circumference of a circle with a radius of 2 centimeters?

F. π

G. $\frac{\pi}{2}$

H. 4π

J. 16π

K. 4

END OF TEST 2

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

DO NOT RETURN TO THE PREVIOUS TEST.

SCIENCE TEST

35 Minutes—40 Questions

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

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

Passage I

Torrent frogs (*Staurois guttatus*) can cling to wet surfaces, even when the surfaces are at an angle of 90° (vertical) or greater. Researchers conducted 2 experiments to study how surface texture and water flow over the surface affects the clinging ability of *S. guttatus*.

Experiment 1

An apparatus was constructed with a transparent platform that could have different surface textures applied to it and that could be rotated 180°. A pump could direct water from a tank to flow over the platform (see Figure 1).
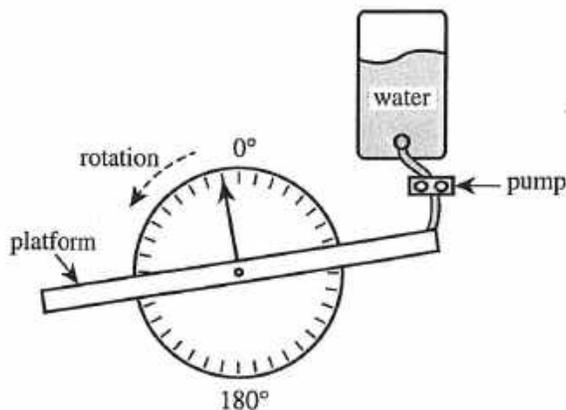
Figure 1

Then, in each of 9 trials (Trials 1–9), each of 10 *S. guttatus* (identical in size) was tested as follows:

1. The water flow rate was adjusted, a surface texture was applied to the platform, and the platform was rotated to a 10° angle.

2. A frog was placed on the platform.

3. The platform was rotated from 10° to 180° at a rate of 5° per sec.

4. The *angle of detachment* (angle at which the frog detached from the platform) was recorded.

The average angle of detachment was determined for each trial (see Table 1).

	Table 1		
Trial	Flow rate (L/min)	Surface texture	Average angle of detachment
1	0.0	smooth	180°
2	0.0	fine rough	136°
3	0.0	coarse rough	109°
4	1.0	smooth	165°
5	1.0	fine rough	150°
6	1.0	coarse rough	136°
7	4.0	smooth	155°
8	4.0	fine rough	125°
9	4.0	coarse rough	146°

Experiment 2

Trial 1 of Experiment 1 was repeated, but with a camera attached to the underside of the platform. At specific platform rotation angles during the trial, the camera was used to determine each frog's *contact area* (the surface area of the frog that was in contact with the platform), in millimeters squared (mm^2). The average contact area was determined for each angle (see Figure 2).
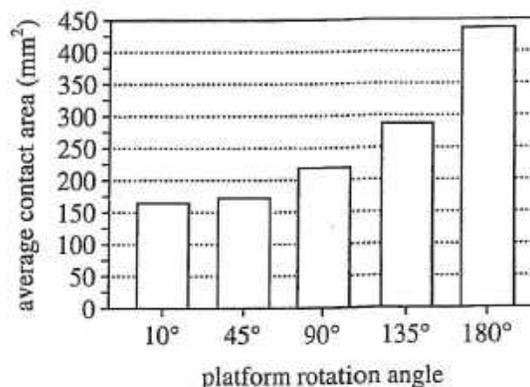
Figure 2

Table and figures adapted from T. Endlein et al., "Sticking Under Wet Conditions: The Remarkable Attachment Abilities of the Torrent Frog, *Staurois guttatus*." ©2013 by T. Endlein et al.

1. According to the results of Experiment 2, as the platform rotation angle was increased, the average contact area:

   A. increased only.
   B. decreased only.
   C. increased and then decreased.
   D. decreased and then increased.

2. In Experiment 1, how many trials, in total, resulted in an average angle of detachment of 130° or less?

   F. 2
   G. 4
   H. 6
   J. 9

3. According to the results of Experiment 1, which of the following combinations of flow rate and platform texture resulted in an average angle of detachment of 150° ?

	flow rate (L/min)	platform texture
A.	1.0	smooth
B.	4.0	smooth
C.	1.0	fine rough
D.	4.0	fine rough

4. In Experiment 1, how long did it take the platform to rotate from 10° to 180° ?

   F. 13 sec
   G. 26 sec
   H. 34 sec
   J. 48 sec

5. Upon completion of the experiments, how many trials involving a smooth surface texture had been performed?

   A. 1
   B. 4
   C. 9
   D. 10

6. If a platform rotation angle of 150° had been tested in Experiment 2, the average contact area would most likely have been:

   F. less than 170 mm^2.
   G. between 170 mm^2 and 220 mm^2.
   H. between 220 mm^2 and 265 mm^2.
   J. greater than 265 mm^2.

