

Math/Science
Version

Form Z04

(April 2021)



The **ACT**[®]

2021

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.

**MATHEMATICS TEST***60 Minutes—60 Questions*

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

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

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

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

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

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

1. The numbers 1 through 15 were each written on individual pieces of paper, 1 number per piece. Then the 15 pieces of paper were put in a jar. One piece of paper will be drawn from the jar at random. What is the probability of drawing a piece of paper with a number less than 9 written on it?

- A. $\frac{1}{9}$
- B. $\frac{1}{15}$
- C. $\frac{6}{15}$
- D. $\frac{7}{15}$
- E. $\frac{8}{15}$

2. Which of the following expressions is equivalent to $-4x^3 - 12x^3 + 9x^2$?

- F. x^8
- G. $-7x^8$
- H. $-8x^3 + 9x^2$
- J. $-16x^3 + 9x^2$
- K. $-16x^6 + 9x^2$

3. When $x = 2$, $10 + 3(12 \div (3x)) = ?$

- A. 12
- B. 16
- C. 26
- D. 34
- E. 104

4. $|6 - 4| - |3 - 8| = ?$

- F. -7
- G. -3
- H. 3
- J. 7
- K. 21

DO YOUR FIGURING HERE.



5. The expression $(4c - 3d)(3c + d)$ is equivalent to:

- A. $12c^2 - 13cd - 3d^2$
- B. $12c^2 - 13cd + 3d^2$
- C. $12c^2 - 5cd - 3d^2$
- D. $12c^2 - 5cd + 3d^2$
- E. $12c^2 - 3d^2$

DO YOUR FIGURING HERE.

6. Of the 180 students in a college course, $\frac{1}{4}$ of the students earned an A for the course, $\frac{1}{3}$ of the students earned a B for the course, and the rest of the students earned a C for the course. How many of the students earned a C for the course?

- F. 75
- G. 90
- H. 105
- J. 120
- K. 135

7. The number of fish, f , in Skipper's Pond at the beginning of each year can be modeled by the equation $f(x) = 3(2^x)$, where x represents the number of years after the beginning of the year 2000. For example, $x = 0$ represents the beginning of the year 2000, $x = 1$ represents the beginning of the year 2001, and so forth. According to the model, how many fish were in Skipper's Pond at the beginning of the year 2006 ?

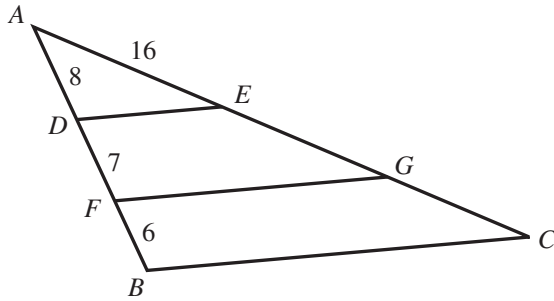
- A. 96
- B. 192
- C. 384
- D. 1,458
- E. 46,656

8. Manish drove from Chicago to Baton Rouge. At 8:00 a.m., he was 510 km from Baton Rouge. At 1:00 p.m., he was 105 km from Baton Rouge. Which of the following values is closest to Manish's average speed, in kilometers per hour, from 8:00 a.m. to 1:00 p.m. ?

- F. 58
- G. 68
- H. 81
- J. 94
- K. 102



9. In the figure shown below, E and G lie on \overline{AC} , D and F lie on \overline{AB} , \overline{DE} and \overline{FG} are parallel to \overline{BC} , and the given lengths are in feet. What is the length of \overline{AC} , in feet?



- A. 13
 B. 26
 C. 29
 D. 42
 E. 48
10. Katerina runs 15 miles in $2\frac{1}{2}$ hours. What is the average number of *minutes* it takes her to run 1 mile?
- F. 6
 G. 10
 H. $12\frac{1}{2}$
 J. $16\frac{2}{3}$
 K. $17\frac{1}{2}$
11. A bag contains 8 red marbles, 9 yellow marbles, and 7 green marbles. How many additional red marbles must be added to the 24 marbles already in the bag so that the probability of randomly drawing a red marble is $\frac{3}{5}$?
- A. 11
 B. 16
 C. 20
 D. 24
 E. 32

DO YOUR FIGURING HERE.



12. In the standard (x,y) coordinate plane, the point $(2,1)$ is the midpoint of \overline{CD} . Point C has coordinates $(6,8)$. What are the coordinates of point D ?

- F. $(-2, -\frac{7}{2})$
 G. $(-2, -6)$
 H. $(4, \frac{9}{2})$
 J. $(10, 10)$
 K. $(10, 15)$

DO YOUR FIGURING HERE.

13. At his job, the first 40 hours of each week that Thomas works is *regular time*, and any additional time that he works is *overtime*. Thomas gets paid \$15 per hour during regular time. During overtime Thomas gets paid 1.5 times as much as he gets paid during regular time. Thomas works 46 hours in 1 week and gets \$117 in deductions taken out of his pay for this week. After the deductions are taken out, how much of Thomas's pay for this week remains?

- A. \$492
 B. \$573
 C. \$609
 D. \$618
 E. \$735

14. At Sweet Stuff Fresh Produce the price of a bag of grapes depends on the total number of bags purchased at 1 time, as shown in the table below. In 2 trips to Sweet Stuff this week, Janelle purchased 3 bags of grapes on Monday and 4 bags of grapes on Wednesday. How much money would Janelle have saved if she had instead purchased 7 bags of grapes in 1 trip on Monday?

Number of bags	Price per bag
1–3	\$3.00
4–6	\$2.80
7–9	\$2.60
10 or more	\$2.50

- F. \$0.20
 G. \$1.00
 H. \$1.40
 J. \$2.00
 K. \$2.50

15. What is 3% of 4.14×10^4 ?

- A. 1,242
 B. 1,380
 C. 12,420
 D. 13,800
 E. 124,200



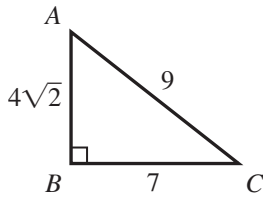
16. What value of x satisfies the equation $-3(4x - 5) = 2(1 - 5x)$?

- F. $-\frac{17}{2}$
 G. $-\frac{17}{22}$
 H. -1
 J. $\frac{3}{17}$
 K. $\frac{13}{2}$

DO YOUR FIGURING HERE.

17. In right triangle $\triangle ABC$ shown below, the given lengths are in millimeters. What is $\sin A$?

- A. $\frac{4\sqrt{2}}{9}$
 B. $\frac{4\sqrt{2}}{7}$
 C. $\frac{7\sqrt{2}}{8}$
 D. $\frac{7}{9}$
 E. $\frac{9}{7}$

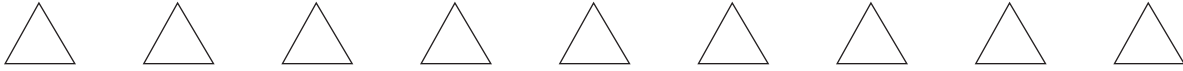


18. $\left(\frac{27}{64}\right)^{-\frac{2}{3}} = ?$

- F. $-\frac{9}{16}$
 G. $-\frac{9}{32}$
 H. $\frac{9}{32}$
 J. $\frac{16}{9}$
 K. $\frac{32}{9}$

19. Loto begins at his back door and walks 8 yards east, 6 yards north, 12 yards east, and 5 yards north to the barn door. About how many yards less would he walk if he could walk directly from the back door to the barn door?

