Math/Science
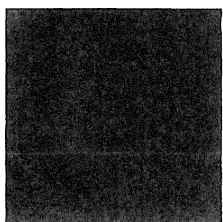# Version

Form D03

(December 2020)

ACT® 2020 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.

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1. Which of the following expressions is equivalent to the expression below?

$$-7(5a - b) + 3(-8b + a)$$

   A. $-38a - 31b$
   B. $-34a - 25b$
   C. $-34a - 17b$
   D. $-32a - 25b$
   E. $-32a - 17b$

2. For Bill's birthday party, his parents will pay \$35 for the cake plus \$15 per person for catering expenses. They will spend *at most* a total of \$300 for his party. The greatest integer in the solution set of one of the following inequalities gives the maximum number of people, p, who can attend the party. Which one?

   F. $p + 50 \geq 300$
   G. $p(15p + 35) \geq 300$
   H. $(35 + 15)p \leq 300$
   J. $15p \leq 300$
   K. $15p + 35 \leq 300$

3. The number 312.8 is 34% of x. What is the value of x rounded to the nearest whole number?

   A.   9
   B.   11
   C.   106
   D.   920
   E.   10,635

4. For $\overleftrightarrow{RT}$ shown below, point S is on $\overline{RT}$, the length of $\overline{RS}$ is 8 cm, and the length of $\overline{ST}$ is 18 cm. What is the distance, in centimeters, between T and the midpoint of $\overline{RS}$?

   R   8   S   18   T
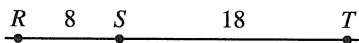
   F.   13
   G.   17
   H.   18
   J.   22
   K.   26

DO YOUR FIGURING HERE.

DO YOUR FIGURING HERE.

5. A certain committee is composed of 9 juniors and 11 seniors. Two different members of the committee will be randomly selected for 2 different leadership roles. Given that the 1st member who will be selected is a senior, what is the probability that the 2nd member who will be selected is a junior?

A. $\frac{9}{19}$

B. $\frac{9}{20}$

C. $\frac{10}{19}$

D. $\frac{10}{20}$

E. $\frac{11}{20}$

6. What is the least common multiple of 60, 70, and 90 ?
   F. 60
   G. 220
   H. 630
   J. 1,260
   K. 378,000

7. The Newton High School girls' softball team currently has a record of 8 wins, 5 losses, and 0 ties. What is the *least* number of its remaining 10 games the team must win to finish the season winning *more than* 50% of all the team's games?
   A. 3
   B. 4
   C. 5
   D. 6
   E. 7

8. For what value of x is $2(x - 12) + x = 24$ true?
   F. 0
   G. 4
   H. 12
   J. 16
   K. 24

9. The principal of Lowe High School (LHS) authorized a study to estimate the percent of the LHS student population that will attend a 4-year college after graduation. LHS students in honors courses were asked about their postgraduation plans, and their responses were recorded. Students in other courses were NOT included in the study. Which of the following phrases best describes the principal's study?

   A. Randomized census
   B. Randomized experiment
   C. Nonrandomized experiment
   D. Randomized sample survey
   E. Nonrandomized sample survey

15

GO ON TO THE NEXT PAGE.

10. Triangles $\triangle ABC$ and $\triangle A'B'C'$ are graphed in the standard (x,y) coordinate plane below.
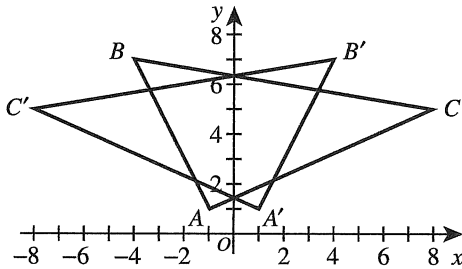
Triangle $\triangle A'B'C'$ is the image of $\triangle ABC$ under one of the following transformations. Which one?

F. 90° clockwise rotation about the origin
G. 90° counterclockwise rotation about the origin
H. Horizontal translation
J. Reflection across the x-axis
K. Reflection across the y-axis

11. Banu will build a fence around a rectangular 30-foot-by-25-foot play area. Given that fencing costs $4.05 per foot, how much will the fencing cost for Banu to completely surround the play area?

A. $445.50
B. $344.25
C. $324.00
D. $268.00
E. $222.75

12. The diagonal of a rectangular flat television screen is 26.0 inches. The width of the screen is 22.7 inches, and the height of the screen is 10.0 inches less than the width of the screen. Which of the following is closest to the area, in square inches, of the television screen?

F. 144
G. 165
H. 288
J. 330
K. 590

13. For all $a \neq 0$, $\dfrac{a^8}{a^4}$ is equivalent to:

A. 1
B. a^2
C. a^4
D. a^{12}
E. a^{32}

DO YOUR FIGURING HERE.

14. An ellipse with a major axis of length 6 inches and a minor axis of length 4 inches is inscribed in a rectangle, as shown below. The region inside the rectangle but outside the ellipse is shaded. What is the area, in square inches, of the shaded region?
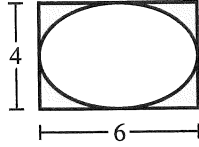
(Note: The area, A, of any ellipse can be found by the formula $A = \pi ab$ where a is $\frac{1}{2}$ the length of the major axis and b is $\frac{1}{2}$ the length of the minor axis.)

F. $24 - 24\pi$
G. $24 - 12\pi$
H. $24 - 6\pi$
J. 6π
K. $24 + 6\pi$

15. Given $2x - \sqrt{3} = 6$, what is the value of x ?

A. $3 - \frac{\sqrt{3}}{2}$

B. $3 - \sqrt{3}$

C. $3 + \frac{\sqrt{3}}{2}$

D. $3 + \sqrt{3}$

E. $4 + \sqrt{3}$

16. What is the largest possible product for 2 even integers whose sum is 18 ?
F. 11
G. 19
H. 77
J. 80
K. 81

17. Juanita walked from her home to the bakery, first walking 0.3 miles due east and then 0.4 miles due north. What is the straight-line distance, in miles, from the bakery to Juanita's home?
A. 0.1
B. 0.2
C. 0.3
D. 0.5
E. 0.7

ACT-D03

17

GO ON TO THE NEXT PAGE.

18. $\begin{bmatrix} 10 & -13 \\ -8 & 11 \end{bmatrix} - \begin{bmatrix} -9 & -17 \\ -8 & 14 \end{bmatrix} = ?$

DO YOUR FIGURING HERE.

    F. $\begin{bmatrix} -3 & 26 \\ 3 & -6 \end{bmatrix}$

    G. $\begin{bmatrix} 1 & -30 \\ -16 & -3 \end{bmatrix}$

    H. $\begin{bmatrix} 1 & -30 \\ -16 & 25 \end{bmatrix}$

    J. $\begin{bmatrix} 2 & -2 \\ 17 & 3 \end{bmatrix}$

    K. $\begin{bmatrix} 19 & 4 \\ 0 & -3 \end{bmatrix}$

19. The line with equation $2x + 5y = 9$ is graphed in the standard (x,y) coordinate plane. What is the slope of the line?