7. Based on the results of Experiment 1, for a flow rate of 4.0 L/min, what is the order of platform texture, from the texture that resulted in the smallest average angle of detachment to the texture that resulted in the largest average angle of detachment?

   A. Smooth, fine rough, coarse rough
   B. Smooth, coarse rough, fine rough
   C. Fine rough, smooth, coarse rough
   D. Fine rough, coarse rough, smooth

Passage II

In aqueous solutions, vitamin C ($C_6H_8O_6$) reacts with iodine (I_2) according to the balanced chemical equation

$$C_6H_8O_6 + I_2 \rightarrow C_6H_6O_6 + 2HI$$
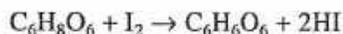
The amount of vitamin C in a solution can be determined by performing a *titration*. The *titrant* (a solution containing a known concentration of I_2) is slowly added to the *analyte* (a solution containing a particular concentration of vitamin C), and a chemical reaction occurs. This process is monitored by adding an *indicator* to the analyte. The indicator is a colorless starch solution that changes to a dark color by reacting with I_2 when no more vitamin C remains, signaling the end of the titration.

Students performed titrations to determine the amount of vitamin C in 4 different types of pulp-free juice.

Experiment 1

A 0.20 mg/mL vitamin C solution was prepared. A 1.0 mL sample of the solution was placed into a vial, and 1 drop of indicator was added to the vial. Drops of the I_2 solution were then added to the vial until the indicator changed to a dark color. The procedure was repeated for solutions of 0.40, 0.60, 0.80, and 1.0 mg/mL of vitamin C (see Figure 1).
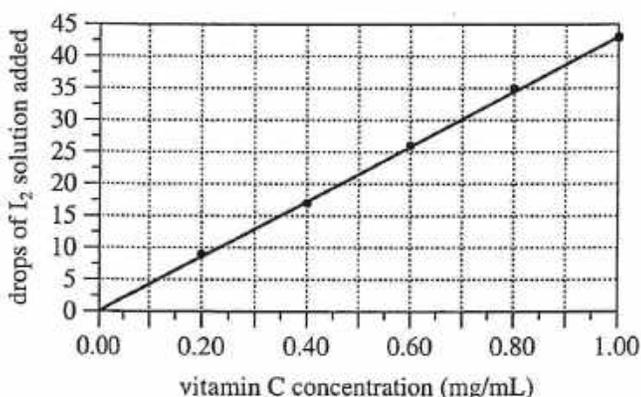
Figure 1

Experiment 2

A 1.0 mL sample of lime juice was placed into a vial, and 1 drop of indicator was added to the vial. Drops of the I_2 solution were added to the vial until the lime juice solution changed to a dark color. This procedure was repeated for 3 other juices (see Table 1).

Table 1	
Juice	Drops of I_2 solution added
Lime	13
Grapefruit	17
Lemon	18
Orange	22

Figure and table adapted from R. Ballentine, "Determination of Ascorbic Acid in Citrus Fruit Juices." ©1941 by the American Chemical Society.

8. Consider the steps performed in Experiment 2 that are listed below.

   1. Stop adding titrant when the indicator changes to a dark color.

   2. Add starch indicator to vial.

   3. Place juice sample into vial.

   4. Slowly add drops of titrant.

   These steps were performed in what sequence?

   F. 3, 2, 1, 4
   G. 3, 2, 4, 1
   H. 2, 4, 1, 3
   J. 2, 4, 3, 1

9. Based on the results of Experiments 1 and 2, which of the juices that were tested contained the greatest concentration of vitamin C ?

  A. Lime
  B. Grapefruit
  C. Lemon
  D. Orange

10. Suppose that the titration of a particular vitamin C solution requires 31 drops of the I_2 solution used in Experiment 1 to cause the indicator to change color. Based on the results of Experiment 1, the vitamin C solution has an approximate concentration of:

  F. 0.30 mg/mL.
  G. 0.50 mg/mL.
  H. 0.70 mg/mL.
  J. 0.90 mg/mL.

11. Based on the results of Experiments 1 and 2, the concentration of vitamin C in the lemon juice was closest to which of the following?

  A. 0.10 mg/mL
  B. 0.30 mg/mL
  C. 0.45 mg/mL
  D. 0.55 mg/mL

12. Suppose that a sample of apple juice had been titrated in Experiment 2 and the concentration of vitamin C in the apple juice was determined to be 0.10 mg/mL. Based on the results of Experiment 1, what is the *minimum* number of drops of the I_2 solution that would have been required to change the indicator in the apple juice solution to a dark color?