- A. 8
 B. 19
 C. 23
 D. 26
 E. 31

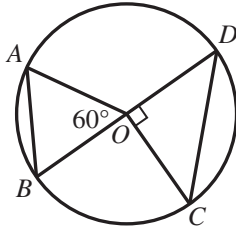


20. For a given set of data, the standard score, z , corresponding to the raw score, x , is given by $z = \frac{x - \mu}{\sigma}$, where μ is the mean of the set and σ is the standard deviation. If, for a set of scores, $\mu = 78$ and $\sigma = 6$, which of the following is the raw score, x , corresponding to $z = 2$?

- F. 90
- G. 84
- H. 80
- J. 76
- K. 66

DO YOUR FIGURING HERE.

21. In the figure below, A , B , C , and D lie on the circle centered at O .



Which of the following does NOT appear in the figure?

- A. Acute triangle
 - B. Equilateral triangle
 - C. Isosceles triangle
 - D. Right triangle
 - E. Scalene triangle
22. What is the slope of a line, in the standard (x,y) coordinate plane, that is parallel to $x + 5y = 9$?
- F. -5
 - G. $-\frac{1}{5}$
 - H. $\frac{1}{5}$
 - J. $\frac{9}{5}$
 - K. 9
23. Given $y = \frac{x}{x-1}$ and $x > 1$, which of the following is a possible value of y ?
- A. -1.9
 - B. -0.9
 - C. 0.0
 - D. 0.9
 - E. 1.9

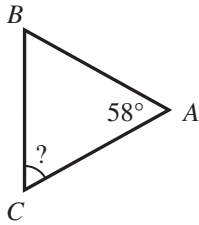
GO ON TO THE NEXT PAGE.



24. The set of all positive integers that are divisible by both 15 and 35 is infinite. What is the least positive integer in this set?
- F. 5
G. 50
H. 105
J. 210
K. 525

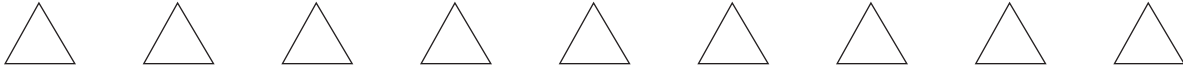
DO YOUR FIGURING HERE.

25. In $\triangle ABC$ shown below, the measure of $\angle A$ is 58° , and $\overline{AB} \cong \overline{AC}$. What is the measure of $\angle C$?



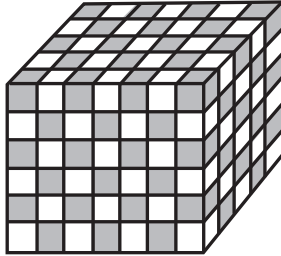
- A. 32°
B. 42°
C. 58°
D. 61°
E. 62°
26. About 1.48×10^8 square kilometers of Earth's surface is land; the rest, about 3.63×10^8 square kilometers, is water. If a returning space capsule lands at a random point on Earth's surface, which of the following is the best estimate of the probability that the space capsule will land in water?
- F. 80%
G. 71%
H. 65%
J. 41%
K. 29%
27. On the first 7 statistics tests of the semester, Jamal scored 61, 76, 79, 80, 80, 84, and 91. The mean, median, and mode of his scores were 79, 80, and 80, respectively. On the 8th statistics test, Jamal scored 90. How do the mean, median, and mode of all 8 of his scores compare to the mean, median, and mode of his first 7 scores?
- | | Mean | Median | Mode |
|----|---------|---------|---------|
| A. | equal | greater | greater |
| B. | greater | greater | greater |
| C. | greater | greater | equal |
| D. | greater | equal | greater |
| E. | greater | equal | equal |

GO ON TO THE NEXT PAGE.



28. The solid rectangular prism shown below was built by alternating congruent black cubes and white cubes such that 2 cubes of the same color have at most 1 edge touching. What is the total number of *white* cubes that were used to build the prism?

DO YOUR FIGURING HERE.

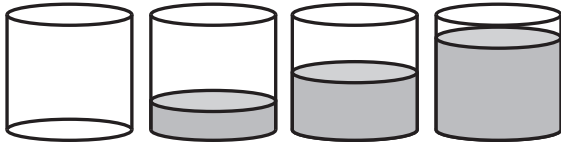


- F. 45
 G. 102
 H. 105
 J. 140
 K. 210
29. One side of square $ABCD$ has a length of 12 meters. A certain rectangle whose area is equal to the area of $ABCD$ has a width of 8 meters. What is the length, in meters, of the rectangle?
- A. 12
 B. 16
 C. 18
 D. 20
 E. 24
30. The average of a list of 4 numbers is 92.0. A new list of 4 numbers has the same first 3 numbers as the original list, but the fourth number in the original list is 40, and the fourth number in the new list is 48. What is the average of this new list of numbers?
- F. 81.0
 G. 92.0
 H. 94.0
 J. 94.4
 K. 96.6
31. The vector \mathbf{i} represents 1 mile per hour east, and the vector \mathbf{j} represents 1 mile per hour north. Maria is jogging south at 12 miles per hour. One of the following vectors represents Maria's velocity, in miles per hour. Which one?
- A. $-12\mathbf{i}$
 B. $-12\mathbf{j}$
 C. $12\mathbf{i}$
 D. $12\mathbf{j}$
 E. $12\mathbf{i} + 12\mathbf{j}$

GO ON TO THE NEXT PAGE.



32. Four identical glasses are shown below. One glass is empty, and the other 3 glasses are $\frac{1}{4}$ full, $\frac{1}{2}$ full, and $\frac{4}{5}$ full of water, respectively. If the water were redistributed equally among the 4 glasses, what fractional part of each glass would be filled?



- F. $\frac{2}{11}$
 G. $\frac{8}{11}$
 H. $\frac{3}{22}$
 J. $\frac{31}{60}$
 K. $\frac{31}{80}$
33. Aurelio is purchasing carpet tiles to cover an area of his living room floor that is $8\frac{1}{3}$ feet wide by 10 feet long. Each carpet tile is a square 20 inches wide by 20 inches long. What is the minimum number of carpet tiles that Aurelio must purchase to cover this area of his living room floor?
- A. 5
 B. 11
 C. 21
 D. 30
 E. 84
34. In the standard (x,y) coordinate plane, a circle with its center at $(8,5)$ and a radius of 9 coordinate units has which of the following equations?
- F. $(x - 8)^2 + (y - 5)^2 = 81$
 G. $(x - 8)^2 + (y - 5)^2 = 9$
 H. $(x + 8)^2 + (y + 5)^2 = 81$
 J. $(x + 8)^2 + (y + 5)^2 = 9$
 K. $(x + 5)^2 + (y + 8)^2 = 81$

DO YOUR FIGURING HERE.



Use the following information to answer questions 35–38.

DO YOUR FIGURING HERE.

Many humans carry the gene Yq77. The Yq test determines, with 100% accuracy, whether a human carries Yq77. If a Yq test result is positive, the human carries the Yq77 gene. If a Yq test result is negative, the human does NOT carry Yq77. Sam designed a less expensive test for Yq77 called the Sam77 test. It produces some incorrect results. To determine the accuracy of the Sam77 test, both tests were administered to 1,000 volunteers. The results from this administration are summarized in the table below.