    A. $-\dfrac{5}{2}$

    B. $-\dfrac{2}{5}$

    C. $\dfrac{2}{5}$

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

    E. 2

20. Yolanda is calculating the weekly payroll for her small business. One employee earns $7.20 per hour and has worked 4 days this week: $9\frac{1}{4}$ hours the first day, 8 hours the second day, $6\frac{3}{4}$ hours the third day, and $7\frac{1}{2}$ hours the fourth day. Which of the following is the employee's pay for this week, before any deductions are made?

    F. $226.80
    G. $225.00
    H. $219.60
    J. $131.40
    K. $ 38.70

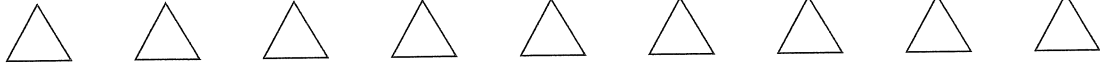21. What is the (x,y) solution, if one exists, to the system of equations $y = 2x + 6$ and $6x + 12 = 3y$?
    A. $(-3,0)$
    B. $(-2,0)$
    C. $(0,4)$
    D. $(0,6)$
    E. There is no solution to this system.

22. Sets A, B, and C are defined below.

$$A = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$$
$$B = \{2, 4, 6, 8\}$$
$$C = \{4, 8\}$$

A number will be randomly selected from A. What is the probability that the selected number will be an element of C *and* an element of B ?

F. $\frac{1}{9}$

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

H. $\frac{4}{9}$

J. $\frac{6}{9}$

K. 1

23. Maranda is going to a leadership conference and was given the map below to guide her to the Conference Center. The map has no scale, but she knows that the distance between Exits 77 and 79 on Interstate 29 is 2 miles. On the map, this distance is $\frac{3}{4}$ of an inch. She plans to exit Interstate 29 at Exit 77, travel on 41st Street to Cliff Avenue, and then proceed on Cliff Avenue to the Conference Center. The distance on the map from Exit 77 to the Conference Center over this route is $3\frac{3}{8}$ inches. What is this distance, in miles?

A. 4
B. 5
C. 9
D. 12
E. 18

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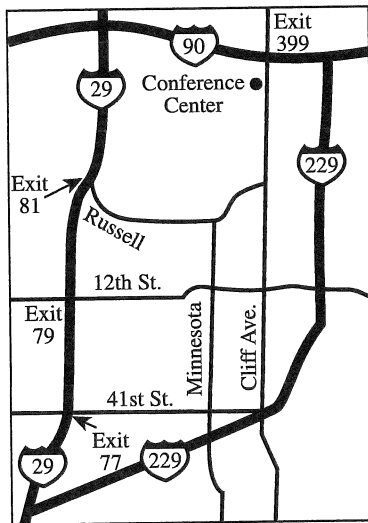
24. The histogram below shows the results of a survey of 100 people. Each person identified the number of hours per week that they watch TV. How many people surveyed watch TV at least 4 hours per week?

[0, 2) [2, 4) [4, 6) [6, 8) [8, 10)

number of hours
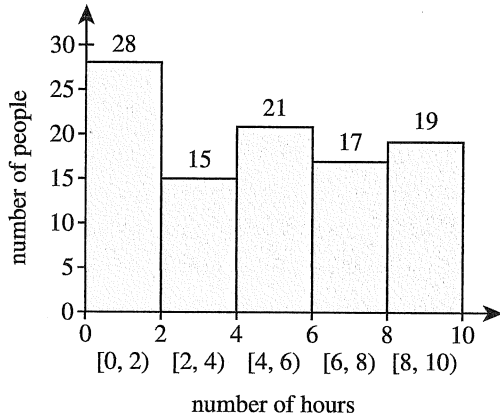
- **F.** 57
- **G.** 38
- **H.** 28
- **J.** 21
- **K.** 19

25. Each side of a square is 4 cm long. One vertex of the square is at (6,2) on a square coordinate grid marked in centimeter units. Which of the following points on the grid could be another vertex of the square?

- **A.** (10, 2)
- **B.** (7, 3)
- **C.** (2, 5)
- **D.** (1,−5)
- **E.** (−4, 2)

26. An outlier is added to the data set below. Which of the following pairs of statistics has no change in value as a result of the addition of the outlier?

$$\{60, 63, 66, 70, 72, 72, 73, 73, 73, 75\}$$

- **F.** Mean and median
- **G.** Mean and mode
- **H.** Mean and range
- **J.** Median and mode
- **K.** Median and range

27. Given that $\angle R$ is the included angle between the 2 congruent sides of the isosceles triangle $\triangle RST$, and the measure of $\angle R$ is 50°, what is the measure of $\angle S$?

- **A.** 20°
- **B.** 50°
- **C.** 65°
- **D.** 80°
- **E.** 130°

DO YOUR FIGURING HERE.

28. In the standard (x,y) coordinate plane, what is the distance, in coordinate units, from $A\left(5\frac{1}{3},-3\right)$ to $B\left(-1\frac{5}{9},-3\right)$?

   F. $\frac{8}{9}$

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

   H. $3\frac{7}{9}$

   J. $6\frac{8}{9}$

   K. $12\frac{8}{9}$

29. Hikers' World Foods sells raisin-nut mix in bulk to stores. The dollar amount *per pound*, $P(x)$, for a store to purchase x pounds of raisin-nut mix from Hikers' World is given by the function below.
$$P(x) = 3.50 + 0.90^x$$
   To the nearest \$0.01, which of the following dollar values is equal to the total price for a store to purchase 100 pounds of raisin-nut mix in a single order from Hikers' World?

   A. \$350.00
   B. \$359.00
   C. \$440.00
   D. \$616.00
   E. \$903.50

30. In right triangle $\triangle ABC$ shown below, $\sin C = \frac{5}{7}$ and the length of $\overline{AB}$ is 14 inches. What is the length, in inches, of $\overline{AC}$?

   F. $\sqrt{24}$
   G. $\sqrt{74}$
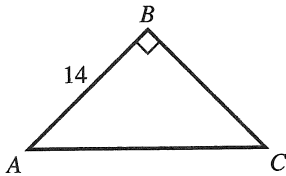   H. 10
   J. 19.6
   K. 24

31. The 1st term of a geometric sequence is 27, and the 4th term is 64. In terms of n, what is the nth term of the sequence?

   A. $27\left(\frac{3}{4}\right)^{n-1}$

   B. $27\left(\frac{3}{4}\right)^{n}$

   C. $27\left(\frac{4}{3}\right)^{n-1}$

   D. $27\left(\frac{4}{3}\right)^{n}$

   E. $27\left(\frac{4}{3}\right)n$

21

GO ON TO THE NEXT PAGE.

32. A series of transformations are applied to the graph in the standard (x,y) coordinate plane below. The graph below is reflected across the x-axis. The new graph is reflected across the y-axis. This new graph is rotated 90° clockwise ($\circlearrowright$) about the origin.
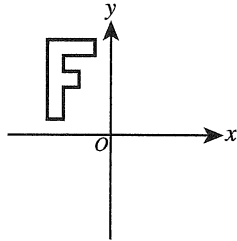
DO YOUR FIGURING HERE.

The resulting graph is one of the following graphs. Which one?

