

Ivy Global

SAT Online Subject Test

Mathematics Level 2

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SAT Online Subject Test in Mathematics Level 2, Edition 1.2

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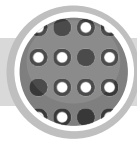
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| 20 A B C D E | 40 A B C D E | 60 A B C D E | 80 A B C D E | 100 A B C D E |



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Level 2 Mathematics Subject Test

Reference Materials

THE FORMULAS BELOW MAY BE USEFUL IN ANSWERING QUESTIONS ON THIS TEST.

$S = 4\pi r^2$ is the formula for the surface area of a sphere with a radius of r .

$V = \frac{1}{3}\pi r^2 h$ is the formula for a right circular cone with a radius of r and a height of h .

$V = \frac{4}{3}\pi r^3$ is the formula for a sphere with a radius of r .

$V = \frac{1}{3}Bh$ is the formula for a pyramid with a base area of B and a height of h .

When choosing an answer, find the CLOSEST answer possible. If the precise numerical value that you have found is not an answer choice, select the choice that is closest to your answer. Use the answer sheet and fill in the bubble corresponding to your choice.

- Notes:
- (1) You ARE permitted the use of a graphing or scientific calculator, which you may use at your own discretion. You will also have to choose between degree or radian mode for some questions; , so keep track of what mode your calculator is in.
 - (2) You may assume that figures are drawn as accurately as possible UNLESS it is explicitly stated that a figure is not drawn to scale. Further, all figures are in a plane UNLESS it is stated otherwise.
 - (3) For any function f , unless otherwise specified, you may assume that a real number x is in the domain of f if and only if $f(x)$ is a real number. The range of f consists of all and only those real numbers of the form $f(x)$, where x is in the domain of f .
 - (4) Four formulas are provided in the box above for your reference.

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USE THIS SPACE FOR SCRATCHWORK.

1. If $3^{x-3} + 10 = 19$, then $x =$
 - (A) 3
 - (B) 4
 - (C) 5
 - (D) 6
 - (E) 7

2. A number's prime factors are 2, 5, 7, 13, and 31. Which of the following must be a factor of the number?
 - (A) 4
 - (B) 6
 - (C) 10
 - (D) 15
 - (E) 25

3. What is the slope of the line that passes through the points (5, 4) and (-2, 3)?
 - (A) 0.14
 - (B) 0.20
 - (C) 0.33
 - (D) 5.00
 - (E) 7.00

4. What is the magnitude of the vector $\mathbf{v} = (5, 0, 7)$?
 - (A) 0.0
 - (B) 3.5
 - (C) 4.2
 - (D) 8.6
 - (E) 12.0

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5. $\frac{a^{-b}}{a^a} \times a^2$ is equivalent to

- (A) a^{-a-b+2}
- (B) a^{a-b+2}
- (C) a^{a+b-2}
- (D) $a^{-\frac{2b}{a}}$
- (E) $-\frac{2b}{a}$

6. If f is a linear function with nonzero slope, and $c < d$, which of the following must be FALSE?

- (A) $f(c) = f(d)$
- (B) $f(c) \neq f(d)$
- (C) $f(c) > f(d)$
- (D) $f(c) < f(d)$
- (E) $f(c) = 0$ or $f(d) = 0$

7. If $\sin \theta = \frac{4}{5}$, then $\cos \theta =$

- (A) $\frac{4}{5}$
- (B) $\frac{5}{4}$
- (C) $\frac{\pi}{2} - \frac{4}{5}$
- (D) $\frac{\pi}{2} - \theta$
- (E) $\frac{3}{5}$

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8. For which of the following values of x is

$$f(x) = \frac{7}{(x^4 - 5x^3 - 12x^2 + 36x)} \text{ defined?}$$

- (A) -3
- (B) 0
- (C) 2
- (D) 3
- (E) 6

$$\text{If } a + b = 0, \text{ then } |a| = |b|.$$

9. If a and b are real numbers, which of the following can be inferred from the statement above?

- (A) If $|a| = |b|$, then $a + b = 0$.
- (B) If $|a| \neq |b|$, then $a + b \neq 0$.
- (C) If $a + b \neq 0$, then $|a| \neq |b|$.
- (D) If $a - b = 0$, then $|a| \neq |b|$.
- (E) If $|a| \neq |b|$, then $a - b = 0$.

10. The mean of 7 numbers is 15. When an 8th number is added, the mean decreases to 12. What is the 8th number?

- (A) -12
- (B) -9
- (C) 0
- (D) 8
- (E) 12

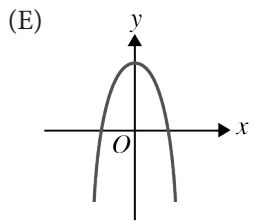
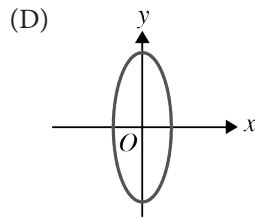
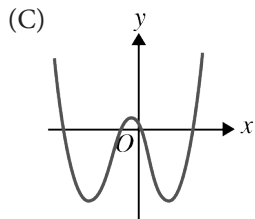
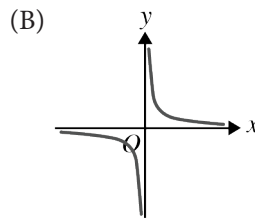
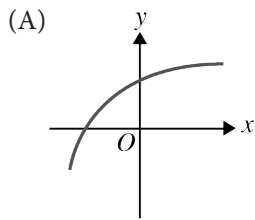
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11. If $f(x) = 3x$, $g(x) = 5x + 3$, and $h(x) = 1 - x^2$, then $f(g(h(x))) =$