	Positive Yq test	Negative Yq test
Positive Sam77 test	590	10
Negative Sam77 test	25	375

35. It cost \$2,500 to administer each Yq test and \$50 to administer each Sam77 test. What was the total cost to administer both tests to all the volunteers?
- A. \$1,537,500
 B. \$1,556,750
 C. \$1,568,250
 D. \$2,500,000
 E. \$2,550,000
36. What percent of the volunteers actually carry Yq77 ?
- F. 57.5%
 G. 60.0%
 H. 60.5%
 J. 61.5%
 K. 62.5%
37. For how many volunteers did the Sam77 test give an incorrect result?
- A. 10
 B. 25
 C. 35
 D. 385
 E. 400
38. One of the volunteers whose Sam77 test result was positive will be chosen at random. To the nearest 0.001, what is the probability the chosen volunteer does NOT possess Yq77 ?
- F. 0.017
 G. 0.026
 H. 0.035
 J. 0.041
 K. 0.063



39. Given matrices $X = [-1 \ 0]$ and $Y = \begin{bmatrix} -2 \\ -1 \end{bmatrix}$, which of the following matrices is XY ?

- A. $[-4]$
- B. $[-3]$
- C. $[-2]$
- D. $[\ 2]$
- E. $[\ 3]$

DO YOUR FIGURING HERE.

40. Regardless of how the graph is oriented in the standard (x,y) coordinate plane, NO graph in one of the following categories has a vertical line of symmetry. Which one?

- F. Line
- G. Square
- H. Pentagon
- J. Parallelogram
- K. Scalene triangle

41. The equation $24x^2 + 2x = 15$ has 2 solutions. What is the greater of the 2 solutions?

- A. $\frac{3}{4}$
- B. $\frac{4}{3}$
- C. $\frac{5}{6}$
- D. $\frac{7}{6}$
- E. $\frac{11}{15}$

42. Which of the following expressions is equal to $(\sin 60^\circ)(\cos 30^\circ) + (\cos 60^\circ)(\sin 30^\circ)$?

- F. $\cos(60^\circ - 30^\circ)$
- G. $\cos(60^\circ + 30^\circ)$
- H. $\sin(60^\circ - 30^\circ)$
- J. $\sin(60^\circ + 30^\circ)$
- K. $\sin\left(\frac{60^\circ + 30^\circ}{2}\right)$

43. What is the area, in square units, of a circle that has a circumference 12π units long?

- A. 6π
- B. 12π
- C. 24π
- D. 36π
- E. 144π



44. A barrel contains 25 liters of a solvent mixture that is 40% solvent and 60% water. Lee will add pure solvent to the barrel, without removing any of the mixture currently in the barrel, so that the new mixture will contain 50% solvent and 50% water. How many liters of pure solvent should Lee add to create this new mixture?

F. 2.5
 G. 5
 H. 10
 J. 12.5
 K. 15

DO YOUR FIGURING HERE.

45. For all $x \neq \pm y$, $\frac{x}{x+y} + \frac{y}{x-y} = ?$

A. $\frac{1}{x-y}$
 B. $\frac{x+y}{x-y}$
 C. $\frac{x+y}{2x}$
 D. $x^2 + y^2$
 E. $\frac{x^2 + y^2}{x^2 - y^2}$

46. Mary, James, and Carlos sold $\frac{1}{4}$ -page advertisements for the school yearbook. Mary sold twice as many as Carlos did, and James sold 3 times as many as Mary did. What fraction of these advertisements did Carlos sell?

F. $\frac{1}{9}$
 G. $\frac{1}{7}$
 H. $\frac{1}{6}$
 J. $\frac{1}{5}$
 K. $\frac{1}{3}$

47. In a window display at a flower shop, there are 3 spots for 1 plant each. To fill these 3 spots, Emily has 6 plants to select from, each of a different type. Selecting from the 6 plants, Emily can make how many possible display arrangements with 1 plant in each spot?

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

A. 3
 B. 6
 C. 15
 D. 120
 E. 216

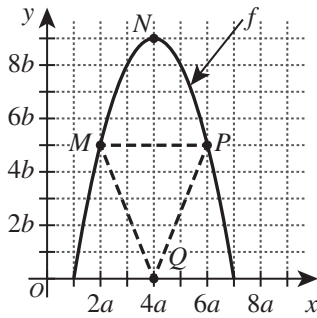
GO ON TO THE NEXT PAGE.



Use the following information to answer questions 48–50.

DO YOUR FIGURING HERE.

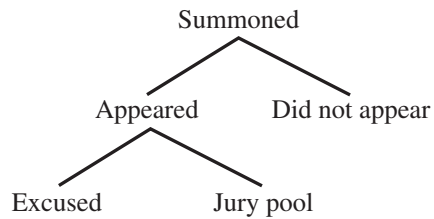
The quadratic function f and $\triangle MPQ$ are graphed in the standard (x,y) coordinate plane below. Points $M(2a, 5b)$, $N(4a, 9b)$, and $P(6a, 5b)$ are on f . Point $Q(4a, 0)$ is NOT on f .



48. In terms of a and b , what is the area, in square coordinate units, of $\triangle MPQ$?
- F. $8ab$
 - G. $10ab$
 - H. $12ab$
 - J. $15ab$
 - K. $20ab$
49. Point M will remain fixed, and point Q will move to the right along the x -axis. As Q continues to move to the right, which of the following statements describes what will happen to the slope of \overline{MQ} ?
- A. It will decrease and eventually be negative.
 - B. It will decrease but never be negative.
 - C. It will stay the same.
 - D. It will increase but never be positive.
 - E. It will increase and eventually be positive.
50. One of the following values is equal to $f(5a)$. Which one?
- F. $3a$
 - G. $5a$
 - H. $5b$
 - J. $8a$
 - K. $8b$



51. Twelve jurors are needed for an upcoming trial. The diagram below illustrates a part of the process of jury selection. The 12 jurors will be selected from a jury pool of about 60 people. The court records show a trend that only 40% of the people who are summoned for jury duty actually appear and that of the people who appear, $\frac{1}{3}$ are excused. If this same trend continues, how many people should be summoned to have as close as possible to 60 people in the jury pool?



- A. 45
 B. 90
 C. 150
 D. 225
 E. 800
52. What is the 275th digit after the decimal point in the repeating decimal $0.\overline{6295}$?
- F. 0
 G. 2
 H. 5
 J. 6
 K. 9
53. Given that $f(x) = x^2 - 4$ and $g(x) = x + 3$, what are all the values of x for which $f(g(x)) = 0$?
- A. -5 and -1
 B. -3 , -2 , and 2
 C. -1 and 1
 D. 1 and 5
 E. $-\sqrt{5}$ and $\sqrt{5}$
54. Given that p is a positive number, n is a negative number, and $|p| > |n|$, which of the following expressions has the greatest value?

F. $\left| \frac{p-n}{p} \right|$

G. $\left| \frac{p-n}{n} \right|$

H. $\left| \frac{p+n}{p-n} \right|$

J. $\left| \frac{p+n}{p} \right|$

K. $\left| \frac{p+n}{n} \right|$

DO YOUR FIGURING HERE.



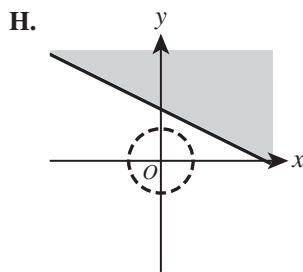
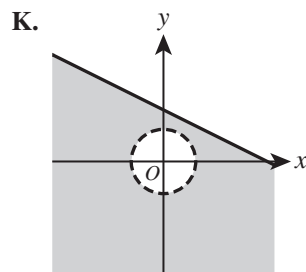
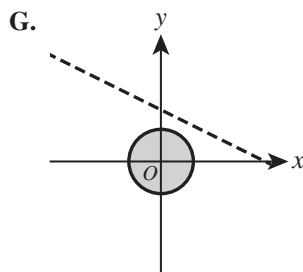
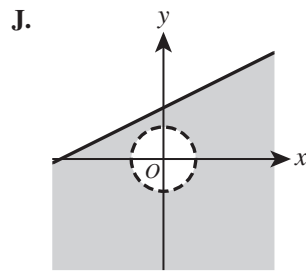
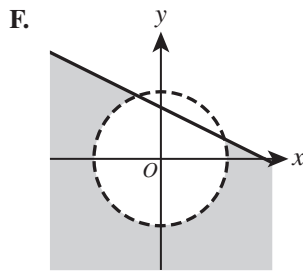
55. If $i = \sqrt{-1}$, then $\frac{i+i^2+i^3}{i^3+i^4+i^5} = ?$

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

DO YOUR FIGURING HERE.