F.
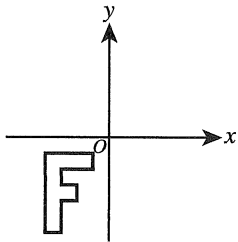
J.
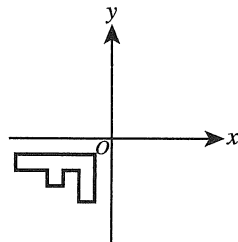
G.
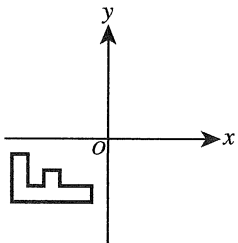
K.
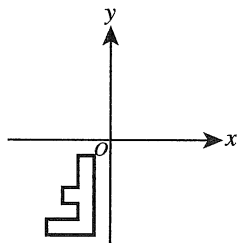
H.
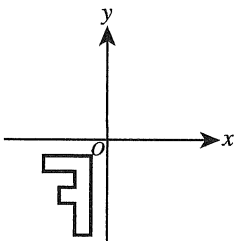
33. What is the least positive number that has a remainder of 3 when divided by 6 and a remainder of 6 when divided by 9 ?

A. 15
B. 18
C. 24
D. 42
E. 72

34. What rational number is exactly halfway between $\frac{2}{8}$ and $\frac{6}{14}$ on the real number line?

F. $\frac{2}{11}$

G. $\frac{19}{14}$

H. $\frac{19}{28}$

J. $\frac{5}{56}$

K. $\frac{19}{56}$

35. On a certain day in Katie's yard, the average rate of change in temperature per hour between 1 p.m. and 11 p.m. was −2°F per hour. The temperature in Katie's yard at 11 p.m. that day was 42°F. Which of the following was the temperature in Katie's yard at 1 p.m. that day?

A. 14°F
B. 22°F
C. 62°F
D. 64°F
E. 84°F

36. Given that i is the imaginary unit, which of the following complex numbers is equal to $(7 + 6i)^2$?

F. 13
G. 85
H. $13 + 84i$
J. $14 + 12i$
K. $85 + 84i$

37. Two motorcycles, starting at the same point at the same time, travel away from each other at a 90° angle. One travels at 40 miles per hour and the other at 60 miles per hour. If they continue traveling at these constant rates, after about how many hours will they be 200 miles apart?

A. 1.4
B. 2.8
C. 3.2
D. 7.7
E. 8.7

Use the following information to answer questions 38–40.

A website about birds made the 4 claims below about American robins.

1. The population of American robins in 2015 was 320 million.

2. The wingspans of all American robins can be fit to a normal distribution model that has a mean of 36.00 cm and a standard deviation of 2.50 cm.

3. The maximum reported flight speed for an American robin is 3,168 feet per minute.

4. A certain conservation organization will only consider American robins *threatened* if the total number of American robins declines by at least 30% over a 10-year period.

38. Suppose the population of American robins increased each year from 2005 to 2015. The conservation organization will consider American robins threatened provided that their population in 2025 is no greater than what number?

F.   960,000
G.   9,600,000
H.   22,400,000
J.   96,000,000
K. 224,000,000

39. The population of American robins in 2015 is equal to 3.2×10^k for some integer k. What is the value of k ?

A. −8
B. −7
C. 2
D. 7
E. 8

40. A certain robin flew for 15 seconds at the maximum reported flight speed cited by the website. Which of the following values is closest to the number of *meters* the robin flew during that time?

(Note: 1 meter ≈ 3.3 feet)

F. 64
G. 240
H. 697
J. 792
K. 960

41. Let x be a real number. Which of the following statements is true for all possible values of x ?

A. $-x < x$
B. $-x < |x|$
C. $x = |x|$
D. $|x| = |-x|$
E. $-|x| = |-x|$

42. In the standard (x,y) coordinate plane, the 3 distinct points $A(3,5)$, $B(6,8)$, and C are collinear, and B is equidistant from A and C. What are the coordinates of C ?

F. $(4,7)$
G. $(9,11)$
H. $(1.5,1.5)$
J. $(4.5,6.5)$
K. $(7.5,10.5)$

43. If $90° < \theta < 180°$ and $\sin \theta = \frac{8}{17}$, then $\cos \theta = ?$

A. $\frac{8}{15}$

B. $\frac{17}{8}$

C. $-\frac{17}{8}$

D. $-\frac{15}{17}$

E. $-\frac{17}{15}$

44. The mean of 10 numbers entered into a computer statistics program was 75.0. One number was incorrectly entered as 73 instead of 78. When the 73 is replaced by 78, by how much will the mean increase?

F. 0.1
G. 0.5
H. 1.5
J. 3.0
K. 5.0

45. At Mort's Sporting Goods Store, the sale price of a pair of athletic shoes is 30% off the regular price of the shoes. The sale price of the shoes is $84.00. What is the regular price of the shoes?

A. $ 54.00
B. $ 64.62
C. $109.20
D. $114.00
E. $120.00

Use the following information to answer questions 46–48.

Data from a random sample of 335 car owners in a certain city are listed below. The table indicates the number of owners in 3 age brackets (16–25, 26–45, 46–60) who own cars from 3 car companies (A, B, C) in this city. Each owner in the sample owns only 1 car.

Age (in years)	Car companies			
	A	B	C	Total
16–25	16	24	40	80
26–45	54	48	53	155
46–60	65	23	12	100
Total	135	95	105	335

46. Two car owners from this sample will be chosen at random. Given that no owner is chosen twice, which of the following expressions gives the probability that both owners chosen will be from the same age bracket?

F. $\dfrac{80(79)}{335(334)} + \dfrac{155(154)}{335(334)} + \dfrac{100(99)}{335(334)}$

G. $\dfrac{135(134)}{335(334)} + \dfrac{95(94)}{335(334)} + \dfrac{105(104)}{335(334)}$

H. $\dfrac{80}{335} + \dfrac{155}{335} + \dfrac{100}{335}$

J. $\dfrac{80}{335}\left(\dfrac{155}{334}\right)\left(\dfrac{100}{333}\right)$

K. $\dfrac{1}{3}\left(\dfrac{1}{3}\right)\left(\dfrac{1}{3}\right)$

47. For those in the sample who are 26 to 45 years old, which of the following values is closest to the average number of car owners per company?

A. 37
B. 45
C. 52
D. 112
E. 155

48. A circle graph will be drawn with 3 sectors each representing the proportion of owners from Company A, B, and C who are 16 to 25 years old. What is the measure of the central angle for the Company A sector of the graph?

F. 5°
G. 17°
H. 20°
J. 43°
K. 72°

DO YOUR FIGURING HERE.

49. The vertices of $\triangle PQR$ are given in the standard (x,y) coordinate plane below. What is the area, in square coordinate units, of $\triangle PQR$?
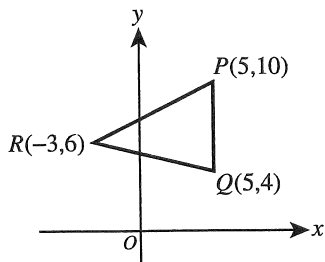
A. 24
B. 25
C. 30
D. 48
E. 50

50. The table below gives values of the functions f and g at different values of x. What is $f\big(g(1)\big)$?

F. −6
G. 1
H. 2
J. 3
K. 7

x	1	2	3
$f(x)$	3	−6	2
$g(x)$	2	7	1

51. Joe, Carmen, and Dave each receive an allowance. The ratio of Joe's allowance to Dave's allowance is 3:2, and the ratio of Dave's allowance to Carmen's allowance is 3:4. What is the ratio of Joe's allowance to Carmen's allowance?

