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.

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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

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) $\frac{17}{3}$

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MATHEMATICS LEVEL 2 TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

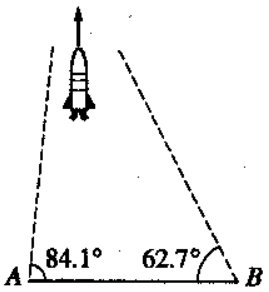
5. If $f(x) = 3\ln(x) - 1$ and $g(x) = e^x$, then $f(g(5)) =$

(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

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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) $x^2 + 1$

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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 $f(x) = \frac{5}{x^2 - 8x + 16}$, 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

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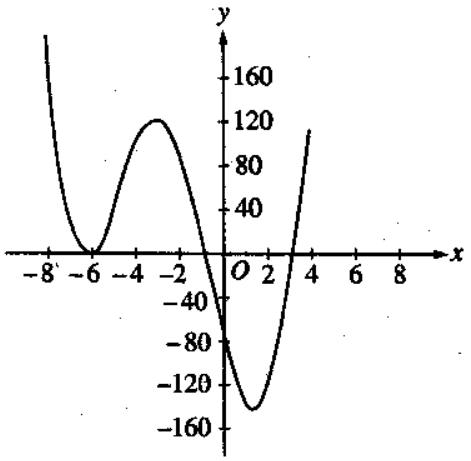
USE THIS SPACE FOR SCRATCHWORK.



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

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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) $\frac{5}{2}$

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MATHEMATICS LEVEL 2 TEST—*Continued*

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°

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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

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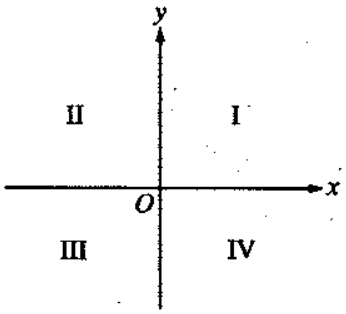
USE THIS SPACE FOR SCRATCHWORK.

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.

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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

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

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MATHEMATICS LEVEL 2 TEST—*Continued*

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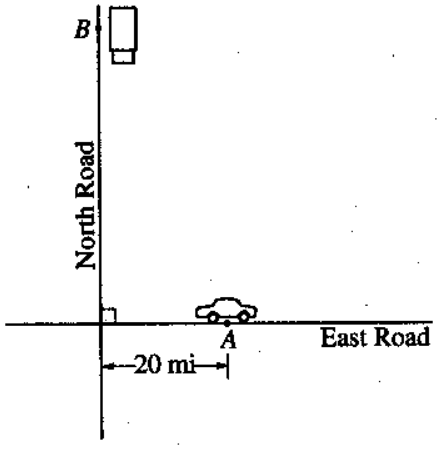

34. The figure above shows a car that has broken down on East Road. A tow truck leaves a garage on North Road at point B. The straight-line distance between points A and B is 50 miles. If the tow truck travels at an average speed of 45 miles per hour along North and East Roads, how long will it take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

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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

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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

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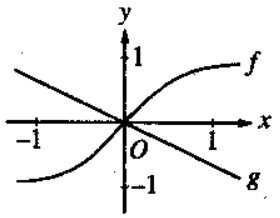
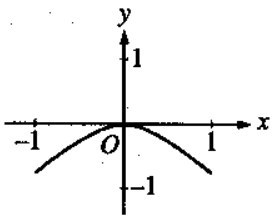
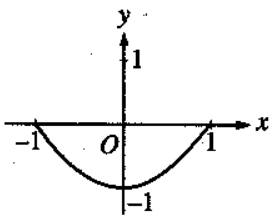


41. Portions of the graphs of f and g are shown above. Which of the following could be a portion of the graph of fg ?

(A)



(B)



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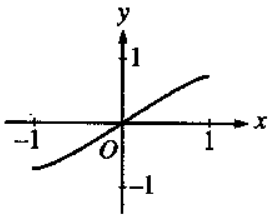

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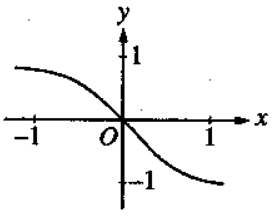

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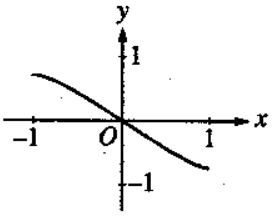

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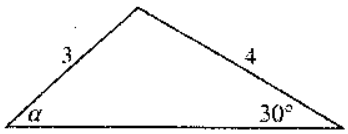
MATHEMATICS LEVEL 2 TEST—*Continued*

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

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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

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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

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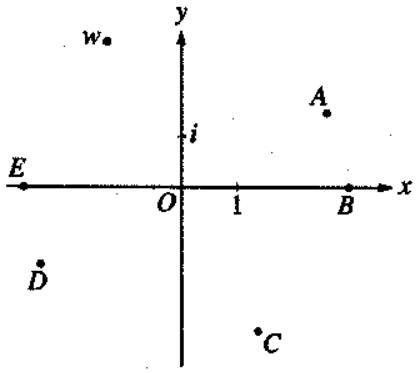
USE THIS SPACE FOR SCRATCHWORK.



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.

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.

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 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		