Mathematics Level 2

Sample Questions

All questions in the Mathematics Level 2 Test are multiple-choice questions in which you must choose the BEST response from the five choices offered. The directions that follow are the same as those that are in the Mathematics Level 2 test.

For each of the following problems, decide which is the BEST of the choices given. If the exact numerical value is not one of the choices, select the choice that best approximates this value. Then fill in the corresponding circle on the answer sheet.

Notes: (1) A scientific or graphing calculator will be necessary for answering some (but not all) of the questions in this test. For each question you will have to decide whether or not you should use a calculator.

(2) For some questions in this test you may have to decide whether your calculator should be in the radian mode or the degree mode.

(3) Figures that accompany problems in this test are intended to provide information useful in solving the problems. They are drawn as accurately as possible EXCEPT when it is stated in a specific problem that its figure is not drawn to scale. All figures lie in a plane unless otherwise indicated.

(4) Unless otherwise specified, the domain of any function f is assumed to be the set of all real numbers x for which $f(x)$ is a real number. The range of f is assumed to be the set of all real numbers $f(x)$, where x is in the domain of f.

(5) Reference information that may be useful in answering the questions in this test can be found on the page preceding Question 1.

Reference Information: The following information is for your reference in answering some of the questions in this test.

Volume of a right circular cone with radius r and height h: $V = \frac{1}{3}\pi r^2 h$

Lateral Area of a right circular cone with circumference of the base c and slant height ℓ: $S = \frac{1}{2}c\ell$

Volume of a sphere with radius r: $V = \frac{4}{3}\pi r^3$

Surface Area of a sphere with radius r: $S = 4\pi r^2$

Volume of a pyramid with base area B and height h: $V = \frac{1}{3}Bh$

Number and Operations

1. From a group of 6 juniors and 8 seniors on the student council, 2 juniors and 4 seniors will be chosen to make up a 6-person committee. How many different 6-person committees are possible?
   (A) 84
   (B) 85
   (C) 1,050
   (D) 1,710
   (E) 1,890

Choice (C) is the correct answer to question 1. The 2 juniors on the committee can be chosen from the 6 juniors in $\binom{6}{2} = 15$ ways. The 4 seniors on the committee can be chosen from the 8 seniors in $\binom{8}{4} = 70$ ways. Therefore, there are $(15)(70) = 1{,}050$ possibilities for the 6-person committee.

Algebra and Functions

2. If $2^x = 3$, what does 3^x equal?
   (A) 5.7
   (B) 5.2
   (C) 2.0
   (D) 1.8
   (E) 1.6

A calculator is useful for this problem. To solve for x, you can take the natural log of both sides of the equation.

$$\ln 2^x = \ln 3$$
$$x \ln 2 = \ln 3$$
$$x = \frac{\ln 3}{\ln 2} = \frac{1.0986}{0.6931} \approx 1.5850$$
$$3^x \approx 5.7045$$

Choice (A) is the correct answer to question 2. Since the directions to this test state, "If the exact numerical value is not one of the choices, select the choice that best approximates this value," the correct answer is choice (A).

You can also solve this problem by graphing $Y1 = 2^x$ and $Y2 = 3$ and finding the point of intersection of the two graphs in the standard viewing window. The two graphs intersect at the point with x-coordinate ≈ 1.5850. You can store this x-value and then evaluate 3^x, which gives 5.7045. Many graphing calculators retain the last calculation from the graph screen in memory. If you return to the home screen immediately after finding the point of intersection, you can use the x-coordinate (called "X" or "xc," depending on the calculator) to evaluate 3^x.

$$ax^5 + bx^4 + cx^3 + dx^2 + e = 0$$

3. Let a, b, c, d, and e represent nonzero real numbers in the equation above. If the equation has $2i$ as a root, which of the following statements must be true?
   (A) The only other nonreal root of the equation is $-2i$.
   (B) The equation has an odd number of nonreal roots.
   (C) The equation has exactly one real root.
   (D) The equation has an odd number of real roots.
   (E) All real roots of the equation are positive.

Choice (D) is the correct answer to question 3. Since $ax^5 + bx^4 + cx^3 + dx^2 + e = 0$ is a 5th-degree polynomial equation with real coefficients, the equation has exactly 5 roots in the complex number system. Because $2i$ is a root of the equation, $-2i$ is also a root. Complex roots always occur in conjugate pairs $a \pm bi$, where a and b are real numbers and $b \neq 0$.

There are two possibilities for the other 3 roots of the equation.
(1) 1 real root, 2 complex (nonreal) roots
(2) 3 real roots

Since the equation could have 4 nonreal roots, choice (A) does not have to be true. Since nonreal roots always occur in pairs, choice (B) cannot be true. Since the equation could have 3 real roots, choice (C) does not have to be true. We do not have enough information about the polynomial equation to determine the sign of the real roots. Therefore, choice

(E) does not have to be true. Since the equation could have 1 or 3 real roots, choice (D) must be true.

4. Two environmentalists have proposed two different function models for the survival rate of a particular endangered species.

$$f(t) = 100(0.7)^t$$

$$g(t) = 100(0.999993)^{t^5}$$

For the functions f and g above, $f(t)$ and $g(t)$ represent the percentage of the species that survive t years from a starting point $t=0$. Which of the following statements about the models are true?

I. Both models give the same prediction at approximately $t=15$ years.

II. Model g predicts that the population size will decrease most rapidly from $t=0$ to $t=5$ years.

III. The greatest difference in the two model predictions occurs at approximately $t=6$ years.

(A) I only

(B) I and II only

(C) I and III only

(D) II and III only

(E) I, II, and III

Choice (C) is the correct answer to question 4 since statements I and III are true. You can use a graphing calculator to help you solve this problem. Enter functions f and g in the calculator as $Y1$ and $Y2$, respectively.

By examining the graphs of the two functions or a table of values for the two functions, you can determine that $f(t)=g(t)$ for a value between $t=15$ and $t=16$. Both models give the same prediction at approximately $t=15.024$. Thus, statement I is true.

By examining the graph of g or a table of values for g on the interval from $t=0$ to $t=5$, you can see that the $g(t)$ values are fairly constant and show little decrease. The function values start to decrease after $t=5$ years. Thus, statement II is not true.