  F. 4
  G. 13
  H. 26
  J. 38

13. Based on the chemical equation in the passage, when vitamin C reacted with I_2 in the experiments, vitamin C:

  A. lost oxygen atoms.
  B. lost hydrogen atoms.
  C. gained oxygen atoms.
  D. gained hydrogen atoms.

14. Based on the results of Experiment 1, what approximate mass of vitamin C in a 1.0 mL sample reacted with each drop of the I_2 solution?

  F. 0.02 mg
  G. 0.05 mg
  H. 0.08 mg
  J. 0.10 mg

Passage III

All known *exoplanets* (planets in orbit about stars other than the Sun) are too distant from Earth to be studied in detail, so mathematical models have been developed to help predict their properties. Figures 1–3 each show how a different property varies with altitude above the surface of Earth and above the surfaces of 2 hypothetical exoplanets: Planet X and Planet Y. Figure 1 shows how atmospheric temperature, T (in kelvins, K), varies; Figure 2 shows how atmospheric pressure, P (in atmospheres, atm), varies; and Figure 3 shows how gravitational field strength, g (in newtons per kilogram, N/kg), varies.
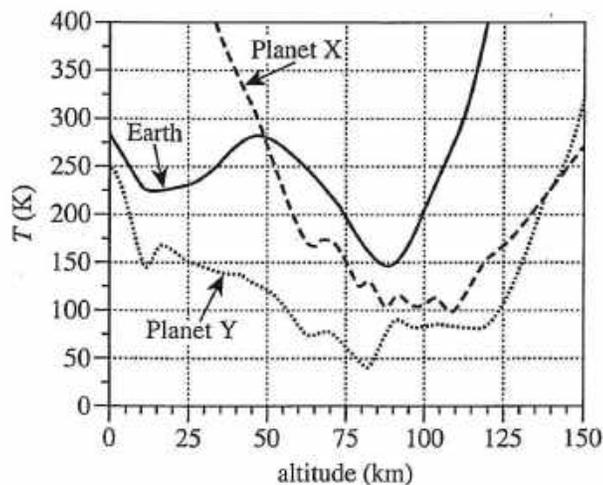
Figure 1
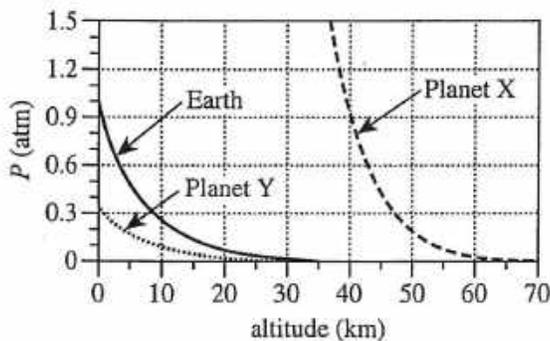
Figure 2
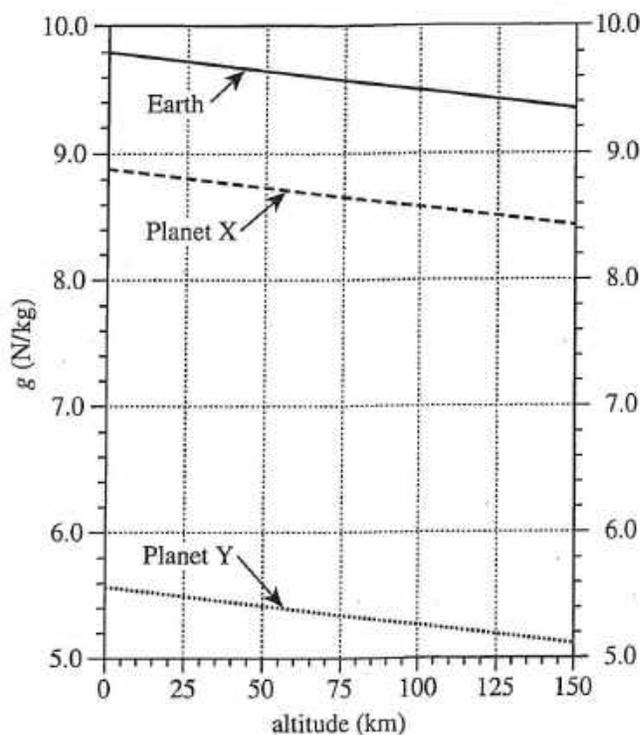
Figure 3

15. According to Figure 1, at approximately what altitude above their respective surfaces do Planets X and Y have the same atmospheric temperature, and what is that temperature?

	altitude (km)	temperature (K)
A.	50	225
B.	50	275
C.	140	225
D.	140	275

16. According to Figure 2, which of the following graphs best represents the altitude above the surface of Earth, of Planet X, and of Planet Y at which $P = 0.3$ atm ?

F.

H.

G.