56. In one of the following graphs in the standard (x,y) coordinate plane, the solution set to the system of inequalities below is shown shaded. Which one?

$$\begin{cases} x + 2y \leq 6 \\ 3x^2 > 12 - 3y^2 \end{cases}$$

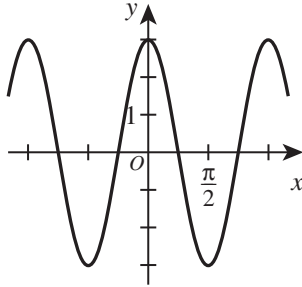


57. Let a , b , c , and d be real numbers. Given that $ac = 1$, $\frac{b+c}{d}$ is undefined, and $abc = d$, which of the following *must* be true?

- A. $a = 0$ or $c = 0$
- B. $a = 1$ and $c = 1$
- C. $a = -c$
- D. $b = 0$
- E. $b + c = 0$



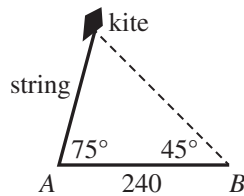
58. A cosine function is shown in the standard (x,y) coordinate plane below.



DO YOUR FIGURING HERE.

One of the following equations represents this function. Which one?

- F. $y = 2 \cos\left(\frac{x}{3}\right)$
 G. $y = 2 \cos(3x)$
 H. $y = 3 \cos\left(\frac{x}{3}\right)$
 J. $y = 3 \cos\left(\frac{x}{2}\right)$
 K. $y = 3 \cos(2x)$
59. The figure below shows a flying kite. At a certain moment, the kite string forms an angle of elevation of 75° from point A on the ground. At the same moment, the angle of elevation of the kite at point B , 240 ft from A on level ground, is 45° . What is the length, in feet, of the string?



- A. $60\sqrt{3}$
 B. $80\sqrt{6}$
 C. 144
 D. 180
 E. 240
60. If a publisher charges \$15 for the first copy of a book that is ordered and \$12 for each additional copy, which of the following expressions represents the cost of y books?
- F. $12y + 3$
 G. $12y + 15$
 H. $15y - 3$
 J. $15y + 3$
 K. $15y + 12$

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

In a particular *playa* (relatively flat, dry desert basin) evidence shows that some large rocks have moved along the surface, leaving shallow trails in the clay sediment, some up to several hundred meters long. Three scientists provided explanations for how these rocks moved.

Scientist 1

In the spring, snowmelt from surrounding mountains runs downhill and collects in the *playa*. At night, cold temperatures cause this water to freeze around the rocks. When temperatures rise again, the ice begins to melt, leaving a layer of mud on the surface and ice “rafts” around the rocks. The buoyancy of the ice rafts floats the rocks on top of the mud such that even light winds can then push the rocks along the surface. Evidence of this lifting is seen in that the trails left by rocks are both shallow and only about $\frac{2}{3}$ as wide as the rocks themselves. Due to the combination of ice, mud, and light winds, the rocks are able to move several hundred meters in a few days.

Scientist 2

Snowmelt from surrounding mountains does collect in the *playa* during the spring. However, the temperature in the *playa* does not get cold enough for ice to form. When the *playa*’s surface gets wet, the top layer of clay transforms into a slick, muddy film. In addition, dormant algae present in the dry clay begin to grow rapidly when the clay becomes wet. The presence of mud and algae reduces friction between the rocks and the clay. Even so, relatively strong winds are required to push the rocks along the wet surface, forming trails. Due to the combination of mud, algae, and strong winds, the rocks are able to move several hundred meters in a few hours.

Scientist 3

Water does collect in the *playa*, producing mud and ice. However, neither mud nor ice is responsible for the rocks’ movements. The *playa* is located along a fault line between tectonic plates. Minor vertical shifts in the plates cause the rocks to move downhill, leaving trails. Due to the combination of tectonic plate movement and strong winds, the rocks are able to move only a few meters over several years.

- According to Scientist 2, friction between the rocks and the clay is reduced by which of the following?
 - Ice only
 - Algae only
 - Ice and mud only
 - Mud and algae only
- Suppose a researcher observed that wind speeds greater than 80 miles per hour are needed to move the rocks in the *playa*. This observation is consistent with which of the scientists’ explanations?
 - Scientists 1 and 2 only
 - Scientists 1 and 3 only
 - Scientists 2 and 3 only
 - Scientists 1, 2, and 3
- Suppose that no seismic activity was recorded in the *playa* where the trails left by the rocks are found. This finding would *weaken* which of the scientists’ explanations?
 - Scientist 1 only
 - Scientist 3 only
 - Scientist 1 and Scientist 2 only
 - Scientist 2 and Scientist 3 only
- Suppose it were discovered that a particular rock formed a 200 m long trail in 72 hr. Would this discovery support Scientist 1’s explanation?
 - Yes; Scientist 1 indicated the rocks can move several hundred meters in a few hours.
 - Yes; Scientist 1 indicated the rocks can move several hundred meters in a few days.
 - No; Scientist 1 indicated the rocks can move several hundred meters in a few hours.
 - No; Scientist 1 indicated the rocks can move several hundred meters in a few days.



5. Suppose that during one year there was no measurable movement of any rocks in the playa during the spring. Scientists 1 and 2 would most likely both agree that this was due to the absence of which of the following factors?
- A. Algae
 - B. Snowmelt
 - C. Strong winds
 - D. Subzero temperatures
6. Suppose that air temperature in the playa varies between 4°C and 47°C . Would this information support the explanation of Scientist 2 ?
- F. Yes, because ice cannot form in that temperature range.
 - G. Yes, because ice can form in that temperature range.
 - H. No, because ice cannot form in that temperature range.
 - J. No, because ice can form in that temperature range.
7. Based on Scientist 1's explanation, a rock trail that is 33 cm wide was most likely made by a rock with approximately what width?
- A. 10 cm
 - B. 25 cm
 - C. 50 cm
 - D. 65 cm

**Passage II**

When certain substances are added to diet cola, CO_2 gas is produced, generating a foam. Two experiments were done to study this process.

In each trial, an apparatus like that shown in Figure 1 was used as follows: A jar was nearly filled with H_2O and fitted with a 2-holed lid. One end of a tube (Tube B) was inserted through one of the holes and submerged. The other end of Tube B was placed in an empty graduated cylinder. Another tube (Tube A) was inserted through the other hole in the lid. A certain solid substance was inserted into the other end of Tube A, and the substance was secured by a clamp. Tube A was then attached to a freshly opened bottle containing 355 mL of diet cola. The clamp was removed, releasing the substance into the diet cola. The foam that was produced traveled into the jar, and liquid was transferred into the cylinder. The mass of CO_2 produced was calculated based on the volume of liquid that was measured in the cylinder after foaming had ceased.