You can look at the graph of $Y1-Y2$ or a table of values for $Y1-Y2$ to determine where the greatest difference between the two model predictions occurs. The greatest difference occurs at approximately $t=5.976$. Thus, statement III is true.

5. If $f(x) = \frac{1-x}{x-1}$ for all $x \neq 1$, which of the following statements must be true?

I. $f(3) = f(2)$

II. $f(0) = f(2)$

III. $f(0) = f(4)$

(A) None

(B) I only

(C) II only

(D) II and III only

(E) I, II, and III

Choice (E) is the correct answer to question 5. Realizing that $\frac{1-x}{x-1} = -1$ for all $x \neq 1$ greatly simplifies this problem. Since $f(0)$, $f(2)$, $f(3)$, and $f(4)$ are all equal to -1, statements I, II, and III are all true. If you do not realize $f(x) = -1$, you can easily substitute the numbers in f. Using a calculator may actually be a disadvantage to you if you spend time substituting the numbers into an expression of this kind to find the answer. However, using a graphing calculator, you can graph $y = \frac{1-x}{x-1}$ and see that the graph is a horizontal line crossing the y-axis at -1. Therefore, $f(x) = -1$ for all values of x except 1.

6. Let h be the function defined by $h(t) = |5\cos\left(\frac{2}{3}t\right) - 2|$. What is the period of h ?

(A) $\frac{2}{3}$

(B) 3

(C) 5

(D) 2π

(E) 3π

Choice (E) is the correct answer to question 6. The period of h corresponds to the length of one cycle of the graph of h. The smallest positive real number k such that $h(x+k) = h(x)$ for every value of x in the domain of h is the period. By examining the graph of h on your graphing calculator, you can see that the values of $h(x)$ repeat every 3π units.

Alternately, note that the graph of h is obtained from the graph of $y = \cos t$ by applying several transformations. The vertical "stretch" by a factor of 5 units and the shift down 2 units do not affect the period of the function. The absolute value, in this case, also does not affect the period of the function. The horizontal "stretch" is a result of the $\frac{2}{3}$.

This affects the period. Since the period of $\cos t$ is 2π, the period of h can be found by $\frac{2\pi}{\left|\frac{2}{3}\right|} = 3\pi$.

7. If $f(x) = \frac{1}{x-5}$ and $g(x) = \sqrt{x+4}$, what is the domain of $f-g$?
   (A) All x such that $x \neq 5$ and $x \leq 4$
   (B) All x such that $x \neq -5$ and $x \leq 4$
   (C) All x such that $x \neq 5$ and $x \geq -4$
   (D) All x such that $x \neq -4$ and $x \geq -5$
   (E) All real numbers x

Choice (C) is the correct answer to question 7. The function $f-g$ will be defined at exactly those points where f and g are both defined. In other words, the domain of $f-g$ is the intersection of the domain of f and the domain of g. Since $f(x) = \frac{1}{x-5}$ is defined for all $x \neq 5$, and $g(x) = \sqrt{x+4}$ is defined for all $x \geq -4$, the domain of $f-g$ is all x such that $x \neq 5$ and $x \geq -4$.

You can also examine the graph of $f-g$. The graph is defined for all real numbers $x \geq -4$ except for $x = 5$, where the graph has a vertical asymptote.

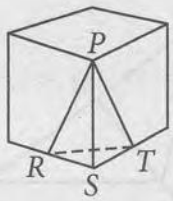
Geometry and Measurement: Coordinate Geometry

8. A translation in the xy-plane moves the point with coordinates (x, y) to the point with coordinates $(x-4, y+7)$. If point A' is the image of point A under this translation, what is the distance between points A and A'?
   (A) 3.0
   (B) 5.7
   (C) 7.9
   (D) 8.1
   (E) 11.0

Choice (D) is the correct answer to question 8. Point A' is 4 units to the left and 7 units above point A in the xy-plane. Point A can be represented by coordinates (x, y) and point A' can be represented by coordinates $(x-4, y+7)$. You can use the distance formula to find the distance between the two points.

$$\text{distance} = \sqrt{((x-4)-x)^2 + ((y+7)-y)^2}$$
$$= \sqrt{16+49} = \sqrt{65} \approx 8.1$$

Geometry and Measurement: Three-Dimensional Geometry



9. In the figure above, R and T are the midpoints of two adjacent edges of the cube. If the length of each edge of the cube is h, what is the volume of pyramid $PRST$?

(A) $\frac{h^3}{24}$

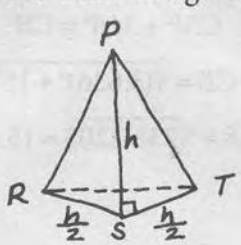
(B) $\frac{h^3}{12}$

(C) $\frac{h^3}{8}$

(D) $\frac{h^3}{6}$

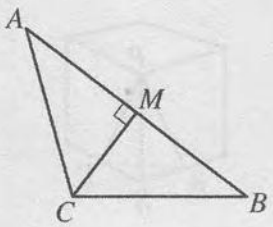
(E) $\frac{h^3}{4}$

The formula for the volume of the pyramid and several other formulae are given in the reference information at the beginning of the test. The volume of a pyramid is $\frac{1}{3}Bh$, where B is the area of the base of the pyramid and h is its height. It may be helpful to mark the figure to indicate those parts whose lengths are given or that can be deduced.



Choice (A) is the correct answer to question 9. Since $\overline{PS}$ is perpendicular to the triangular base RST, its length h is the height of the pyramid $PRST$. R and T are the midpoints of the two adjacent edges of the cube; therefore, $RS = ST = \frac{h}{2}$. Since $\triangle RST$ is a right triangle, its area is $\left(\frac{1}{2}\right)\left(\frac{h}{2}\right)\left(\frac{h}{2}\right) = \frac{h^2}{8}$. Thus, the volume of $PRST$ is $\left(\frac{1}{3}\right)\left(\frac{h^2}{8}\right)(h) = \frac{h^3}{24}$.

Geometry and Measurement: Trigonometry



Note: Figure not drawn to scale.