J.
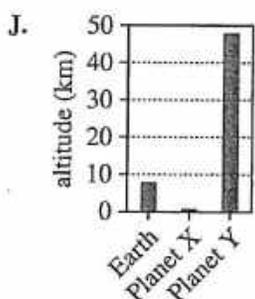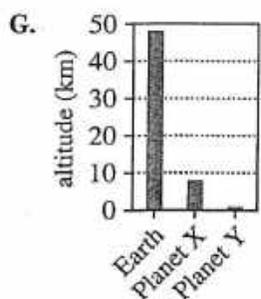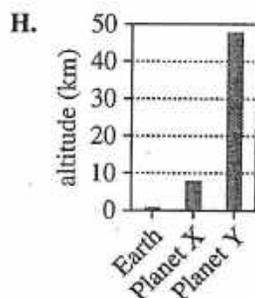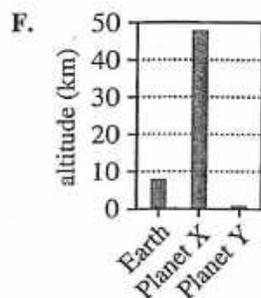
17. Atmospheric *density* and P are directly proportional to each other. Based on Figure 2, which planet more likely has the more dense atmosphere at an altitude of 5 km, Earth or Planet Y ?

A. Earth; at an altitude of 5 km, P for Earth is less than P for Planet Y.
B. Earth; at an altitude of 5 km, P for Earth is greater than P for Planet Y.
C. Planet Y; at an altitude of 5 km, P for Planet Y is less than P for Earth.
D. Planet Y; at an altitude of 5 km, P for Planet Y is greater than P for Earth.

18. At the surface of a planet, g is given by the equation

$$g = \frac{GM}{R^2}$$

where G is a constant, M is the planet's mass, and R is the planet's radius. Assume that Earth, Planet X, and Planet Y have equal radii. Based on Figure 3, which planet has the greatest mass?

F. Earth
G. Planet X
H. Planet Y
J. Cannot be determined from the given information

19. Based on Figure 1, is the average kinetic energy of the gas particles in Earth's atmosphere more likely greater at an altitude of 40 km or 80 km ?

A. 40 km, because the average kinetic energy of gas particles is directly proportional to gas temperature.
B. 40 km, because the average kinetic energy of gas particles is inversely proportional to gas temperature.
C. 80 km, because the average kinetic energy of gas particles is directly proportional to gas temperature.
D. 80 km, because the average kinetic energy of gas particles is inversely proportional to gas temperature.

20. The gravitational field strength at the surface of Planet X is approximately what percent of the gravitational field strength at the surface of Earth?

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

Passage IV

As sound waves travel through seawater, some of their energy is absorbed by the seawater. This *sound absorption* depends on several factors, including the pH of the water, the depth below the water's surface at which the sound waves travel, the frequency of the sound waves, the water temperature, and the water's *salinity* (concentration of dissolved salts in the water). Figures 1, 2, and 3 show—under the given conditions, respectively—how sound absorption (in decibels per kilometer, dB/km) varies with frequency (in kilohertz, kHz), temperature (in °C), and salinity (in parts per thousand, ppt; 1 ppt = 1 g/kg).