A. 1:2
B. 1:6
C. 2:5
D. 3:4
E. 9:8

52. The figure below shows a flower bed consisting of 3 regions each bordered by garden edging. The edging forms 3 concentric circles with the distance between successive borders equal to the radius, r meters, of the smallest circle. The length of edging needed for the border of the smallest region is 10 meters. What is the total length, in meters, of edging needed for the borders of all 3 regions?
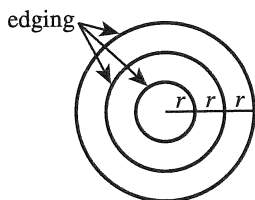
F. 30
G. 60
H. 90
J. 110
K. 140

53. If $\ln x = 2$, then $x = ?$

A. 1

B. $\dfrac{2}{e}$

C. $2e$

D. e

E. e^2

54. The first 4 elements of a pattern are shown below. Each element is composed of small squares that are 18 inches wide and 18 inches long. Each element is a square with both dimensions 18 inches less than the dimensions of the next element. What is the perimeter, in *feet*, of the 5th element?

F. 6
G. 7.5
H. 20
J. 25
K. 30
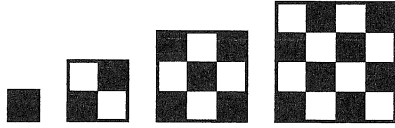
DO YOUR FIGURING HERE.

55. For all positive x, which of the following is equal to

$$2 + \frac{3x}{x+2} - \frac{6}{2x+4} \ ?$$

A. $\dfrac{5x+1}{x+2}$

B. $\dfrac{6x-6}{2x+4}$

C. $\dfrac{7x+2}{2x+4}$

D. $\dfrac{3x-4}{3x+6}$

E. $\dfrac{3x-4}{3x+7}$

56. In $\triangle ABC$ shown below, the given side lengths are in meters. Which of the following expressions gives the area, in square meters, of $\triangle ABC$?
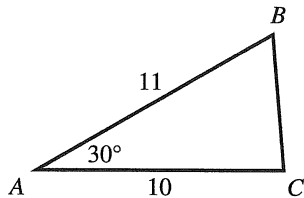
F. $\dfrac{1}{2}(11)(10)$

G. $\sqrt{10^2 + 11^2}$

H. $\dfrac{1}{2}(11)(10)(\cos 30°)$

J. $\dfrac{1}{2}(11)(10)(\sin 30°)$

K. $\sqrt{10^2 + 11^2 - 2(10)(11)(\cos 30°)}$

57. The simple interest for 1 year for an investment was $372. If the interest rate had been 1% higher for this investment, the simple interest for 1 year would have been $434. How much money was invested?

A. $ 62
B. $ 520
C. $ 620
D. $5,200
E. $6,200

58. For what values of b does the equation $x^2 + bx + 1 = 0$ have no real solutions?

   F. All $b < 0$
   G. All $b < 1$
   H. All $b < 2$
   J. $0 < b < 4$
   K. $-2 < b < 2$

DO YOUR FIGURING HERE.

59. In the standard (x,y) coordinate plane below, the endpoints of the major and minor axes of the ellipse are labeled. Which of the following equations determines the ellipse?
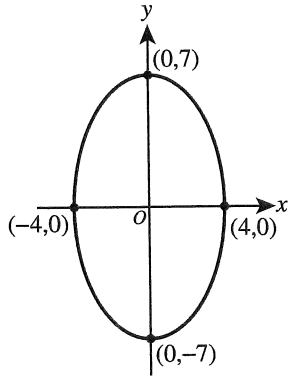
   A. $\dfrac{x^2}{4} + \dfrac{y^2}{7} = 1$

   B. $\dfrac{x^2}{8} + \dfrac{y^2}{14} = 1$

   C. $\dfrac{x^2}{16} + \dfrac{y^2}{49} = 1$

   D. $(x - 4)^2 + (y - 7)^2 = 1$

   E. $(x + 4)^2 + (y + 7)^2 = 1$

60. One root of the quadratic polynomial $ax^2 + 13x - 6$ is equal to -3. Which of the following binomials is a factor of $ax^2 + 13x - 6$?

   F. $x - \dfrac{2}{5}$

   G. $x + \dfrac{2}{5}$

   H. $x - 3$

   J. $x - 5$

   K. $x + 5$

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

Scientists conducted a study to examine the *caching* (storing food) and feeding behaviors of gray squirrels.

Prior to the study, acorns were collected from a park and sorted into types, first according to the species of tree they grew on—red oak, pin oak, or white oak—and then according to whether the acorn was undamaged, *infested* (contained insect larvae), or *shelled* (shell removed). Each acorn was stored at 2°C until the day it was to be used.

Study

The study was conducted over 75 consecutive autumn days. Beginning at the same time each morning, 225 acorns were placed, one at a time, at a given location in the park where the acorns had been collected. Each of the 9 acorn types was presented an equal number of times, and the order in which the acorns were presented was random. All the acorns were picked up by squirrels within 1 minute. Table 1 shows, for each acorn type, the percent of acorns that were cached, eaten, or *rejected* (dropped after being picked up) by the squirrels.

Table 1			
	Percent of acorns:		
Acorn type	cached	eaten	rejected
Undamaged red oak	52	44	4
Infested red oak	40	56	4
Shelled red oak	32	60	8
Undamaged pin oak	24	64	12
Infested pin oak	24	68	8
Shelled pin oak	20	64	16
Undamaged white oak	12	88	0
Infested white oak	24	76	0
Shelled white oak	20	76	4

In addition, for each red oak acorn that was not rejected, the average distance (including both horizontal and vertical) the squirrel traveled before caching or eating the acorn was determined (see Table 2).

Table 2		
	Average distance traveled (m) before:	
Acorn type	caching	eating
Undamaged red oak	11.4	22.2
Infested red oak	12.5	20.2
Shelled red oak	10.4	15.0

1. The study was most likely designed to answer which of the following questions about squirrel behavior?
   A. Does the presence of insect larvae in acorns increase the amount of protein consumed by squirrels?
   B. Are squirrels more likely to reject acorns that are infested or acorns that are shelled?
   C. Does the percent of acorns cached by squirrels vary from season to season?
   D. Are squirrels more likely to travel a greater distance during the morning or during the afternoon?

2. Which of the following factors was held constant during the study?
   F. Percent of acorns that were cached
   G. Time of day scientists began placing acorns at the park
   H. Order in which the acorn types were presented
   J. Distance a squirrel traveled before eating acorns
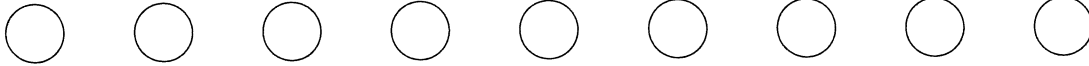
3. Which of the following statements about pin oak acorns is consistent with the results of the study?