10. In $\triangle ABC$ above, $\overline{CM} \perp \overline{AB}$. If $AM = 9$, $MB = 15$, and the measure of $\angle BAC$ is 22°, what is the length of $\overline{CB}$?

(A) 3.64

(B) 9.71

(C) 15.43

(D) 17.16

(E) 17.49

Choice (C) is the correct answer to question 10. You can use right triangle ACM to find the length of $\overline{CM}$.

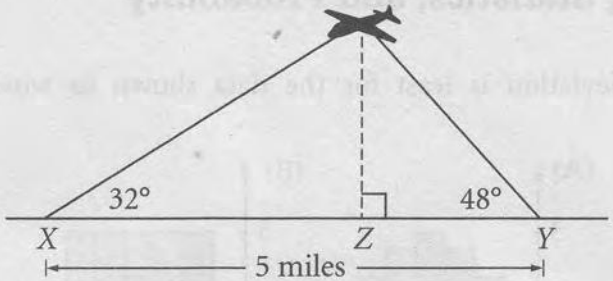
$$\tan 22° = \frac{CM}{9}; \text{ thus, } CM \approx 3.636.$$

Now you can use the Pythagorean theorem on right triangle CMB to find the length of $\overline{CB}$.

$$CM^2 + MB^2 = CB^2$$

$$CB = \sqrt{(3.636)^2 + 15^2}$$

$$CB \approx \sqrt{238.2205} \approx 15.43$$



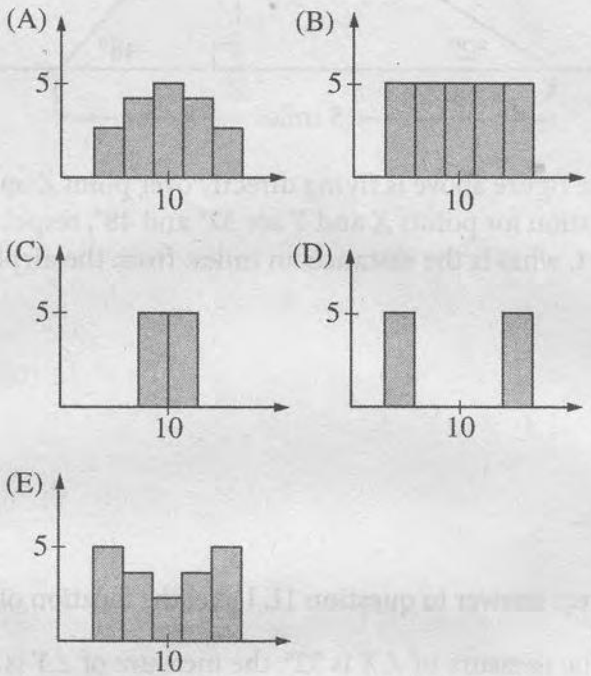
11. The airplane in the figure above is flying directly over point Z on a straight, level road. The angles of elevation for points X and Y are 32° and 48°, respectively. If points X and Y are 5 miles apart, what is the distance, in miles, from the airplane to point X?

(A) 1.60
(B) 2.40
(C) 2.69
(D) 3.77
(E) 7.01

Choice (D) is the correct answer to question 11. Label the location of the airplane as point W. Then in $\triangle XYW$, the measure of $\angle X$ is 32°, the measure of $\angle Y$ is 48°, and the measure of $\angle W$ is 100°. Let x, y, and w denote the lengths, in miles, of the sides of $\triangle XYW$ opposite $\angle X$, $\angle Y$, and $\angle W$, respectively. By the law of sines, $\frac{x}{\sin X} = \frac{y}{\sin Y} = \frac{w}{\sin W}$. Since $w = 5$ and the distance from the plane to point X is y, it follows that $\frac{5}{\sin 100°} = \frac{y}{\sin 48°}$. This gives $y \approx 3.77$ for the distance, in miles, from the plane to point X.

Data Analysis, Statistics, and Probability

12. The standard deviation is least for the data shown in which of the following histograms?



Choice (C) is the correct answer to question 12. The standard deviation is a measure of spread—how far the observations in a set of data are from their mean.

The data is closest to 10 in the histogram in choice (C), and thus has the least standard deviation. In each of the other choices, the data is further spread from 10.

Mathematics Level 2 Test

Practice Helps

The test that follows is an actual, recently administered SAT Subject Test in Mathematics Level 2. To get an idea of what it's like to take this test, practice under conditions that are much like those of an actual test administration.

- Set aside an hour when you can take the test uninterrupted. Make sure you complete the test in one sitting.
- Sit at a desk or table with no other books or papers. Dictionaries, other books, or notes are not allowed in the test room.
- Remember to have a scientific or graphing calculator with you.
- Tear out an answer sheet from the back of this book and fill it in just as you would on the day of the test. One answer sheet can be used for up to three Subject Tests.
- Read the instructions that precede the practice test. During the actual administration, you will be asked to read them before answering test questions.
- Time yourself by placing a clock or kitchen timer in front of you.
- After you finish the practice test, read the sections "How to Score the SAT Subject Test in Mathematics Level 2" and "How Did You Do on the Subject Test in Mathematics Level 2?"
- The appearance of the answer sheet in this book may differ from the answer sheet you see on test day.

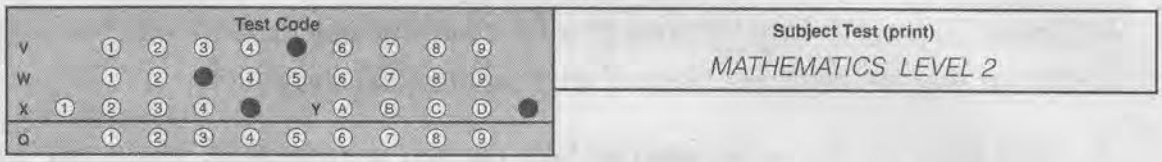
MATHEMATICS LEVEL 2 TEST

The top portion of the section of the answer sheet that you will use in taking the Mathematics Level 2 Test must be filled in exactly as shown in the illustration below. Note carefully that you have to do all of the following on your answer sheet.

1. Print MATHEMATICS LEVEL 2 on the line under the words "Subject Test (print)."

2. In the shaded box labeled "Test Code" fill in four circles:

   —Fill in circle 5 in the row labeled V.
   —Fill in circle 3 in the row labeled W.
   —Fill in circle 5 in the row labeled X.
   —Fill in circle E in the row labeled Y.