Conditions
pH = 8.0
depth = 0.05 km
frequency = 10 kHz
temperature = 20°C
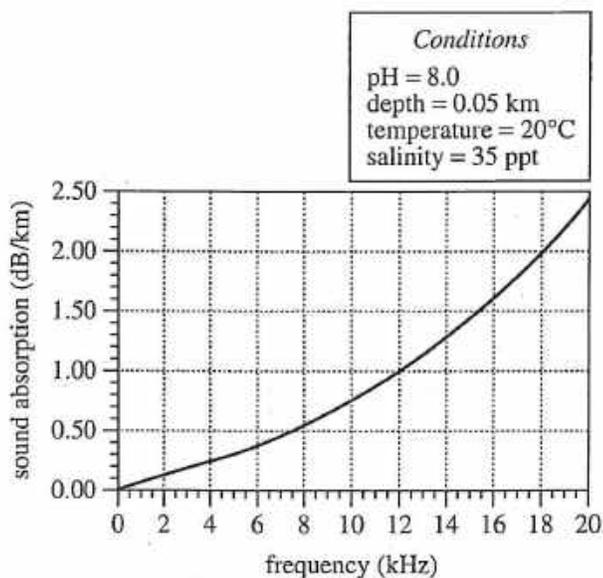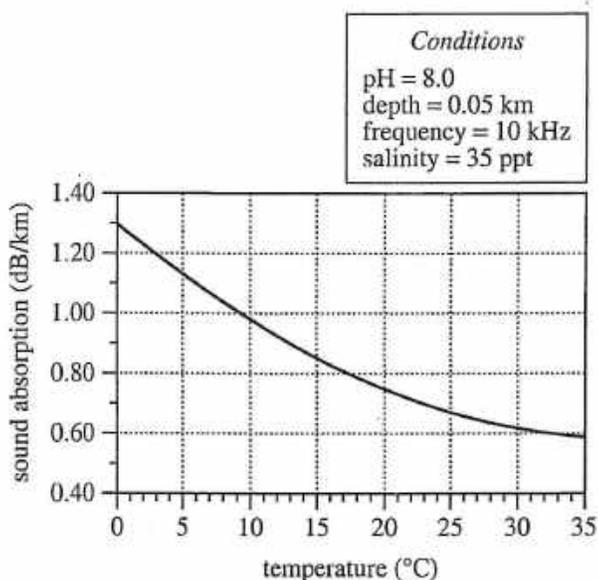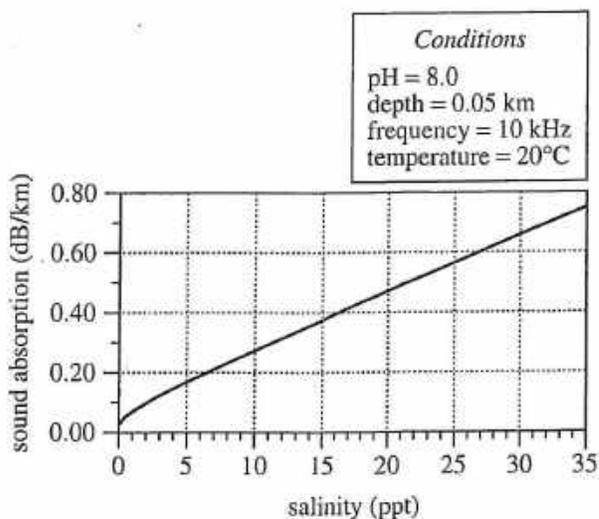
Figure 3

Figures adapted from Michael A. Ainslie and James G. McColm, "A Simplified Formula for Viscous and Chemical Absorption in Sea Water." ©1998 by Acoustical Society of America.

Conditions
pH = 8.0
depth = 0.05 km
temperature = 20°C
salinity = 35 ppt

Figure 1

Conditions
pH = 8.0
depth = 0.05 km
frequency = 10 kHz
salinity = 35 ppt

Figure 2

21. According to Figure 2, at which of the following water temperatures is the sound absorption by the seawater closest to 0.67 dB/km ?

A. 10°C
B. 15°C
C. 20°C
D. 25°C

22. Based on Figure 1, the sound absorption at a frequency of 18 kHz is about how many times as great as the sound absorption at a frequency of 12 kHz ?

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

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

H. 2

J. 3

23. Suppose that, under the conditions given in Figure 3, sound waves travel a distance of 1 km from a source to a detector. Based on Figure 3, the *least* energy would be absorbed from the sound waves by the seawater if it has which of the following salinities?

  A. 5 ppt
  B. 15 ppt
  C. 25 ppt
  D. 35 ppt

24. Suppose sound absorption by seawater is measured under the conditions given in Figure 2, except that the frequency of the sound waves is 16 kHz. Based on Figures 1 and 2, if the temperature of the seawater is 3°C, will the sound absorption more likely be less than 1.20 dB/km or greater than 1.20 dB/km ?

  F. Less than 1.20 dB/km, because sound absorption decreases as frequency decreases.
  G. Less than 1.20 dB/km, because sound absorption decreases as frequency increases.
  H. Greater than 1.20 dB/km, because sound absorption increases as frequency decreases.
  J. Greater than 1.20 dB/km, because sound absorption increases as frequency increases.

25. As the acidity of seawater increases, sound absorption decreases. Based on Figure 2, at a depth of 0.05 km, a salinity of 35 ppt, a frequency of 10 kHz, a water temperature of 20°C, and a pH of 6.0, is the sound absorption less than 0.75 dB/km or greater than 0.75 dB/km ?

  A. Less than 0.75 dB/km, because seawater at pH = 6.0 is less acidic than seawater at pH = 8.0.
  B. Less than 0.75 dB/km, because seawater at pH = 6.0 is more acidic than seawater at pH = 8.0.
  C. Greater than 0.75 dB/km, because seawater at pH = 6.0 is less acidic than seawater at pH = 8.0.
  D. Greater than 0.75 dB/km, because seawater at pH = 6.0 is more acidic than seawater at pH = 8.0.

26. Consider in Figure 1 how sound absorption changes as the frequency of the sound waves increases. As the *wavelength* (NOT frequency) of the sound waves increases, does sound absorption increase or decrease?

  F. Increase; as frequency increases, wavelength increases.
  G. Increase; as frequency increases, wavelength decreases.
  H. Decrease; as frequency increases, wavelength increases.
  J. Decrease; as frequency increases, wavelength decreases.

GO ON TO THE NEXT PAGE.