   A. Shelled pin oak acorns were eaten more frequently than infested pin oak acorns.

   B. Shelled pin oak acorns were rejected less frequently than undamaged pin oak acorns.

   C. Undamaged pin oak acorns and infested pin oak acorns were cached 24% of the time.

   D. Undamaged pin oak acorns were cached 64% of the time, and infested pin oak acorns were cached 68% of the time.

4. According to Table 2, before eating shelled red oak acorns, the squirrels traveled an average distance of:

   F. 10.4 m.

   G. 11.4 m.

   H. 12.5 m.

   J. 15.0 m.

5. Which of the following statements comparing the distances squirrels traveled before eating infested acorns to the distances they traveled before caching infested acorns is supported by the results in Table 2 ? On average, the distance traveled before:

   A. eating was farther than the distance traveled before caching for infested red oak acorns.

   B. caching was farther than the distance traveled before eating for infested red oak acorns.

   C. eating was farther than the distance traveled before caching for infested white oak acorns.

   D. caching was farther than the distance traveled before eating for infested white oak acorns.

6. Assume that the more *perishable* (likely to decay) a given type of acorn, the more likely a squirrel is to eat that acorn rather than cache it. Consider the results in Table 1 for the shelled red oak acorns, infested pin oak acorns, and undamaged white oak acorns. Based on these results, what is the order of these 3 acorn types, from most perishable to least perishable?

   F. Shelled red oak, infested pin oak, undamaged white oak

   G. Shelled red oak, undamaged white oak, infested pin oak

   H. Undamaged white oak, shelled red oak, infested pin oak

   J. Undamaged white oak, infested pin oak, shelled red oak

7. Of the 1,875 undamaged pin oak acorns tested in the study, the number of those acorns that were cached by squirrels was closest to which of the following?

   A. 225

   B. 475

   C. 675

   D. 1,200

Passage II

In the periodic table, a column of elements is called a *group*. For each of 5 elements in Group 2A and for each of 5 elements in Group 3A, Table 1 gives the *atomic mass* (average mass of 1 atom in atomic mass units, amu) and 3 other properties at a temperature of 298 K:

- density,

- *specific heat* (amount of heat required to raise the temperature of 1 g of a substance by 1 K),

- *thermal conductivity* (ability to conduct heat; the greater the thermal conductivity, the more effectively the substance conducts heat).

	Table 1				
Group in periodic table	Element (symbol)	Atomic mass (amu)	Density at 298 K (g/cm^3*)	Specific heat at 298 K [J/(g·K)†]	Thermal conductivity at 298 K [W/(m·K)‡]
2A	Beryllium (Be)	9.012	1.85	1.83	200
	Magnesium (Mg)	24.31	1.74	1.02	156
	Calcium (Ca)	40.08	1.54	0.647	200
	Strontium (Sr)	87.62	2.64	0.306	35.3
	Barium (Ba)	137.3	3.62	0.204	18.4
3A	Boron (B)	10.81	2.34	1.03	27.4
	Aluminum (Al)	26.98	2.70	0.897	237
	Gallium (Ga)	69.72	5.91	0.373	40.6
	Indium (In)	114.8	7.31	0.233	81.6
	Thallium (Tl)	204.4	11.8	0.129	46.1

*grams per cubic centimeter
†joules per gram per kelvin
‡watts per meter per kelvin

Figure 1 shows, for Al and for Mg, how the thermal conductivity varies between 1 K and 100 K.
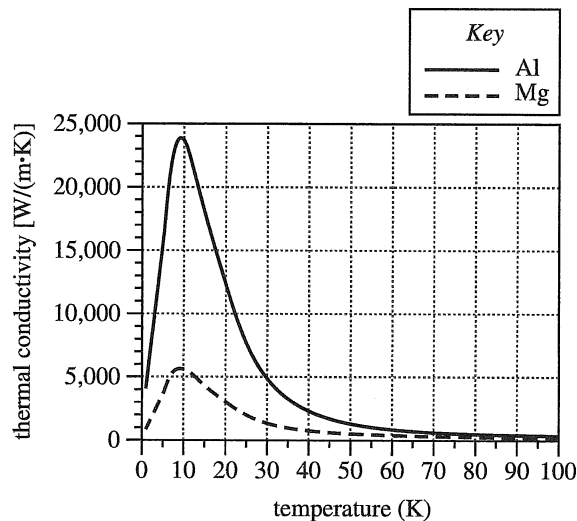
Figure 1

8. Based on Table 1, among the Group 2A elements, as atomic mass increases, the specific heat:

    F. increases only.
    G. decreases only.
    H. increases and then decreases.
    J. decreases and then increases.

9. According to Table 1, at 298 K, the specific heat of indium is closest in value to the specific heat of which of the following elements?

    A. Ba
    B. Ca
    C. Sr
    D. Tl

10. Based on the definition of thermal conductivity and on Table 1, does strontium or thallium conduct heat more effectively at 298 K ?

    F. Strontium; the thermal conductivity of strontium is greater than that of thallium.
    G. Strontium; the thermal conductivity of strontium is less than that of thallium.
    H. Thallium; the thermal conductivity of thallium is greater than that of strontium.
    J. Thallium; the thermal conductivity of thallium is less than that of strontium.

11. Neither Table 1 nor Figure 1 gives the thermal conductivity of magnesium at which of the following temperatures?

    A. 50 K
    B. 98 K
    C. 200 K
    D. 298 K

12. Based on Figure 1, at which of the following temperatures is the thermal conductivity of Al closest in value to the thermal conductivity of Mg ?

    F. 10 K
    G. 30 K
    H. 50 K
    J. 80 K

13. What is the meaning of the value for the density of indium given in Table 1 ?

    A. Each cm^3 of indium has a mass of 7.31 g.
    B. Each cm^3 of indium has a volume of 7.31 g.
    C. Each g of indium has a volume of 7.31 cm^3.
    D. Each g of indium has a mass of 7.31 cm^3.

GO ON TO THE NEXT PAGE.

Passage III

When viewed from above, the path of a launched object is expected to be a straight line. However, because Earth rotates, the *Coriolis effect* causes the object to be deflected, either to the right of the expected path in the Northern Hemisphere, or to the left of the expected path in the Southern Hemisphere. The *magnitude of deflection* (MOD) is a distance that serves as a measure of the Coriolis effect (see Figure 1). The MOD is the same when measured at the same latitude (for example, 30°) in either hemisphere.
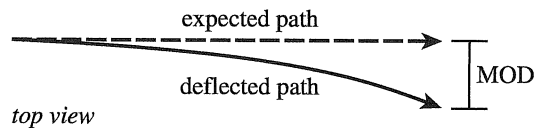
Figure 1

Students conducted 3 experiments to study the Coriolis effect.

Experiment 1

The students performed 5 trials, each at a different latitude. In each trial, they launched a ball due east at a speed of 25 m/s over a distance of 100 m. They then measured the ball's MOD, in cm (see Table 1).

Table 1	
Latitude (°N)	MOD (cm)
15	0.75
30	1.46
45	2.06
60	2.53
75	2.82

Experiment 2

The students performed 5 trials, each at 45°N latitude. In each trial, they launched a ball due east at a different speed over a distance of 100 m. They then measured the ball's MOD (see Table 2).