3. Please answer Part I and Part II below by filling in the specified circles in row Q that correspond to the courses you have taken or are presently taking, and the circle that corresponds to the type of calculator you are going to use to take this test. The information that you provide is for statistical purposes only and will not affect your score on the test.

Part I. Which of the following describes a mathematics course you have taken or are currently taking? (FILL IN **ALL** CIRCLES THAT APPLY.)

- Algebra I or Elementary Algebra **OR** Course I of a college preparatory mathematics sequence —Fill in circle 1.
- Geometry **OR** Course II of a college preparatory mathematics sequence —Fill in circle 2.
- Algebra II or Intermediate Algebra **OR** Course III of a college preparatory mathematics sequence —Fill in circle 3.
- Elementary Functions (Precalculus) and/or Trigonometry **OR** beyond Course III of a college preparatory mathematics sequence —Fill in circle 4.
- Advanced Placement Mathematics (Calculus AB or Calculus BC) —Fill in circle 5.

Part II. What type of calculator did you bring to use for this test? (FILL IN THE **ONE** CIRCLE THAT APPLIES. If you did not bring a scientific or graphing calculator, do not fill in any of circles 6-9.)

- Scientific —Fill in circle 6.
- Graphing (Fill in the circle corresponding to the model you used.)

  Casio 9700, Casio 9750, Casio 9800, Casio 9850, Casio FX 1.0, Sharp 9200, Sharp 9300, Sharp 9600, Sharp 9900, TI-82, TI-83, TI-83 Plus, TI-83 Plus Silver, TI-84 Plus, TI-84 Plus Silver, TI-85, or TI-86 —Fill in circle 7.

  Casio 9970, Casio Algebra FX 2.0, HP 38G, HP 39 series, HP 40G, HP 48 series, HP 49 series, TI-89, or TI-89 Titanium —Fill in circle 8.

  Some other graphing calculator —Fill in circle 9.

When the supervisor gives the signal, turn the page and begin the Mathematics Level 2 Test. There are 100 numbered circles on the answer sheet and 50 questions in the Mathematics Level 2 Test. Therefore, use only circles 1 to 50 for recording your answers.

MATHEMATICS LEVEL 2 TEST

REFERENCE INFORMATION

THE FOLLOWING INFORMATION IS FOR YOUR REFERENCE IN ANSWERING SOME OF THE QUESTIONS IN THIS TEST.

Volume of a right circular cone with radius r and height h: $V = \frac{1}{3}\pi r^2 h$

Lateral Area of a right circular cone with circumference of the base c and slant height ℓ: $S = \frac{1}{2}c\ell$

Volume of a sphere with radius r: $V = \frac{4}{3}\pi r^3$

Surface Area of a sphere with radius r: $S = 4\pi r^2$

Volume of a pyramid with base area B and height h: $V = \frac{1}{3}Bh$

DO NOT DETACH FROM BOOK.

GO ON TO THE NEXT PAGE

MATHEMATICS LEVEL 2 TEST

For each of the following problems, decide which is the BEST of the choices given. If the exact numerical value is not one of the choices, select the choice that best approximates this value. Then fill in the corresponding circle on the answer sheet.

Notes: (1) A scientific or graphing calculator will be necessary for answering some (but not all) of the questions in this test. For each question you will have to decide whether or not you should use a calculator.

(2) For some questions in this test you may have to decide whether your calculator should be in the radian mode or the degree mode.

(3) Figures that accompany problems in this test are intended to provide information useful in solving the problems. They are drawn as accurately as possible EXCEPT when it is stated in a specific problem that its figure is not drawn to scale. All figures lie in a plane unless otherwise indicated.

(4) Unless otherwise specified, the domain of any function f is assumed to be the set of all real numbers x for which $f(x)$ is a real number. The range of f is assumed to be the set of all real numbers $f(x)$, where x is in the domain of f.

(5) Reference information that may be useful in answering the questions in this test can be found on the page preceding Question 1.

USE THIS SPACE FOR SCRATCHWORK.

1. If $3x + 6 = \frac{k}{4}(x + 2)$ for all x, then $k =$

(A) $\frac{1}{4}$ (B) 3 (C) 4 (D) 12 (E) 24

3YBC

GO ON TO THE NEXT PAGE

MATHEMATICS LEVEL 2 TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

2. The relationship between a reading C on the Celsius temperature scale and a reading F on the Fahrenheit temperature scale is $C = \frac{5}{9}(F - 32)$, and the relationship between a reading on the Celsius temperature scale and a reading K on the Kelvin temperature scale is $K = C + 273$. Which of the following expresses the relationship between readings on the Kelvin and Fahrenheit temperature scales?

   (A) $K = \frac{5}{9}(F - 241)$

   (B) $K = \frac{5}{9}(F + 305)$

   (C) $K = \frac{5}{9}(F - 32) + 273$

   (D) $K = \frac{5}{9}(F - 32) - 273$

   (E) $K = \frac{5}{9}(F + 32) + 273$

3. What is the slope of the line containing the points $(3, 11)$ and $(-2, 5)$?

   (A) 0.17
   (B) 0.83
   (C) 1.14
   (D) 1.20
   (E) 6

4. If $x + y = 2$, $y + z = 5$, and $x + y + z = 10$, then $y =$

   (A) -3

   (B) $\frac{3}{17}$

   (C) 1

   (D) 3

   (E) $\frac{17}{3}$

GO ON TO THE NEXT PAGE

MATHEMATICS LEVEL 2 TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

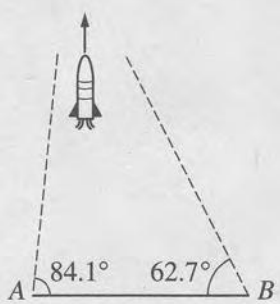
5. If $f(x) = 3\ln(x) - 1$ and $g(x) = e^x$, then $f(g(5)) =$

(A) 6.83
(B) 12
(C) 14
(D) 45.98
(E) 568.17

6. The intersection of a cube with a plane could be which of the following?

I. A square
II. A parallelogram
III. A triangle

(A) I only
(B) II only
(C) III only
(D) I and III only
(E) I, II, and III



7. The figure above shows a rocket taking off vertically. When the rocket reaches a height of 12 kilometers, the angles of elevation from points A and B on level ground are 84.1° and 62.7°, respectively. What is the distance between points A and B?