Passage V

Giant puffball mushrooms (GPMs) have belowground and aboveground structures. Belowground, tubelike threads called *hyphae* extend throughout the soil. Aboveground, the visible portion of the GPM is referred to as a *basidiocarp*. When some GPMs are disrupted, such as when they are stepped on by an animal, a cloud of particles resembling smoke is released from the basidiocarp. Two students discuss the function of the hyphae and basidiocarps in GPMs and also discuss the contents of the cloud of particles released when the basidiocarp is disrupted.

Student 1

The basidiocarps of GPMs are reproductive structures. When cells in the basidiocarp are mature, they produce, by meiosis, cells called *spores*. The spores are stored directly below the surface of the basidiocarp until the basidiocarp is disrupted. After release, a spore may settle in the soil, germinate, and then form a new hypha. When a newly formed hypha meets another newly formed hypha, they fuse and then produce a new basidiocarp. Young basidiocarps do not yet contain spores and thus do not produce a cloud of particles when disrupted.

The hyphae of a GPM acquire nutrients for the organism from organic matter in the soil. The nutrients are then transported to feed the aboveground structure.

Student 2

The hyphae of GPMs are reproductive structures, similar to the roots of some plants that reproduce asexually. To produce a new GPM, the hyphae grow away from the parental GPM to another location in the soil. Once the hyphae have grown away from the parental GPM, the hyphae produce a new basidiocarp. After the new basidiocarp has formed, the newly grown hyphae separate from the parental hyphae.

Like the leaves of plants, the basidiocarps of GPMs produce energy for the organisms through the process of photosynthesis. Basidiocarps also function as deterrents to predators by releasing a cloud of particles containing toxins when disrupted. Young GPMs do not yet produce toxins and are thus unable to release a cloud of particles.

27. According to Student 1 and Student 2, respectively, what is the main functional component contained in the cloud of particles from a disrupted basidiocarp?

	Student 1	Student 2
A.	spores	carbohydrates
B.	spores	toxins
C.	toxins	carbohydrates
D.	toxins	spores

28. Student 1 implies that the basidiocarps of some GPMs do *not* release a cloud of particles when disrupted because the:

F. cells of the basidiocarp have not yet made toxins.
G. cells of the basidiocarp have not yet become reproductively mature.
H. basidiocarp has not yet separated from the parental GPM.
J. basidiocarp has not yet produced enough energy for the GPM.

29. Student 2 indicates that the hyphae of a GPM are primarily involved in producing:

A. energy.
B. spores.
C. toxins.
D. offspring.

46

GO ON TO THE NEXT PAGE.

30. Consider the diagram of the life cycle of a GPM shown below.
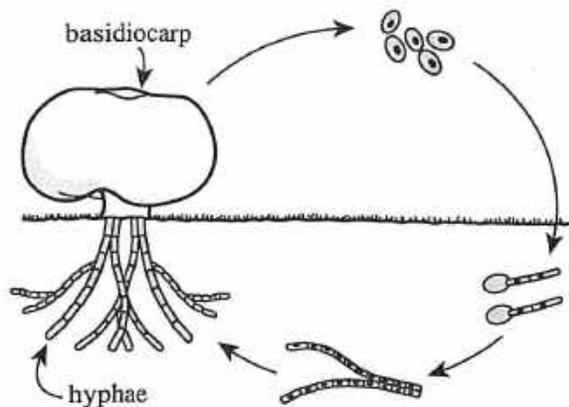
This diagram is consistent with the discussion(s) of which student(s), if either?

F. Student 1 only
G. Student 2 only
H. Both Student 1 and Student 2
J. Neither Student 1 nor Student 2

31. Based on Student 1's discussion, spore germination can best be described as a process that directly results in the production of new:

A. spores.
B. toxins.
C. hyphae.
D. basidiocarps.

32. Do Student 1 and Student 2, respectively, describe the portion of the GPM involved in obtaining energy as being located aboveground or belowground?

	Student 1	Student 2
F.	aboveground	aboveground
G.	aboveground	belowground
H.	belowground	aboveground
J.	belowground	belowground

33. Based on Student 2's discussion, why do newly formed hyphae separate from parental hyphae *after*, rather than before, the formation of a new basidiocarp?

A. The basidiocarp of a GPM provides energy for other organisms.
B. The basidiocarp of a GPM provides energy for the GPM.
C. The hyphae of a GPM provide energy for other organisms.
D. The hyphae of a GPM provide energy for the GPM.

Passage VI

A *semiconductor* is a substance whose electrical properties can be fine-tuned by *doping* (replacing some of the substance's atoms with atoms of another substance). *Silicon* is one example of a semiconductor. A scientist performed 2 experiments to study the electrical resistance, R, of silicon *wafers* (thin blocks) that had been doped.