Table 2	
Speed (m/s)	MOD (cm)
15	3.44
20	2.58
30	1.72
35	1.47
40	1.29

Experiment 3

The students performed 5 trials, each at a different latitude. In each trial, they repeatedly launched 2 identical disks, each 4 cm in diameter, directly toward one another at identical speeds across a 200 m long frictionless horizontal plane. The speed was adjusted for each launch until the students had determined the *minimum* launch speed required for the disks to just avoid colliding (see Figure 2). Table 3 shows their results.
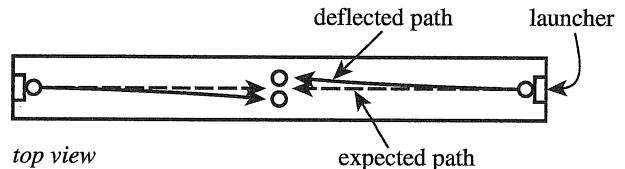
Figure 2

Table 3	
Latitude (°N)	Minimum speed (m/s)
15	9.44
30	18.23
45	25.78
60	31.58
75	35.22

14. Suppose that in Experiment 2, the students had launched the ball at a speed of 33 m/s. The ball's MOD at this speed would most likely have been:

   F. smaller than 1.29 cm.
   G. between 1.29 cm and 1.47 cm.
   H. between 1.47 cm and 1.72 cm.
   J. larger than 1.72 cm.

15. According to the results of Experiment 1, as latitude increased, the MOD due to the Coriolis effect:

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

16. Based on the results of Experiment 3, which of the following graphs best shows the relationship between latitude and minimum speed required to avoid a collision?

F.

G.

H.

J.
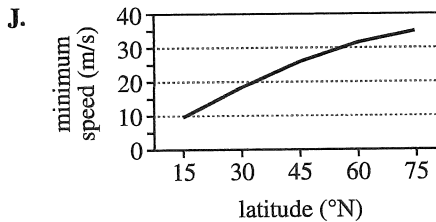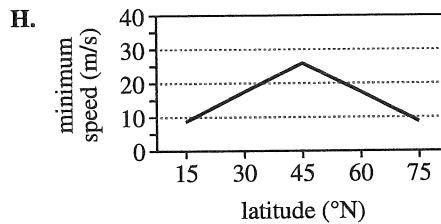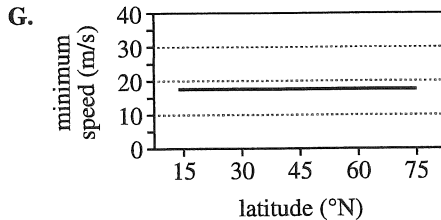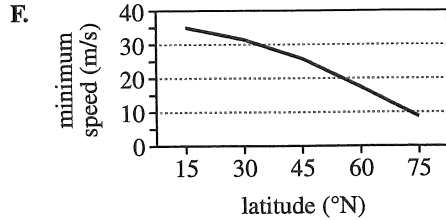
17. The students made certain to use the same ball in both Experiment 1 and Experiment 2. The students most likely did this to ensure that the ball's MOD would be:

A. unaffected by variations in object shape or mass.
B. unaffected by variations in launch speed or latitude.
C. the same for each trial.
D. different for each trial.

18. Based on the results of Experiment 2, by how many *millimeters* did the ball's MOD decrease when the launch speed was increased from 15 m/s to 20 m/s ?

F. 2.5 mm
G. 3.4 mm
H. 5.2 mm
J. 8.6 mm

19. Suppose that in Experiment 1, a trial had been performed in which a ball had been launched at a speed of 25 m/s at 45° *South* latitude. This trial would most likely have resulted in the ball deflecting to the:

A. right of its expected path with an MOD of 2.06 cm.
B. right of its expected path with an MOD of 25.78 cm.
C. left of its expected path with an MOD of 2.06 cm.
D. left of its expected path with an MOD of 25.78 cm.

20. Which of the following statements best summarizes the procedures of Experiment 3 ? The students:

F. repeatedly adjusted the disks' launch speed until the resulting MOD for each disk was slightly larger than 2 cm.
G. repeatedly adjusted the latitude at which the disks were launched until the resulting MOD for each disk was slightly larger than 2 cm.
H. repeatedly adjusted the disks' launch speed until the resulting MOD for each disk was slightly larger than 200 cm.
J. repeatedly adjusted the latitude at which the disks were launched until the resulting MOD for each disk was slightly larger than 200 cm.

Passage IV

In human blood, calcium (Ca^{2+}) concentration is regulated by vitamin D_3. First, vitamin D_3 is converted to *calcidiol* (CD) in the liver. An elevated concentration of CD inhibits further conversion of vitamin D_3. Next, CD is converted to *calcitriol* (CT) in the kidneys in a reaction that requires *parathyroid hormone* (PTH). An elevated concentration of CT increases Ca^{2+} concentration, which in turn inhibits further release of PTH. See Figure 1.
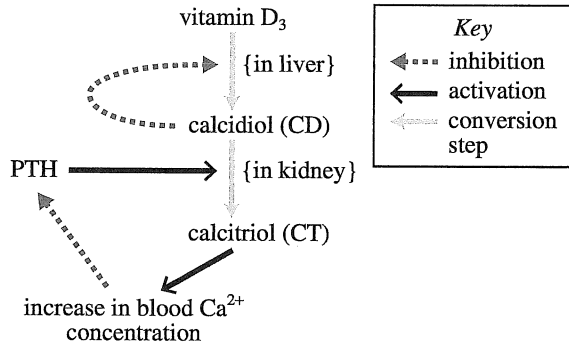
Figure 1

Figures 2 and 3, respectively, show how dietary consumption of vitamin D_3 affects relative blood CD concentration and how blood Ca^{2+} concentration affects relative blood CT concentration.
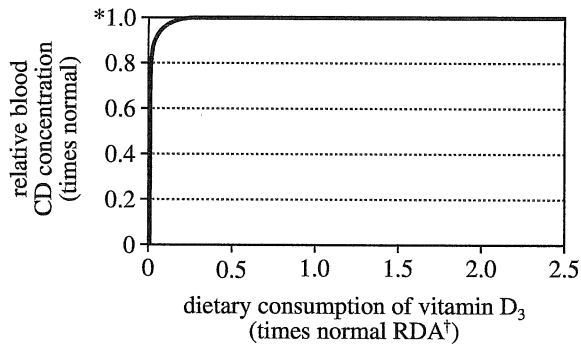
*1.0 represents the normal blood calcidiol concentration

†recommended daily allowance

Note: Assumes minimal exposure to sunlight.

Figure 2
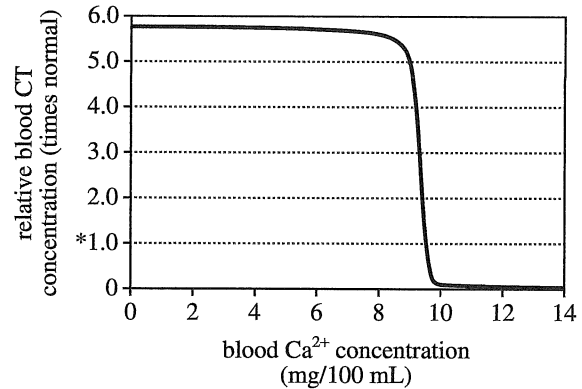
*1.0 represents the normal blood calcitriol concentration

Figure 3

Figures adapted from Hall, John E., *Guyton and Hall Textbook of Medical Physiology*, 12th ed. ©2011 by Saunders Elsevier.

21. According to Figure 2, if an individual increased dietary consumption of vitamin D_3 from 1.0 times the normal RDA to 2.0 times the normal RDA, would the individual's relative blood CD concentration increase?