(A) 0.97 km
(B) 6.36 km
(C) 7.43 km
(D) 22.60 km
(E) 139.37 km

GO ON TO THE NEXT PAGE

MATHEMATICS LEVEL 2 TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

8. What is the value of x^2 if $x = \sqrt{15^2 - 12^2}$?

   (A) $\sqrt{3}$ (B) 3 (C) 9 (D) 81 (E) 81^2

9. The points in the rectangular coordinate plane are transformed in such a way that each point $P(x, y)$ is moved to the point $P'(2x, 2y)$. If the distance between a point P and the origin is d, then the distance between the point P' and the origin is

   (A) $\frac{1}{d}$

   (B) $\frac{d}{2}$

   (C) d

   (D) $2d$

   (E) d^2

10. If $f(g(x)) = \frac{2\sqrt{x^2+1}-1}{\sqrt{x^2+1}+1}$ and $f(x) = \frac{2x-1}{x+1}$, then $g(x) =$

    (A) $\sqrt{x}$

    (B) $\sqrt{x^2+1}$

    (C) x

    (D) x^2

    (E) $x^2 + 1$

GO ON TO THE NEXT PAGE

MATHEMATICS LEVEL 2 TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

11. If A is the degree measure of an acute angle and $\sin A = 0.8$, then $\cos(90° - A) =$

(A) 0.2
(B) 0.4
(C) 0.5
(D) 0.6
(E) 0.8

12. The set of points (x, y, z) such that $x^2 + y^2 + z^2 = 1$ is

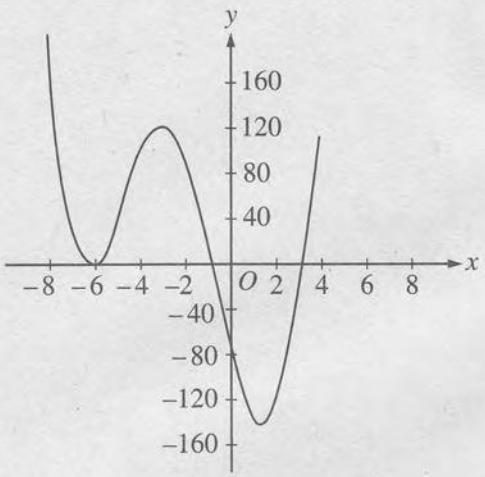
(A) empty
(B) a point
(C) a sphere
(D) a circle
(E) a plane

13. The graph of the rational function f, where $f(x) = \dfrac{5}{x^2 - 8x + 16}$, has a vertical asymptote at $x =$

(A) 0 only
(B) 4 only
(C) 5 only
(D) 0 and 4 only
(E) 0, 4, and 5

GO ON TO THE NEXT PAGE

USE THIS SPACE FOR SCRATCHWORK.



14. The graph of $y = x^4 + 10x^3 + 10x^2 - 96x + c$ is shown above. Which of the following could be the value of c ?

(A) 3,240
(B) 1,080
(C) 72
(D) −72
(E) −3,240

15. If $\cos x = 0.4697$, then $\sec x =$

(A) 2.1290
(B) 2.0452
(C) 1.0818
(D) 0.9243
(E) 0.4890

GO ON TO THE NEXT PAGE

MATHEMATICS LEVEL 2 TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

16. A club is planning a trip to a museum that has an admission price of $7 per person. The club members going on the trip must share the $200 cost of a bus and the admission price for 2 chaperones who will accompany them on the trip. Which of the following correctly expresses the cost, in dollars, for each club member as a function of n, the number of club members going on the trip?

(A) $c(n) = \frac{200 + 7n}{n}$

(B) $c(n) = \frac{214 + 7n}{n}$

(C) $c(n) = \frac{200 + 7n}{n + 2}$

(D) $c(n) = \frac{200 + 7n}{n - 2}$

(E) $c(n) = \frac{214 + 7n}{n - 2}$

17. Which of the following is an equation whose graph is the set of points equidistant from the points $(0, 0)$ and $(0, 4)$?

(A) $x = 2$
(B) $y = 2$
(C) $x = 2y$
(D) $y = 2x$
(E) $y = x + 2$

18. What is the sum of the infinite geometric series

$\frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \frac{1}{32} + \ldots$?

(A) $\frac{1}{2}$ (B) 1 (C) $\frac{3}{2}$ (D) 2 (E) $\frac{5}{2}$

GO ON TO THE NEXT PAGE

USE THIS SPACE FOR SCRATCHWORK.

19. Which of the following is equivalent to $p + s > p - s$?

(A) $p > s$
(B) $p > 0$
(C) $s > p$
(D) $s > 0$
(E) $s < 0$

20. If a and b are in the domain of a function f and $f(a) < f(b)$, which of the following must be true?

(A) $a = 0$ or $b = 0$
(B) $a < b$
(C) $a > b$
(D) $a \neq b$
(E) $a = b$

21. In a recent survey, it was reported that 75 percent of the population of a certain state lived within ten miles of its largest city and that 40 percent of those who lived within ten miles of the largest city lived in single-family houses. If a resident of this state is selected at random, what is the probability that the person lives in a single-family house within ten miles of the largest city?

(A) 0.10
(B) 0.15
(C) 0.30
(D) 0.35
(E) 0.53

22. To the nearest degree, what is the measure of the smallest angle in a right triangle with sides of lengths 3, 4, and 5 ?