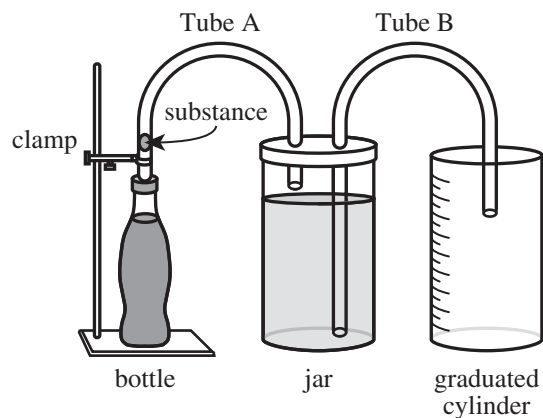


Figure 1

Experiment 1

In each of Trials 1–4, a different 1 of 4 substances of equal mass—a piece of chalk, a sugar cube, a fruit-flavored piece of candy, or a mint-flavored piece of candy—was added to a bottle of diet cola at 3°C . See Table 1.

Trial	Substance	Volume of liquid in cylinder (mL)	Mass of CO_2 produced (g)
1	chalk	699	1.36
2	sugar cube	570	1.11
3	fruit candy	525	1.02
4	mint candy	631	1.23

Experiment 2

In each of Trials 5–8, Trial 4 from Experiment 1 was repeated, except that the temperature of the diet cola was different in each trial. See Table 2.

Trial	Temperature ($^\circ\text{C}$)	Volume of liquid in cylinder (mL)	Mass of CO_2 produced (g)
5	10	598	1.13
6	25	539	0.969
7	45	501	0.844
8	60	476	0.766

Tables 1 and 2 adapted from Christopher J. Huber and Aaron M. Massari, "Quantifying the Soda Geyser." ©2014 by Division of Chemical Education, Inc., American Chemical Society.



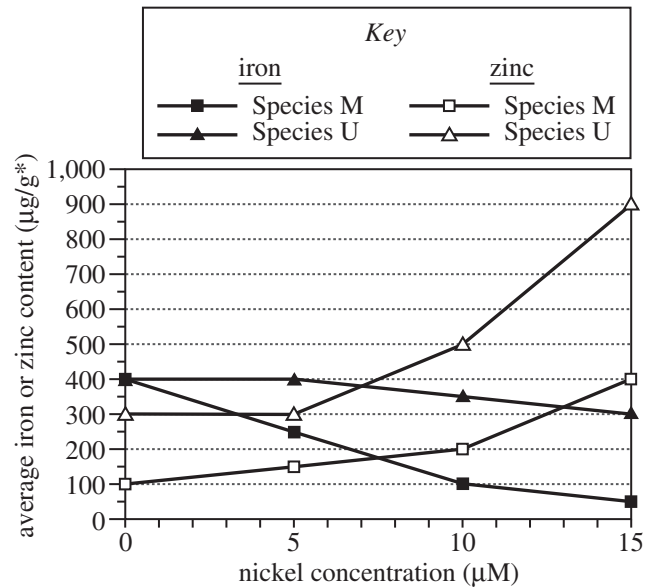
8. If another trial had been performed in Experiment 2 and 450 mL of liquid had been measured in the cylinder, the temperature of the diet cola in this trial would most likely have been:
- F. less than 25°C.
 - G. between 25°C and 45°C.
 - H. between 45°C and 60°C.
 - J. greater than 60°C.
9. Suppose Trial 6 had been repeated, but the bottle of diet cola had been opened and then left undisturbed at 25°C for 12 hours *before* it was attached to the apparatus. Would the mass of CO₂ produced in this trial likely be greater than 0.969 g or less than 0.969 g ?
- A. Greater, because over the 12 hours, the concentration of CO₂ in the diet cola would have decreased.
 - B. Greater, because over the 12 hours, the concentration of CO₂ in the diet cola would have increased.
 - C. Less, because over the 12 hours, the concentration of CO₂ in the diet cola would have decreased.
 - D. Less, because over the 12 hours, the concentration of CO₂ in the diet cola would have increased.
10. One *millimole* (mmol) of CO₂ has a mass of 0.044 g. How many trials resulted in the production of at least 1 mmol of CO₂ ?
- F. 1
 - G. 4
 - H. 5
 - J. 8
11. According to Figure 1, which of Tube A and Tube B, if either, had at least one end submerged in a liquid before the clamp was removed?
- A. Tube A only
 - B. Tube B only
 - C. Both Tube A and Tube B
 - D. Neither Tube A nor Tube B
12. Is the relationship between the volume of liquid in the cylinder at the end of the experiment and the mass of CO₂ produced a direct relationship or an inverse relationship?
- F. Direct; as the volume of liquid that was measured in the cylinder increased, the mass of CO₂ produced increased.
 - G. Direct; as the volume of liquid that was measured in the cylinder increased, the mass of CO₂ produced decreased.
 - H. Inverse; as the volume of liquid that was measured in the cylinder increased, the mass of CO₂ produced increased.
 - J. Inverse; as the volume of liquid that was measured in the cylinder increased, the mass of CO₂ produced decreased.
13. Consider these steps that were performed in each trial.
1. Removing clamp
 2. Measuring liquid in cylinder
 3. Inserting a solid substance into Tube A
 4. Attaching Tube A to a bottle of diet cola
- According to the procedure, these steps were performed in what sequence?
- A. 3, 1, 2, 4
 - B. 3, 4, 1, 2
 - C. 4, 2, 3, 1
 - D. 4, 3, 1, 2
14. Assume that *room temperature* is 25°C. In how many trials was the diet cola tested at a temperature *lower* than room temperature?
- F. 1
 - G. 2
 - H. 5
 - J. 8

Passage III

Scientists studied the effects of pH and of nickel concentration on plant growth and on the uptake of iron and zinc by plants. Recently germinated seedlings of Species M and Species U were fed 1 of 12 nutrient solutions (Solutions 1–12) for 8 days and then were harvested. Solutions 1–12 differed only in pH and/or nickel concentration. Table 1 shows, for each species, the average dry mass of the plants that were fed each nutrient solution. Figure 1 shows, for each species, the average iron content and the average zinc content of the plants that were fed Solutions 1–4.

Solution	pH	Nickel concentration (μM^*)	Average dry mass (g) of plants of Species:	
			M	U
1	7	0	33.9	10.7
2	7	5	28.8	10.7
3	7	10	23.8	9.6
4	7	15	18.7	8.5
5	6	0	33.9	9.2
6	6	5	28.8	9.2
7	6	10	23.8	8.1
8	6	15	18.7	7.0
9	5	0	27.8	7.7
10	5	5	22.7	7.7
11	5	10	17.6	6.6
12	5	15	12.4	5.4

* μM = micromoles per liter



* $\mu\text{g/g}$ = micrograms of iron or zinc per gram of plant dry mass

Figure 1

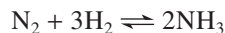
15. According to Figure 1, as the nickel concentration in the nutrient solutions increased, the average iron content of Species M plants:
- increased only.
 - decreased only.
 - increased, then decreased.
 - decreased, then increased.