   A. No; according to Figure 2 the relative blood CD concentration would decrease.
   B. No; according to Figure 2 the relative blood CD concentration would remain the same.
   C. Yes; according to Figure 2 the relative blood CD concentration would increase from 0.5 times normal to 1.0 times normal.
   D. Yes; according to Figure 2 the relative blood CD concentration would increase from 1.0 times normal to 2.0 times normal.

22. According to Figure 3, the relative blood CT concentration is between 5 times normal and 6 times normal within which of the following blood Ca^{2+} concentration ranges?

   F. 8 mg/100 mL to 9 mg/100 mL
   G. 10 mg/100 mL to 11 mg/100 mL
   H. 11 mg/100 mL to 12 mg/100 mL
   J. 13 mg/100 mL to 14 mg/100 mL

23. According to Figure 1, what activates the conversion of CD to CT?

    A. Ca^{2+}
    B. CT
    C. Vitamin D_3
    D. PTH

24. According to Figure 3, when an individual's blood CT concentration is at a normal value, the individual's blood Ca^{2+} concentration is closest to which of the following values?

    F. 0.5 mg/100 mL
    G. 4.5 mg/100 mL
    H. 9.5 mg/100 mL
    J. 11.5 mg/100 mL

25. According to Figure 2, the greatest variation in relative blood CD concentration occurs when the dietary consumption of vitamin D_3 is within which of the following ranges?

    A. 0 times the normal RDA to 0.25 times the normal RDA
    B. 0.25 times the normal RDA to 0.5 times the normal RDA
    C. 0.75 times the normal RDA to 1.0 times the normal RDA
    D. 1.0 times the normal RDA to 1.25 times the normal RDA

26. According to the given information, the inhibition of the conversion of vitamin D_3 to CD is caused by:

    F. a low concentration of CT.
    G. a low concentration of CD.
    H. an elevated concentration of CT.
    J. an elevated concentration of CD.

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Passage V

The *Atwood machine* shown in Figure 1 was used as part of 2 studies on objects moving with constant acceleration.
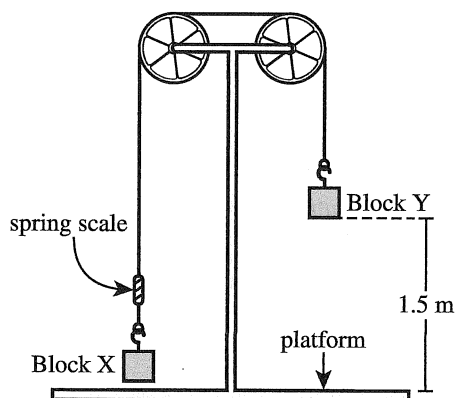
Figure 1

Study 1

In each of 10 trials, the following procedure was performed:

1. A string was passed over 2 pulleys. The string had a ring on each end and a *spring scale* (a device that can measure forces) near one end.

2. Block X, having a mass m_X, was hooked onto the left ring. Block Y, having a mass m_Y, was hooked onto the right ring.

3. Block X was pulled down and held in place so that Block Y was 1.5 m above the platform.

4. With all objects starting at rest, Block X was released, and both F (the force on the string) and t (the time required for Block Y to fall to the platform) were measured.

(Note: All objects other than the 2 blocks had negligible mass. The string was not stretchable.)

Table 1 shows the results, with F in newtons (N) and t in seconds (s).

Table 1				
Trial	m_X (kg)	m_Y (kg)	F (N)	t (s)
1	0.2	0.2	1.96	—
2	0.2	0.4	2.61	0.96
3	0.2	0.6	2.94	0.78
4	0.2	0.8	3.14	0.71
5	0.4	0.4	3.92	—
6	0.4	0.6	4.70	1.24
7	0.4	0.8	5.23	0.96
8	0.6	0.6	5.88	—
9	0.6	0.8	6.72	1.46
10	0.8	0.8	7.84	—
Note: A dash indicates that Block Y did not fall.				

Study 2

The acceleration, a, of Block Y in each trial of Study 1 was then calculated using the available t data. Table 2 shows the results, with a in meters per second squared (m/s^2).

Table 2	
Trial	a (m/s^2)
1	0
2	3.27
3	4.90
4	5.88
5	0
6	1.96
7	3.27
8	0
9	1.40
10	0

27. The *speed* (in m/s) of Block Y can be obtained using the equation:

$$\text{speed} = (\text{acceleration}) \times (\text{time})$$

The speed of Block Y at the time it struck the platform in Trial 2 is correctly represented by which of the following expressions?

A. $(3.27 \text{ m/s}^2) \times (0.78 \text{ s})$
B. $(3.27 \text{ m/s}^2) \times (0.96 \text{ s})$
C. $(4.90 \text{ m/s}^2) \times (0.78 \text{ s})$
D. $(4.90 \text{ m/s}^2) \times (0.96 \text{ s})$

28. Which of the following statements is consistent with the available information about the design or procedures of the studies?

F. More trials were performed in Study 2 than were performed in Study 1.
G. In each trial, the mass of Block X was less than or equal to the mass of Block Y.
H. The results of Study 2 were unrelated to the results of Study 1.
J. There was only 1 trial that involved testing blocks of equal mass.

29. Suppose that in Study 1, a trial had been performed in which Block Y was pulled down and then released when Block X was 1.5 m above the platform. Further suppose that in this trial, m_X was 0.8 kg and m_Y was 0.6 kg. The force on the string in this trial would most likely have been closest to which of the following?

A. 3 N
B. 5 N
C. 7 N
D. 9 N

30. Suppose that in Step 3, Block X had been pulled down and held in place so that Block Y was 100 *centimeters* (NOT meters) above the platform. Would the values of t recorded in Study 1 more likely have been greater than or less than those shown in Table 1 ?

F. Greater, because Block Y would have fallen a longer distance.
G. Greater, because Block Y would have fallen a shorter distance.
H. Less, because Block Y would have fallen a longer distance.
J. Less, because Block Y would have fallen a shorter distance.

31. Based on the results of the studies, for a given value of m_X, as m_Y was increased, which of the variables F, t, and a also increased?

A. F and a only
B. F and t only
C. t and a only
D. F, t, and a

32. Based on the description of Study 1, was m_Y a dependent variable or an independent variable?

F. Dependent, because in each trial, its value was intentionally set to one of several chosen values.
G. Dependent, because in each trial, its value was obtained as the result of taking a measurement.
H. Independent, because in each trial, its value was intentionally set to one of several chosen values.
J. Independent, because in each trial, its value was obtained as the result of taking a measurement.

33. Consider any trial in which the block masses were NOT equal. In this trial, once Block X had been released, the gravitational potential energy of Block Y immediately began to:

A. increase, because Block Y began to gain height.
B. increase, because Block Y began to lose height.
C. decrease, because Block Y began to gain height.
D. decrease, because Block Y began to lose height.

GO ON TO THE NEXT PAGE.

Passage VI

Demonstration

A science teacher poured 400 mL of water into a beaker and heated the beaker with a Bunsen burner. After a few minutes, bubbles began to form in the water and float to the surface. Four students were asked to explain how the bubbles were formed and also to describe the composition of the bubbles.
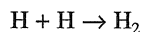
Student 1

The chemical formula of water is H_2O. As H_2O is heated, the chemical bonds between the hydrogen (H) and oxygen (O) atoms break, leaving individual H and O atoms. The H atoms dissolve in the remaining water, while the O atoms combine to form oxygen molecules (O_2). The breakdown of water and the formation of O_2 can be summarized by the following balanced chemical equations:

$$H_2O \rightarrow 2H + O$$
$$O + O \rightarrow O_2$$
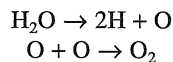
Because O_2 is a gas, it forms bubbles in the water, and the bubbles contain O_2 only.