(A) 27°
(B) 30°
(C) 37°
(D) 45°
(E) 53°

GO ON TO THE NEXT PAGE

MATHEMATICS LEVEL 2 TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

23. Which of the following is an equation of a line perpendicular to $y = -2x + 3$?

(A) $y = 3x - 2$

(B) $y = 2x - 3$

(C) $y = \frac{1}{2}x + 4$

(D) $y = -\frac{1}{2}x + 3$

(E) $y = \frac{1}{-2x + 3}$

24. What is the range of the function f, where $f(x) = -4 + 3\sin(2x + 5\pi)$?

(A) $-7 \leq f(x) \leq 3$
(B) $-7 \leq f(x) \leq -1$
(C) $-3 \leq f(x) \leq 3$
(D) $-3 \leq f(x) \leq -1$
(E) $-1 \leq f(x) \leq 1$

25. Of the following lists of numbers, which has the smallest standard deviation?

(A) 1, 5, 9
(B) 3, 5, 8
(C) 4, 5, 8
(D) 7, 8, 9
(E) 8, 8, 8

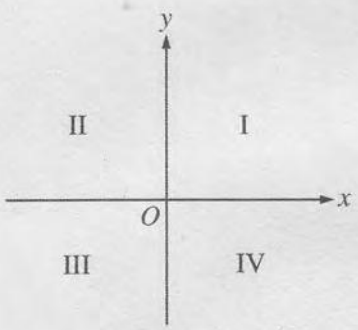
GO ON TO THE NEXT PAGE

MATHEMATICS LEVEL 2 TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

26. The formula $A = Pe^{0.08t}$ gives the amount A that a savings account will be worth after an initial investment P is compounded continuously at an annual rate of 8 percent for t years. Under these conditions, how many years will it take an initial investment of \$1,000 to be worth approximately \$5,000 ?

(A) 4.1
(B) 5.0
(C) 8.7
(D) 20.1
(E) 23.0



27. If $\sin\theta > 0$ and $\sin\theta\cos\theta < 0$, then θ must be in which quadrant in the figure above?

(A) I
(B) II
(C) III
(D) IV
(E) There is no quadrant in which both conditions are true.

GO ON TO THE NEXT PAGE

MATHEMATICS LEVEL 2 TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

28. If $f(-x) = f(x)$ for all real numbers x and if $(3, 8)$ is a point on the graph of f, which of the following points must also be on the graph of f?

(A) $(-8, -3)$
(B) $(-3, -8)$
(C) $(-3, 8)$
(D) $(3, -8)$
(E) $(8, 3)$

If $x = y$, then $x^2 = y^2$.

29. If x and y are real numbers, which of the following CANNOT be inferred from the statement above?

(A) In order for x^2 to be equal to y^2, it is sufficient that x be equal to y.
(B) A necessary condition for x to be equal to y is that x^2 be equal to y^2.
(C) x is equal to y implies that x^2 is equal to y^2.
(D) If x^2 is not equal to y^2, then x is not equal to y.
(E) If x^2 is equal to y^2, then x is equal to y.

30. In how many different orders can 9 students arrange themselves in a straight line?

(A) 9
(B) 81
(C) 181,440
(D) 362,880
(E) 387,420,489

GO ON TO THE NEXT PAGE

MATHEMATICS LEVEL 2 TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

31. What value does $\frac{\ln x}{x-1}$ approach as x approaches 1 ?

(A) 0
(B) 0.43
(C) 1
(D) 2
(E) It does not approach a unique value.

32. If $f(x) = |5 - 3x|$, then $f(2) =$

(A) $f(-2)$

(B) $f(-1)$

(C) $f(1)$

(D) $f\left(\frac{4}{3}\right)$

(E) $f\left(\frac{7}{3}\right)$

33. What is the period of the graph of $y = 2\tan(3\pi x + 4)$?

(A) $\frac{2\pi}{3}$

(B) $\frac{2}{3}$

(C) 2

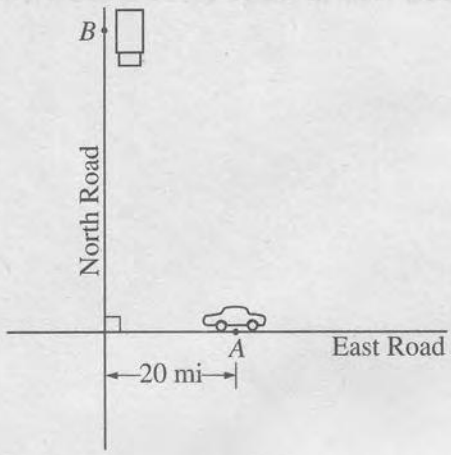
(D) $\frac{1}{3}$

(E) $\frac{\pi}{3}$

GO ON TO THE NEXT PAGE

MATHEMATICS LEVEL 2 TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.



34. The figure above shows a car that has broken down on East Road. A tow truck leaves a garage on North Road at point B. The straight-line distance between points A and B is 50 miles. If the tow truck travels at an average speed of 45 miles per hour along North and East Roads, how long will it take the tow truck to get to the car?

(A) 27 minutes
(B) 1 hour and 7 minutes
(C) 1 hour and 28 minutes
(D) 1 hour and 33 minutes
(E) 1 hour and 46 minutes

GO ON TO THE NEXT PAGE

USE THIS SPACE FOR SCRATCHWORK.

x	$f(x)$
−1	0
0	1
1	−1
2	0

35. If f is a polynomial of degree 3, four of whose values are shown in the table above, then $f(x)$ could equal

(A) $\left(x + \frac{1}{2}\right)(x + 1)(x + 2)$

(B) $(x + 1)(x - 2)\left(x - \frac{1}{2}\right)$

(C) $(x + 1)(x - 2)(x - 1)$

(D) $(x + 2)\left(x - \frac{1}{2}\right)(x - 1)$

(E) $(x + 2)(x + 1)(x - 2)$

36. The only prime factors of a number n are 2, 5, 7, and 17. Which of the following could NOT be a factor of n?

(A) 10 (B) 20 (C) 25 (D) 30 (E) 34

37. If $0 \leq x \leq \frac{\pi}{2}$ and $\sin x = 3 \cos x$, what is the value of x?

(A) 0.322
(B) 0.333
(C) 0.340
(D) 1.231
(E) 1.249

GO ON TO THE NEXT PAGE

MATHEMATICS LEVEL 2 TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

38. If $f(x) = 5\sqrt{2x}$, what is the value of $f^{-1}(10)$?

(A) 0.04
(B) 0.89
(C) 2.00
(D) 2.23
(E) 22.36

39. The Fibonacci sequence can be defined recursively as

$a_1 = 1$

$a_2 = 1$

$a_n = a_{n-1} + a_{n-2}$ for $n \geq 3$.