16. According to Table 1, the Species U plants that were fed the solution that had a pH of 6 and a nickel concentration of $10 \mu\text{M}$ had an average dry mass of:
- F. 7.0 g.
 G. 8.1 g.
 H. 9.2 g.
 J. 23.8 g.
17. According to Table 1, Species M plants that were fed a nutrient solution with which of the following combinations of pH and nickel concentration had the greatest average dry mass?
- | | <u>pH</u> | <u>nickel concentration</u> |
|----|-----------|-----------------------------|
| A. | 6 | $0 \mu\text{M}$ |
| B. | 6 | $5 \mu\text{M}$ |
| C. | 5 | $0 \mu\text{M}$ |
| D. | 5 | $5 \mu\text{M}$ |
18. According to Table 1 and Figure 1, the Species M plants that were fed Solution 3 had an average zinc content of:
- F. $100 \mu\text{g/g}$.
 G. $150 \mu\text{g/g}$.
 H. $200 \mu\text{g/g}$.
 J. $400 \mu\text{g/g}$.
19. According to Table 1 and Figure 1, for the Species M plants that were fed Solutions 1–4, what was the order of the nutrient solutions, from the solution that resulted in the lowest average iron content to the solution that resulted in the highest average iron content?
- A. 1, 2, 3, 4
 B. 1, 4, 3, 2
 C. 4, 2, 1, 3
 D. 4, 3, 2, 1
20. According to Table 1, compared to the average dry mass of Species U plants that were fed Solution 3, the average dry mass of Species M plants that were fed Solution 6 was approximately:
- F. $\frac{1}{3}$ as great.
 G. $\frac{1}{2}$ as great.
 H. 2 times as great.
 J. 3 times as great.

**Passage IV**

Ammonia (NH_3) can be produced according to the chemical equation



The *equilibrium arrow* (\rightleftharpoons) indicates that this reaction proceeds in both directions until it is at *equilibrium*, so that both the forward reaction (production of NH_3) and the backward reaction (production of N_2 and H_2) occur at the same rate. Equilibrium can be shifted forward or backward by changing the temperature, pressure, or concentration of reactants or products.

Two experiments were done using the following apparatus to produce NH_3 .

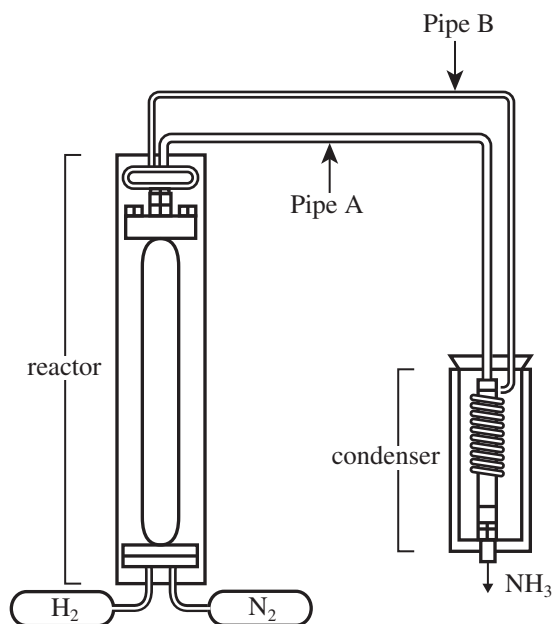


diagram of apparatus

In each trial, Steps 1–4 occurred:

1. A fresh catalyst (Catalyst W, X, Y, or Z), 160 kg of H_2 , and 745 kg of N_2 were placed in the reactor.
2. The H_2 and N_2 reacted at a constant temperature and a constant pressure until equilibrium was established.
3. A mixture of NH_3 and any unreacted H_2 and N_2 flowed through Pipe A to a -50°C condenser at 1 atmosphere (atm) of pressure.
4. NH_3 condensed and exited the apparatus. (H_2 and N_2 do not condense at -50°C .) Any unreacted H_2 and N_2 flowed into Pipe B, returning to the reactor.

Steps 2–4 reoccurred in cycles until no more H_2 and N_2 returned from the condenser.

Experiment 1

A set of 9 trials was conducted with each of the 4 catalysts. For each set, the pressure was 150 atm; within each set, the temperature was different for each trial. Figure 1 shows, for each trial, the number of cycles of Steps 2–4.

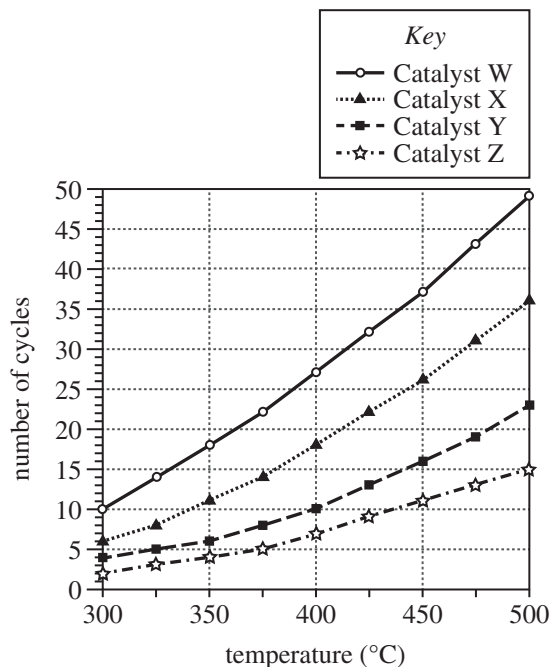


Figure 1

Experiment 2

Four sets of 9 trials each were conducted with Catalyst Z. For each set, the temperature was different; within each set, the pressure was different for each trial. Figure 2 shows, for each trial, the amount of NH_3 produced in the first cycle of Steps 2–4.

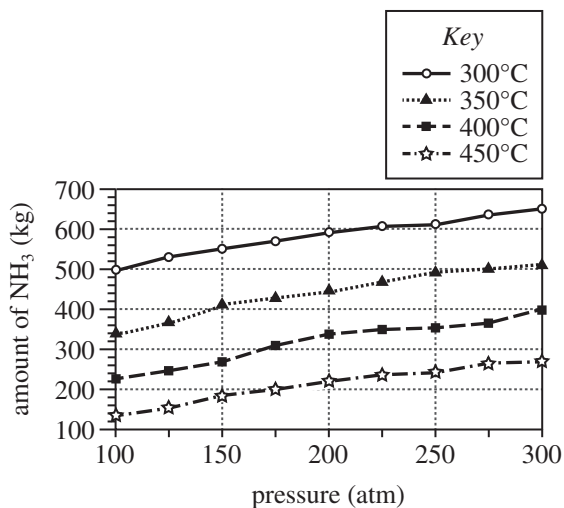
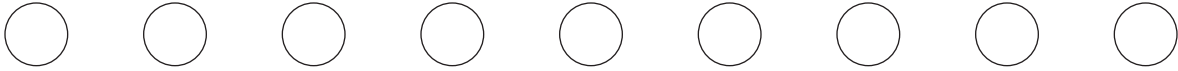


Figure 2



Diagram and figures adapted from Jayant M. Modak, "Haber Process for Ammonia Synthesis." ©2002 by Indian Academy of Sciences.