Experiment 1

The scientist placed 15 silicon wafers into a temperature-controlled chamber. The length and width of each wafer was 10.95 mm, and the thickness of each wafer was 0.95 mm. One wafer was pure silicon, 7 of the wafers had been doped with boron atoms, and 7 of the wafers had been doped with arsenic atoms. Each of the boron-doped wafers and each of the arsenic-doped wafers had a different *doping concentration*, N_d (the number of doping atoms per cubic centimeter, atoms/cm^3). The scientist then connected each wafer to a separate *ohmmeter* (a device that measures R). Figure 1 shows this apparatus; for clarity only 1 wafer is shown connected.
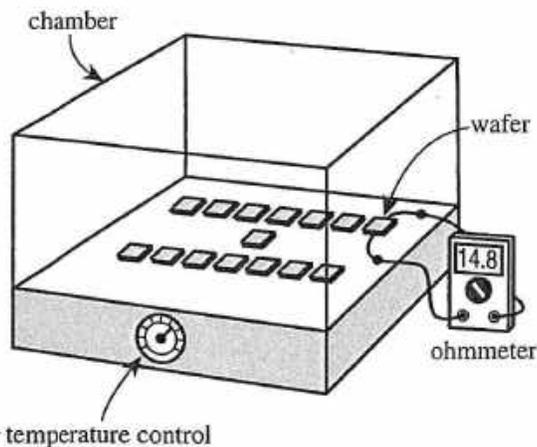
Figure 1

The scientist set the temperature, T, of the chamber at 300 kelvins (K). Then, after the wafers had been in the chamber for 30 min, she measured R (in ohms, Ω) for each wafer. Figure 2 shows R for the doped wafers; R for the pure silicon wafer was 3.2×10^7 Ω.
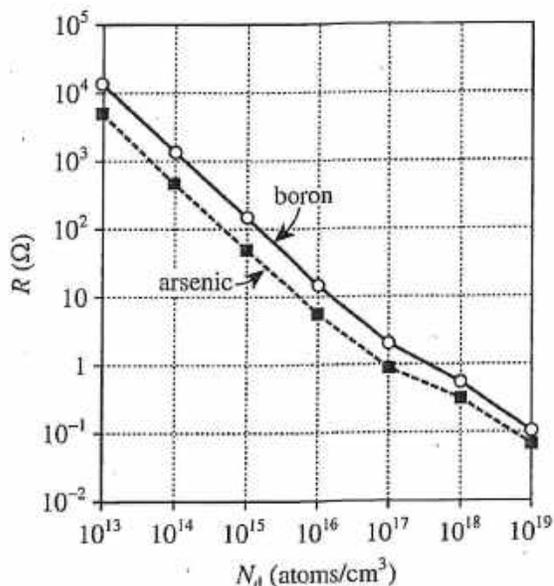
Figure 2

Experiment 2

The scientist removed each wafer from the chamber except for the two having $N_d = 10^{16}$ atoms/cm^3. She measured R for these 2 wafers at various temperatures, waiting 30 min between setting T and measuring R (see Figure 3).
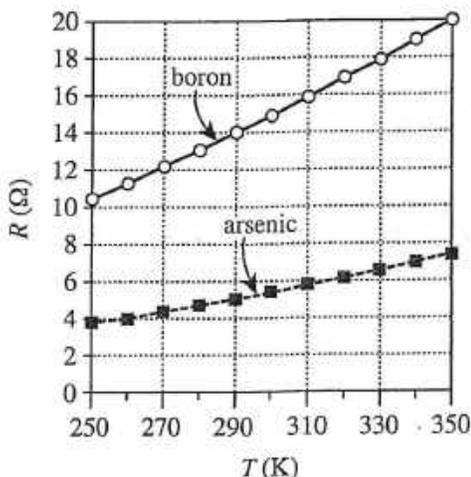
Figure 3

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34. Suppose that in Experiment 2 the scientist had measured a resistance of 22 Ω for the boron-doped wafer. The temperature of the wafer at the time of this measurement would most likely have been:

    F. lower than 340 K.
    G. between 340 K and 360 K.
    H. between 360 K and 380 K.
    J. higher than 380 K.

35. What factor was constant in Experiment 1 but was NOT constant in Experiment 2 ?

    A. Resistance
    B. Temperature
    C. Wafer thickness
    D. Doping concentration

36. Based on the results of Experiments 1 and 2, which of the following statements best summarizes the relationship between R and N_d and the relationship between R and T ? R increased as:

    F. N_d increased and as T increased.
    G. N_d increased and as T decreased.
    H. N_d decreased and as T increased.
    J. N_d decreased and as T decreased.

37. Did the scientist investigate whether the resistance of a doped wafer is affected by the wafer's dimensions?

    A. Yes; the wafers that were tested had different dimensions.
    B. Yes; the wafers that were tested had the same dimensions.
    C. No; the wafers that were tested had different dimensions.
    D. No; the wafers that were tested had the same dimensions.