What is the 10th term of this sequence?

(A) 21
(B) 34
(C) 55
(D) 89
(E) 144

40. If $f(x) = x^3 - 4x^2 - 3x + 2$, which of the following statements are true?

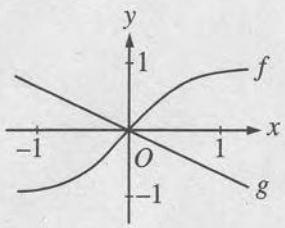
I. The function f is increasing for $x \geq 3$.
II. The equation $f(x) = 0$ has two nonreal solutions.
III. $f(x) \geq -16$ for all $x \geq 0$.

(A) I only
(B) II only
(C) I and II
(D) I and III
(E) II and III

GO ON TO THE NEXT PAGE

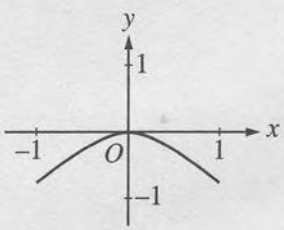
MATHEMATICS LEVEL 2 TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

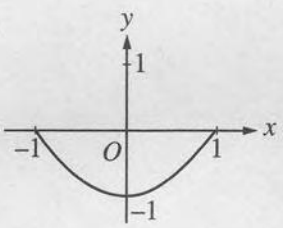


41. Portions of the graphs of f and g are shown above. Which of the following could be a portion of the graph of fg ?

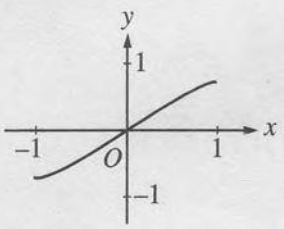
(A)



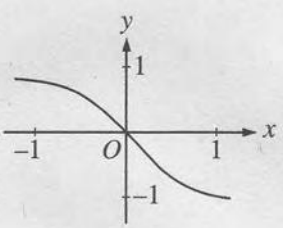
(B)



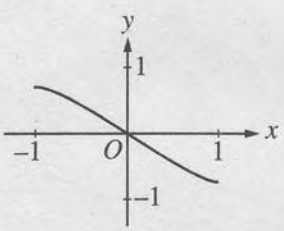
(C)



(D)



(E)



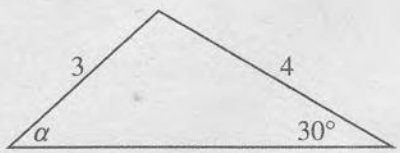
GO ON TO THE NEXT PAGE

MATHEMATICS LEVEL 2 TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

42. The set of all real numbers x such that $\sqrt{x^2} = -x$ consists of

(A) zero only
(B) nonpositive real numbers only
(C) positive real numbers only
(D) all real numbers
(E) no real numbers



43. In the triangle shown above, $\sin \alpha =$

(A) $\frac{3}{8}$

(B) $\frac{1}{2}$

(C) $\frac{2}{3}$

(D) $\frac{3}{4}$

(E) $\frac{4}{5}$

44. The length, width, and height of a rectangular solid are 8, 4, and 1, respectively. What is the length of the longest line segment whose end points are two vertices of this solid?

(A) $4\sqrt{5}$
(B) 9
(C) $3\sqrt{10}$
(D) 10
(E) 12

GO ON TO THE NEXT PAGE

USE THIS SPACE FOR SCRATCHWORK.

45. If $\log_a 3 = x$ and $\log_a 5 = y$, then $\log_a 45 =$

(A) $2x + y$
(B) $x^2 + y$
(C) x^2y
(D) $x + y$
(E) $9x + y$

46. If $\sin\theta = t$, then, for all θ in the interval $0 < \theta < \frac{\pi}{2}$, $\tan\theta =$

(A) $\frac{1}{\sqrt{1-t^2}}$
(B) $\frac{t}{\sqrt{1-t^2}}$
(C) $\frac{1}{1-t^2}$
(D) $\frac{t}{1-t^2}$
(E) 1

47. Which of the following shifts of the graph of $y = x^2$ would result in the graph of $y = x^2 - 2x + k$, where k is a constant greater than 2 ?

(A) Left 2 units and up k units
(B) Left 1 unit and up $k + 1$ units
(C) Right 1 unit and up $k + 1$ units
(D) Left 1 unit and up $k - 1$ units
(E) Right 1 unit and up $k - 1$ units

GO ON TO THE NEXT PAGE

USE THIS SPACE FOR SCRATCHWORK.

48. If the height of a right circular cone is decreased by 8 percent, by what percent must the radius of the base be decreased so that the volume of the cone is decreased by 15 percent?

(A) 4%
(B) 7%
(C) 8%
(D) 30%
(E) 45%

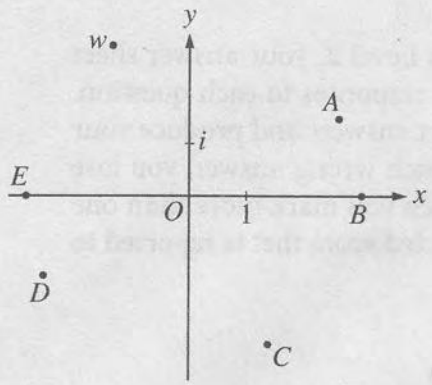
49. If matrix A has dimensions $m \times n$ and matrix B has dimensions $n \times p$, where m, n, and p are distinct positive integers, which of the following statements must be true?

I. The product BA does not exist.
II. The product AB exists and has dimensions $m \times p$.
III. The product AB exists and has dimensions $n \times n$.

(A) I only
(B) II only
(C) III only
(D) I and II
(E) I and III

GO ON TO THE NEXT PAGE

USE THIS SPACE FOR SCRATCHWORK.



50. If w is the complex number shown in the figure above, which of the following points could be $-iw$?

(A) A (B) B (C) C (D) D (E) E

STOP

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS TEST ONLY. DO NOT TURN TO ANY OTHER TEST IN THIS BOOK.