21. According to the results of Experiment 1, for any given catalyst, as the temperature was increased, the number of cycles needed to complete the reaction:
- increased only.
 - decreased only.
 - increased, then decreased.
 - decreased, then increased.
22. In Experiment 1, 26 cycles were needed to complete the reaction at 450°C when which catalyst was used?
- Catalyst W
 - Catalyst X
 - Catalyst Y
 - Catalyst Z
23. The movement of H₂ and N₂ through the apparatus as Steps 1–4 occurred is best represented by which of the following expressions?
- Reactor → condenser → Pipe A → Pipe B
 - Condenser → reactor → Pipe A → Pipe B
 - Reactor → Pipe A → condenser → Pipe B
 - Condenser → Pipe A → reactor → Pipe B
24. Consider the results of Experiment 1 for 375°C. All the H₂ and N₂ were consumed in less than 20 cycles when which catalysts were used?
- Catalysts W and X only
 - Catalysts Y and Z only
 - Catalysts W, X, and Y only
 - Catalysts X, Y, and Z only
25. If a trial had been performed in Experiment 2 at 425°C and 225 atm, the amount of NH₃ produced would most likely have been:
- less than 230 kg.
 - between 230 kg and 320 kg.
 - between 320 kg and 410 kg.
 - greater than 410 kg.
26. At 1 atm of pressure, the melting point of NH₃ is –77°C and the boiling point of NH₃ is –33°C. Based on this information and the description of the apparatus, when the NH₃ exited the condenser, was it more likely a solid or a liquid?
- Solid, because the temperature of the condenser was lower than the melting point of NH₃ and the boiling point of NH₃.
 - Solid, because the temperature of the condenser was between the melting point of NH₃ and the boiling point of NH₃.
 - Liquid, because the temperature of the condenser was higher than the melting point of NH₃ and the boiling point of NH₃.
 - Liquid, because the temperature of the condenser was between the melting point of NH₃ and the boiling point of NH₃.
27. Consider the trial in Experiment 2 that produced 550 kg of NH₃. Based on Figure 1, the number of cycles that were needed to complete the reaction in this trial was most likely:
- less than 5.
 - between 5 and 10.
 - between 10 and 15.
 - greater than 15.



Passage V

As a sound wave travels through a medium, the wave becomes *attenuated* (loses energy). The attenuation coefficient, α , is the rate at which the wave's *intensity level* (a measure of sound volume) decreases with distance as a result of this energy loss; the greater the value of α , the greater the decrease in intensity level with distance. Figure 1 shows, for waves of 3 different frequencies (in hertz, Hz), how α (in decibels per kilometer, dB/km) varies with temperature in air at 10% relative humidity.

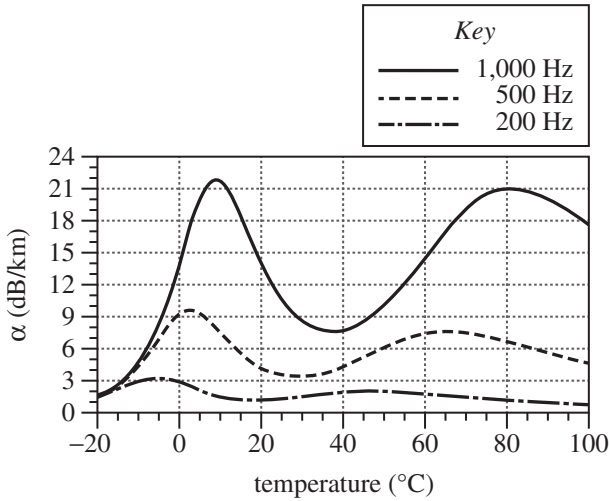


Figure 1

Figure 2 shows, for waves of 3 different frequencies, how α varies with relative humidity in air at 20°C.

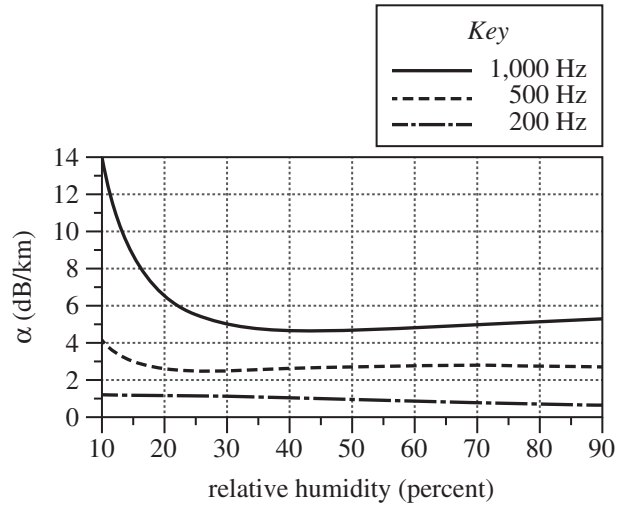


Figure 2

Figures adapted from Richard Lord, "Calculation of Absorption of Sound by the Atmosphere." ©2004 National Physical Laboratory.



28. What is the approximate maximum α shown in Figure 1 for a 200 Hz sound wave in air at 10% relative humidity, and at approximately what temperature does that maximum occur?

	α (dB/km)	temperature ($^{\circ}\text{C}$)
F.	3.0	-5
G.	3.0	35
H.	9.5	-5
J.	9.5	35

29. Based on Figure 2, the attenuation coefficient for a 1,000 Hz sound wave in air at 20°C reaches a *minimum* value at a relative humidity closest to which of the following?

- A. 25%
B. 45%
C. 65%
D. 85%

30. For the range of temperatures and the range of relative humidities shown in Figures 1 and 2, respectively, is α for a 200 Hz sound wave more strongly affected by changes in temperature or by changes in relative humidity?

- F. Temperature, because the maximum variation in α is about 0.5 dB/km in Figure 1 but about 2.5 dB/km in Figure 2.
G. Temperature, because the maximum variation in α is about 2.5 dB/km in Figure 1 but about 0.5 dB/km in Figure 2.
H. Relative humidity, because the maximum variation in α is about 0.5 dB/km in Figure 1 but about 2.5 dB/km in Figure 2.
J. Relative humidity, because the maximum variation in α is about 2.5 dB/km in Figure 1 but about 0.5 dB/km in Figure 2.

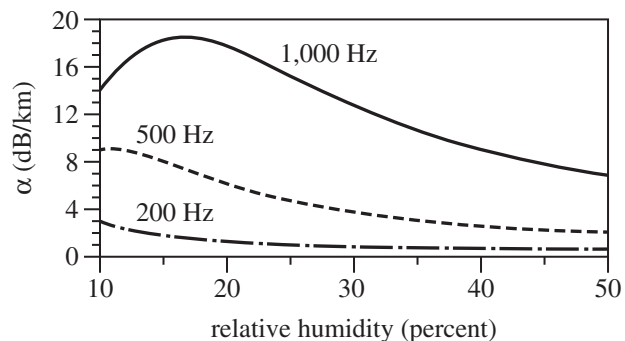
31. Consider a 1,000 Hz sound wave in air at 10% relative humidity. At how many of the temperatures shown in Figure 1 does α for this wave have a value of 18 dB/km?

- A. 2
B. 3
C. 4
D. 5

32. Suppose that 2 sound waves—a 150 Hz wave and a 1,100 Hz wave—are simultaneously emitted from a speaker into air at 20°C and 45% relative humidity. Based on Figure 2, as the waves travel away from the speaker, the intensity level of which wave will more likely decrease at the greater rate due to attenuation?

- F. The 150 Hz wave, because the value of α is lesser for the 150 Hz wave than for the 1,100 Hz wave.
G. The 150 Hz wave, because the value of α is greater for the 150 Hz wave than for the 1,100 Hz wave.
H. The 1,100 Hz wave, because the value of α is lesser for the 1,100 Hz wave than for the 150 Hz wave.
J. The 1,100 Hz wave, because the value of α is greater for the 1,100 Hz wave than for the 150 Hz wave.

33. The graph below shows, for sound waves of 3 different frequencies, how α varies with relative humidity in air at a particular temperature.



Based on Figure 1, the particular air temperature is most likely which of the following?

- A. -20°C
B. 0°C
C. 20°C
D. 100°C

**Passage VI**

Three studies compared the effects of 5 sweeteners (Sweeteners Q–U) on food consumption by rats and on the concentrations of *leptin* and *ghrelin* (hormones that regulate appetite) in the blood of rats. Sweeteners Q–U differ only in the percent by mass of fructose and of glucose (see Table 1).