Student 2

Student 1 is correct about how the chemical bonds in H_2O break down and how O_2 molecules are formed. However, the H atoms do not dissolve in the remaining water; rather, they combine to form hydrogen molecules (H_2), as shown in the following equation:

$$H + H \rightarrow H_2$$

Because both O_2 and H_2 are gases, bubbles are formed in the water, and the bubbles contain a mixture of O_2 and H_2 only.

Student 3

The chemical bonds in water do not break when water is heated. Instead, water molecules form new chemical bonds—called *hydrogen bonds*—with other water molecules. As more and more hydrogen bonds form, a thin circular sheet of hydrogen-bonded water molecules is formed. When this sheet comes in contact with the surface of the water, air pressure pushes down on the center of the sheet, causing it to bow in the middle and close up on itself, forming a spherical bubble (see Figure 1). The bubbles contain air (a mixture of gases) only.

thin circular sheet   bowing of sheet   closed bubble
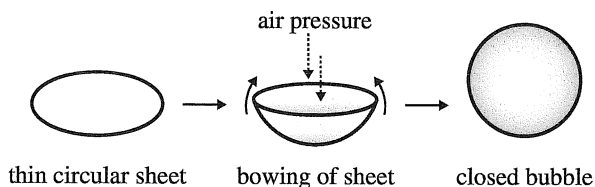
Figure 1

Student 4

As the water is heated, chemical bonds are neither broken nor formed. Instead, the water molecules absorb the heat energy, and this energy is converted into kinetic energy. Once the kinetic energy reaches a certain threshold, the water begins to change from the liquid phase to the gas phase, forming bubbles that contain water vapor only.

34. Based on the description of the demonstration, were the bubbles that formed more dense than the surrounding water, or less dense than the surrounding water?
   F. More dense; the bubbles sank to the bottom after formation.
   G. More dense; the bubbles floated to the surface of the beaker after formation.
   H. Less dense; the bubbles sank to the bottom after formation.
   J. Less dense; the bubbles floated to the surface after formation.

35. During the demonstration, bubbles were observed to form well below the water's surface. This information directly *contradicts* the explanation given by which student?
   A. Student 1
   B. Student 2
   C. Student 3
   D. Student 4

36. Which students stated or implied that the bubbles contain gas molecules?
   F. Students 1 and 2 only
   G. Students 2 and 3 only
   H. Students 2, 3, and 4 only
   J. Students 1, 2, 3, and 4

37. According to Students 1, 2, and 3, the process of bubble formation (in water) involves which of the following changes?
   A. Chemical bonds are formed.
   B. Chemical bonds are broken.
   C. Kinetic energy of the water molecules is increased.
   D. Kinetic energy of the water molecules is decreased.

48
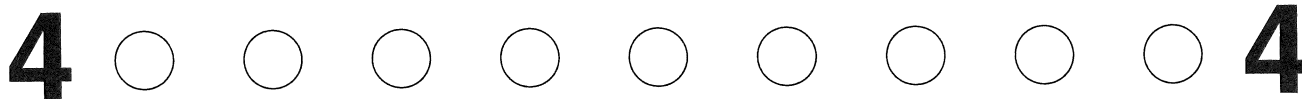
38. Suppose that after the students gave their responses, the teacher filled a balloon with a mixture of H_2 and O_2. Further suppose that she held a lit candle to the balloon and then the balloon exploded. Based on this information, which of Student 2 and Student 4, if either, would be more likely to claim that an explosion would have occurred during the original demonstration if the teacher had held a lit candle above the surface of the water being heated?

   F. Student 2 only
   G. Student 4 only
   H. Both Student 2 and Student 4
   J. Neither Student 2 nor Student 4

39. Which student's explanation is the most scientifically accurate?

   A. Student 1
   B. Student 2
   C. Student 3
   D. Student 4

40. Which of the following balanced chemical equations best summarizes Student 2's explanation?

   F. $2H_2O \rightarrow 2H_2 + O_2$
   G. $2H_2 + O_2 \rightarrow 2H_2O$
   H. $H_2O_2 \rightarrow H_2 + O_2$
   J. $H_2 + O_2 \rightarrow H_2O_2$

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

		Reporting Category*						
		PHM						
	Key	N	A	F	G	S	IES	MDL
31.	C			—				—
32.	G				—			
33.	A						—	
34.	K						—	
35.	C			—				—
36.	H	—						
37.	B		—					—
38.	K						—	—
39.	E		—					
40.	G	—						—
41.	D						—	
42.	G						—	
43.	D			—				
44.	G						—	—
45.	E						—	—
46.	F					—		—
47.	C						—	
48.	K						—	
49.	A						—	
50.	F				—			
51.	E						—	—
52.	G						—	—
53.	E			—				
54.	K						—	
55.	A		—					
56.	J				—			
57.	E						—	—
58.	K	—						—
59.	C				—			
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)	(23)

Test 3: Reading—Scoring Key

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

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

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

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

Test 4: Science—Scoring Key

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

Key		Reporting Category*		
		IOD	SIN	EMI
21.	B	—		
22.	F	—		
23.	D	—		
24.	H	—		
25.	A	—		
26.	J	—		
27.	B	—		
28.	G		—	
29.	C		—	
30.	J		—	
31.	A	—		
32.	H		—	
33.	D			—
34.	J			—
35.	C			—
36.	J			—
37.	A			—
38.	F			—
39.	D			—
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)	____ (18)
Scientific Investigation (SIN)	____ (11)
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 D03   **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	Test 1 English	Test 2 Mathematics	Test 3 Reading	Test 4 Science	Scale Score
36	75	59-60	40	40	36
35	72-74	57-58	39	39	35
34	71	55-56	38	38	34
33	70	54	37	37	33
32	69	53	36	36	32
31	68	52	35	35	31
30	67	50-51	34	—	30
29	66	48-49	—	34	29
28	65	46-47	33	33	28
27	64	43-45	32	32	27
26	62-63	40-42	31	31	26
25	59-61	38-39	30	29-30	25
24	57-58	35-37	29	27-28	24
23	54-56	33-34	27-28	25-26	23
22	51-53	32	26	23-24	22
21	47-50	30-31	24-25	22	21
20	44-46	29	23	20-21	20
19	42-43	27-28	22	19	19
18	40-41	24-26	21	17-18	18
17	38-39	21-23	20	16	17
16	35-37	17-20	18-19	14-15	16
15	32-34	14-16	17	13	15
14	29-31	11-13	15-16	12	14
13	27-28	8-10	14	10-11	13
12	24-26	7	12-13	9	12
11	22-23	6	10-11	8	11
10	18-21	5	9	7	10
9	15-17	4	8	6	9
8	13-14	3	7	5	8
7	11-12	—	6	4	7
6	9-10	2	5	3	6
5	7-8	—	4	2	5
4	5-6	1	3	—	4
3	4	—	2	1	3
2	2-3	—	1	—	2
1	0-1	0	0	0	1

Raw Scores