How to Score the SAT Subject Test in Mathematics Level 2

When you take an actual SAT Subject Test in Mathematics Level 2, your answer sheet will be "read" by a scanning machine that will record your responses to each question. Then a computer will compare your answers with the correct answers and produce your raw score. You get one point for each correct answer. For each wrong answer, you lose one-fourth of a point. Questions you omit (and any for which you mark more than one answer) are not counted. This raw score is converted to a scaled score that is reported to you and to the colleges you specify.

Worksheet 1. Finding Your Raw Test Score

STEP 1: Table A lists the correct answers for all the questions on the Subject Test in Mathematics Level 2 that is reproduced in this book. It also serves as a worksheet for you to calculate your raw score.

- Compare your answers with those given in the table.
- Put a check in the column marked "Right" if your answer is correct.
- Put a check in the column marked "Wrong" if your answer is incorrect.
- Leave both columns blank if you omitted the question.

STEP 2: Count the number of right answers.

Enter the total here: _____

STEP 3: Count the number of wrong answers.

Enter the total here: _____

STEP 4: Multiply the number of wrong answers by .250.

Enter the product here: _____

STEP 5: Subtract the result obtained in Step 4 from the total you obtained in Step 2.

Enter the result here: _____

STEP 6: Round the number obtained in Step 5 to the nearest whole number.

Enter the result here: _____

The number you obtained in Step 6 is your raw score.

Table A

Answers to the Subject Test in Mathematics Level 2, Form 3YBC, and Percentage of Students Answering Each Question Correctly

Question Number	Correct Answer	Right	Wrong	Percentage of Students Answering the Question Correctly*	Question Number	Correct Answer	Right	Wrong	Percentage of Students Answering the Question Correctly*
1	D			88	26	D			85
2	C			91	27	B			70
3	D			90	28	C			65
4	A			87	29	E			47
5	C			90	30	D			73
6	E			54	31	C			54
7	C			62	32	D			72
8	D			93	33	D			23
9	D			85	34	C			62
10	B			89	35	B			57
11	E			84	36	D			51
12	C			54	37	E			63
13	B			87	38	C			52
14	D			75	39	C			52
15	A			88	40	D			48
16	B			67	41	A			42
17	B			62	42	B			33
18	A			70	43	C			63
19	D			76	44	B			54
20	D			72	45	A			46
21	C			82	46	B			46
22	C			67	47	E			44
23	C			70	48	A			35
24	B			66	49	D			25
25	E			60	50	A			26

* These percentages are based on an analysis of the answer sheets of a representative sample of 15,855 students who took the original form of this test in May 2002, and whose mean score was 652. They may be used as an indication of the relative difficulty of a particular question. Each percentage may also be used to predict the likelihood that a typical SAT Subject Test in Mathematics Level 2 candidate will answer that question correctly on this edition of the test.

Finding Your Scaled Score

When you take SAT Subject Tests, the scores sent to the colleges you specify are reported on the College Board scale, which ranges from 200–800. You can convert your practice test score to a scaled score by using Table B. To find your scaled score, locate your raw score in the left-hand column of Table B; the corresponding score in the right-hand column is your scaled score. For example, a raw score of 26 on this particular edition of the Subject Test in Mathematics Level 2 corresponds to a scaled score of 620.

Raw scores are converted to scaled scores to ensure that a score earned on any one edition of a particular Subject Test is comparable to the same scaled score earned on any other edition of the same Subject Test. Because some editions of the tests may be slightly easier or more difficult than others, College Board scaled scores are adjusted so that they indicate the same level of performance regardless of the edition of the test taken and the ability of the group that takes it. Thus, for example, a score of 400 on one edition of a test taken at a particular administration indicates the same level of achievement as a score of 400 on a different edition of the test taken at a different administration.

When you take the SAT Subject Tests during a national administration, your scores are likely to differ somewhat from the scores you obtain on the tests in this book. People perform at different levels at different times for reasons unrelated to the tests themselves. The precision of any test is also limited because it represents only a sample of all the possible questions that could be asked.

Table B

Scaled Score Conversion Table Subject Test in Mathematics Level 2 (Form 3YBC)					
Raw Score	Scaled Score	Raw Score	Scaled Score	Raw Score	Scaled Score
50	800	28	630	6	470
49	800	27	630	5	460
48	800	26	620	4	450
47	800	25	610	3	440
46	800	24	600	2	430
45	800	23	600	1	420
44	800	22	590	0	410
43	790	21	580	-1	400
42	780	20	580	-2	390
41	770	19	570	-3	370
40	760	18	560	-4	360
39	750	17	560	-5	350
38	740	16	550	-6	340
37	730	15	540	-7	340
36	710	14	530	-8	330
35	700	13	530	-9	330
34	690	12	520	-10	320
33	680	11	510	-11	310
32	670	10	500	-12	300
31	660	9	490		
30	650	8	480		
29	640	7	480		

How Did You Do on the Subject Test in Mathematics Level 2?

After you score your test and analyze your performance, think about the following questions:

Did you run out of time before reaching the end of the test?

If so, you may need to pace yourself better. For example, maybe you spent too much time on one or two hard questions. A better approach might be to skip the ones you can't answer right away and try answering all the questions that remain on the test. Then if there's time, go back to the questions you skipped.

Did you take a long time reading the directions?

You will save time when you take the test by learning the directions to the Subject Test in Mathematics Level 2 ahead of time. Each minute you spend reading directions during the test is a minute that you could use to answer questions.

How did you handle questions you were unsure of?

If you were able to eliminate one or more of the answer choices as wrong and guess from the remaining ones, your approach probably worked to your advantage. On the other hand, making haphazard guesses or omitting questions without trying to eliminate choices could cost you valuable points.

How difficult were the questions for you compared with other students who took the test?

Table A shows you how difficult the multiple-choice questions were for the group of students who took this test during its national administration. The right-hand column gives the percentage of students that answered each question correctly.

A question answered correctly by almost everyone in the group is obviously an easier question. For example, 93 percent of the students answered question 8 correctly. But only 23 percent answered question 33 correctly.

Keep in mind that these percentages are based on just one group of students. They would probably be different with another group of students taking the test.

If you missed several easier questions, go back and try to find out why: Did the questions cover material you haven't yet reviewed? Did you misunderstand the directions?