Sweetener	Percent by mass of:	
	fructose	glucose
Q	0	100
R	42	58
S	50	50
T	55	45
U	100	0

Study 1

Each of 5 groups (Groups 1–5) of rats was assigned a solution having a 100 g/L concentration of 1 of the 5 sweeteners. Each rat was placed in a separate cage and provided unlimited access to the assigned sweetener solution and to solid food for 56 days. Table 2 shows, for each group, the amounts of sweetener solution and solid food consumed per rat per day. On Day 56, blood was collected from each rat for analysis in Studies 2 and 3.

Group	Sweetener	Amount consumed per rat per day	
		sweetener solution (mL)	solid food (g)
1	Q	73	9
2	R	55	14
3	S	52	16
4	T	48	18
5	U	29	23

Table 2 adapted from Heather R. Light et al., “The Type of Caloric Sweetener Added to Water Influences Weight Gain, Fat Mass, and Reproduction in Growing Sprague-Dawley Female Rats.” ©2009 by the Society for Experimental Biology and Medicine.

Study 2

A 1 mL blood sample from each rat was placed in a separate test tube containing 0.2 mL of *Indicator N* (which reacts with leptin to form a blue dye). The concentration of blue dye in each tube was directly proportional to the leptin concentration in the blood sample. Table 3 shows the leptin concentration per sample for each group.

Group	Sweetener	Leptin concentration per sample (pM*)
1	Q	804
2	R	622
3	S	553
4	T	475
5	U	251

*picomolar

Study 3

Study 2 was repeated, except that *Indicator P* (which reacts with ghrelin to form a yellow dye) was used instead of *Indicator N*. The concentration of yellow dye in each tube was directly proportional to the ghrelin concentration in the blood sample (see Table 4).

Group	Sweetener	Ghrelin concentration per sample (pM)
1	Q	852
2	R	1,125
3	S	1,279
4	T	1,450
5	U	1,758

Tables 3 and 4 adapted from Andreas Lindqvist, Annemie Baelemans, and Charlotte Erlanson-Albertsson, “Effects of Sucrose, Glucose and Fructose on Peripheral and Central Appetite Signals.” ©2008 by Elsevier B.V.



34. In Study 1, as the ratio of fructose to glucose in the sweetener solutions increased, the amount of sweetener solution consumed per rat per day:
- F. increased only.
 - G. decreased only.
 - H. increased and then decreased.
 - J. decreased and then increased.
35. In Study 1, the amount of sweetener solution consumed daily by each rat could be measured because which of the following steps had been taken?
- A. The rats' access to solid food had been restricted.
 - B. The rats' access to solid food had not been restricted.
 - C. The rats had been placed in the same cage.
 - D. The rats had been placed in separate cages.
36. Suppose that a sweetener composed of 46% fructose and 54% glucose by mass had been tested in Study 1. Based on Table 1 and the results of Study 3, the ghrelin concentration per sample would most likely have been:
- F. less than 852 pM.
 - G. between 852 pM and 1,125 pM.
 - H. between 1,125 pM and 1,279 pM.
 - J. greater than 1,279 pM.
37. Consider the claim "The group of rats that consumed the lowest amount of solid food per rat per day was also the group that had the lowest concentration of leptin per sample." Do the results of Studies 1 and 2 support this claim?
- A. Yes; the rats in Group 1 consumed the lowest amount of solid food per rat per day and also had the lowest concentration of leptin per sample.
 - B. Yes; the rats in Group 5 consumed the lowest amount of solid food per rat per day and also had the lowest concentration of leptin per sample.
 - C. No; the rats in Group 1 consumed the lowest amount of solid food per rat per day, but the rats in Group 5 had the lowest concentration of leptin per sample.
 - D. No; the rats in Group 5 consumed the lowest amount of solid food per rat per day, but the rats in Group 1 had the lowest concentration of leptin per sample.
38. Which of the following groups of rats should have been included in Study 1 to serve as a control for the effect of consuming a sweetener solution on the consumption of solid food by rats? A group of rats that had access:
- F. only to water.
 - G. only to solid food.
 - H. only to water and solid food.
 - J. to neither water nor solid food.
39. Consider the sweetener that resulted in a solid food consumption of 16 g per rat per day in Study 1. Based on Table 1, how many grams of fructose would be present in 200 g of this sweetener?
- A. 50 g
 - B. 100 g
 - C. 150 g
 - D. 200 g
40. The experimental designs of Studies 2 and 3 were identical with respect to which of the factors listed below, if either?
- I. The chemical indicator that was used
 - II. The hormone with which the chemical indicator reacted
- F. I only
 - G. II only
 - H. Both I and II
 - J. Neither I nor II

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.

Test 2: Mathematics—Scoring Key

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

Key	Reporting Category*						
	PHM					IES	MDL
	N	A	F	G	S		
31. B	—						—
32. K							—
33. D							—
34. F				—			
35. E							—
36. J							—
37. C						—	
38. F						—	
39. D	—						
40. K				—			
41. A		—					
42. J			—				
43. D						—	
44. G		—					—
45. E		—					
46. F							—
47. D						—	
48. G						—	
49. D			—				
50. K			—				
51. D							—
52. K							—
53. A			—				
54. G							—
55. B	—						
56. K		—					
57. D							—
58. K			—				
59. B				—			—
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)	_____ (24)

Test 3: Reading—Scoring Key

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

Key	Reporting Category*		
	KID	CS	IKI
21. B			
22. F			
23. C			
24. J			
25. A			
26. J			
27. B			
28. G			
29. C			
30. F			
31. C			
32. G			
33. A			
34. J			
35. C			
36. F			
37. D			
38. G			
39. C			
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)	_____ (12)
Integration of Knowledge & Ideas (IKI)	_____ (5)
Total Number Correct for Reading Test (KID + CS + IKI)	_____ (40)

Test 4: Science—Scoring Key

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

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

***Reporting Categories**

IOD = Interpretation of Data

SIN = Scientific Investigation

EMI = Evaluation of Models,
Inferences & Experimental Results

Number Correct (Raw Score) for:	
Interpretation of Data (IOD)	_____ (18)
Scientific Investigation (SIN)	_____ (12)
Evaluation of Models, Inferences & Experimental Results (EMI)	_____ (10)
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 Z04	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	72-75	58-60	39-40	38-40	36
35	70-71	56-57	38	37	35
34	68-69	54-55	37	36	34
33	67	53	35-36	35	33
32	66	51-52	34	34	32
31	65	49-50	33	—	31
30	64	48	—	33	30
29	62-63	46-47	32	32	29
28	61	44-45	31	31	28
27	60	41-43	30	—	27
26	58-59	39-40	29	30	26
25	56-57	37-38	28	28-29	25
24	53-55	35-36	27	26-27	24
23	51-52	33-34	26	25	23
22	48-50	31-32	24-25	23-24	22
21	45-47	30	23	22	21
20	42-44	28-29	21-22	20-21	20
19	40-41	26-27	20	19	19
18	38-39	24-25	19	17-18	18
17	36-37	21-23	17-18	15-16	17
16	33-35	17-20	16	13-14	16
15	30-32	13-16	14-15	12	15
14	27-29	10-12	12-13	11	14
13	25-26	8-9	11	10	13
12	23-24	6-7	9-10	9	12
11	19-22	5	7-8	8	11
10	16-18	4	6	7	10
9	13-15	—	5	6	9
8	11-12	3	—	5	8
7	9-10	—	4	4	7
6	7-8	2	3	3	6
5	6	—	—	—	5
4	4-5	1	2	2	4
3	3	—	—	1	3
2	2	—	1	—	2
1	0-1	0	0	0	1