38. In Experiments 1 and 2, the scientist most likely waited between setting T and measuring R to ensure that the:

    F. wafers were in thermal equilibrium with the chamber.
    G. ohmmeters were not in thermal equilibrium with the chamber.
    H. chamber was in thermal equilibrium with the greater laboratory environment.
    J. doping atoms within each wafer were not in thermal equilibrium with the chamber.

39. Based on the results of Experiment 1, the ohmmeter shown in Figure 1 is most likely connected to the wafer doped with which type of atoms and at what doping concentration?

	type of doping atoms	N_d (atoms/cm^3)
A.	boron	10^{15}
B.	boron	10^{16}
C.	arsenic	10^{15}
D.	arsenic	10^{16}

40. Based on the value of R for the pure silicon wafer and the data in Figure 2, does replacing some of the silicon atoms in a silicon wafer with doping atoms make the wafer a better conductor or a better insulator?

    F. A better conductor, because the resistance of each doped wafer was less than that of the pure silicon wafer.
    G. A better conductor, because the resistance of each doped wafer was greater than that of the pure silicon wafer.
    H. A better insulator, because the resistance of each doped wafer was less than that of the pure silicon wafer.
    J. A better insulator, because the resistance of each doped wafer was greater than that of the pure silicon wafer.

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.

Test 2: Mathematics—Scoring Key

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

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

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

*Reporting Categories
PHM = Preparing for Higher Math
  N = Number & Quantity
  A = Algebra
  F = Functions
  G = Geometry
  S = Statistics & Probability
IES = Integrating Essential Skills
MDL = Modeling

Number Correct (Raw Score) for:	
Preparing for Higher Math (PHM) (N + A + F + G + S)	___ (35)
Integrating Essential Skills (IES)	___ (25)
Total Number Correct for Mathematics Test (PHM + IES)	___ (60)
Modeling (MDL) (Not included in total number correct for mathematics test raw score)	___ (27)

Test 3: Reading—Scoring Key

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

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

*Reporting Categories
KID = Key Ideas & Details
CS = Craft & Structure
IKI = Integration of Knowledge & Ideas

Number Correct (Raw Score) for:	
Key Ideas & Details (KID)	_____ (23)
Craft & Structure (CS)	_____ (11)
Integration of Knowledge & Ideas (IKI)	_____ (6)
Total Number Correct for Reading Test (KID + CS + IKI)	_____ (40)

Test 4: Science—Scoring Key

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

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

*Reporting Categories
IOD = Interpretation of Data
SIN = Scientific Investigation
EMI = Evaluation of Models,
     Inferences & Experimental Results

Number Correct (Raw Score) for:	
Interpretation of Data (IOD)	_____ (19)
Scientific Investigation (SIN)	_____ (10)
Evaluation of Models, Inferences & Experimental Results (EMI)	_____ (11)
Total Number Correct for Science Test (IOD + SIN + EMI)	_____ (40)

Explanation of Procedures Used to Obtain
Scale Scores from Raw Scores

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

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

ACT Test C02   **Your Scale Score**

English   _____

Mathematics   _____

Reading   _____

Science   _____

Sum of scores   _____

Composite score (sum ÷ 4)   _____

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

Scale Score	Raw Scores				Scale Score
	Test 1 English	Test 2 Mathematics	Test 3 Reading	Test 4 Science	
36	74-75	59-60	40	39-40	36
35	72-73	57-58	38-39	38	35
34	71	55-56	37	37	34
33	69-70	54	36	—	33
32	68	53	35	36	32
31	67	51-52	34	35	31
30	66	49-50	33	34	30
29	65	47-48	32	33	29
28	63-64	44-46	31	—	28
27	62	41-43	30	31-32	27
26	60-61	39-40	29	30	26
25	58-59	36-38	28	29	25
24	55-57	34-35	27	27-28	24
23	52-54	32-33	25-26	26	23
22	49-51	31	24	24-25	22
21	47-48	29-30	22-23	23	21
20	44-46	28	21	21-22	20
19	42-43	26-27	20	20	19
18	40-41	23-25	18-19	18-19	18
17	38-39	20-22	17	17	17
16	35-37	17-19	16	15-16	16
15	31-34	13-16	14-15	13-14	15
14	28-30	10-12	13	12	14
13	26-27	8-9	12	11	13
12	24-25	6-7	10-11	10	12
11	21-23	5	9	8-9	11
10	18-20	4	7-8	7	10
9	15-17	—	6	6	9
8	13-14	3	5	5	8
7	11-12	—	—	4	7
6	9-10	2	4	3	6
5	7-8	—	3	—	5
4	5-6	1	2	2	4
3	4	—	—	1	3
2	2-3	—	1	—	2
1	0-1	0	0	0	1