- (A) $15x^2 + 15$
- (B) $-15x^2 + 18$
- (C) $-15x^2 + 24$
- (D) $-225x^2 + 90x - 8$
- (E) $-225x^2 - 90x - 8$

12. Which of the following is NOT a function of x ?



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13. If a line is perpendicular to $y = \frac{1}{2}x - 3$, then its equation could be

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

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

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

(D) $y = 2x - 3$

(E) $y = -2x - 3$

14. If a pentagon P with vertices at $(-2, -4)$, $(-4, 1)$, $(-1, 4)$, $(2, 4)$, and $(3, 0)$ is reflected across the line $y = x$ to get a new pentagon, P' , then one of the vertices of P' is

(A) $(0, -3)$

(B) $(4, 1)$

(C) $(2, 2)$

(D) $(4, -2)$

(E) $(-4, -2)$

15. Two poles stand on opposite sides of a level street that is 12 meters wide. If one pole is 5 meters taller than the other, what is the angle of elevation between the tops of the poles?

(A) $\sin^{-1}\left(\frac{5}{12}\right)$

(B) $\sin^{-1}\left(\frac{12}{13}\right)$

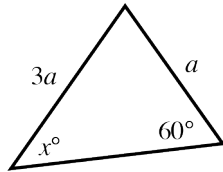
(C) $\tan^{-1}\left(\frac{5}{12}\right)$

(D) $\tan^{-1}\left(\frac{5}{13}\right)$

(E) $\cos^{-1}\left(\frac{5}{12}\right)$

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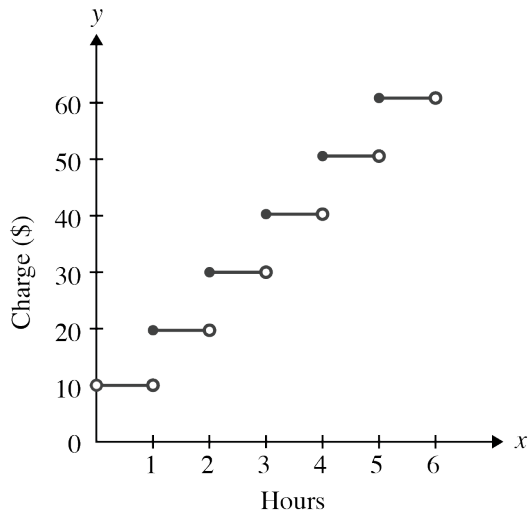
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16. What is the value of $\sin(x^\circ)$?
- (A) 0.289
(B) 0.342
(C) 0.500
(D) 16.778
(E) Cannot be determined from the given information
17. Which of the following points is NOT a solution to both the inequalities $y > 9x - 8$ and $y < -x + 8$?
- (A) $(-2, 15)$
(B) $(-1, 5)$
(C) $(0, 0)$
(D) $(1, 5)$
(E) $(1, 2)$

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18. A lawn mowing company charges its customers according to the step function $y = 10\lfloor x + 1 \rfloor$, for all $x > 0$, as shown in the graph above. If a customer's lawn takes 2 hours and 17 minutes to mow, how much does the company charge?

- (A) \$32.83
- (B) \$30.00
- (C) \$22.83
- (D) \$22.00
- (E) \$20.00

19. What is the range of the function $y = 5 + 3\sin(\pi - x)$?

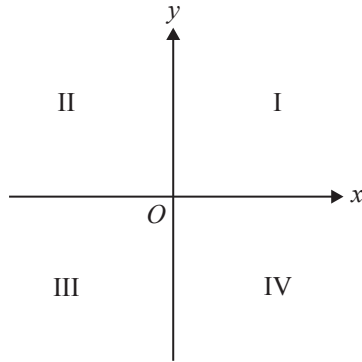
- (A) $-3 \leq y \leq 3$
- (B) $-2 \leq y \leq 8$
- (C) $0 \leq y \leq 6$
- (D) $2 \leq y \leq 8$
- (E) $y \in \mathbb{R}$

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20. If $g(x) = f(-x)$ for all real numbers x , and if $(3, 2)$ is a point on the graph of g , which of the following points MUST be on the graph of f ?

- (A) $(3, 2)$
- (B) $(3, -2)$
- (C) $(-3, 2)$
- (D) $(-3, -2)$
- (E) $(2, 3)$



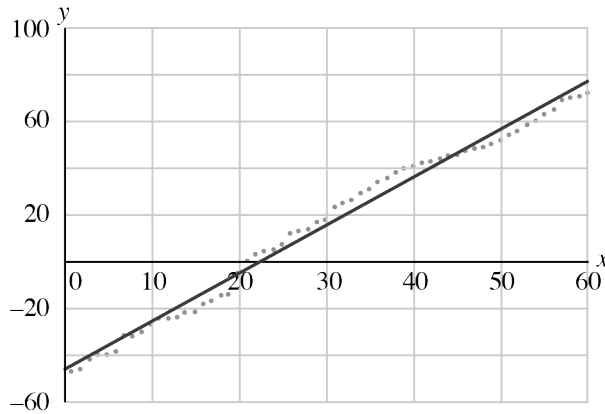
21. The figure above shows xy -coordinate space divided into four quadrants. If an angle measuring a° is located in Quadrant II, then which of the following statements must be true?

- I. $\cos(90^\circ - a^\circ)$ is positive
 - II. $\tan(a^\circ)$ is positive
 - III. a is positive
- (A) I only
 - (B) II only
 - (C) I and III
 - (D) II and III
 - (E) I, II, and III

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22. If $f(x) = x^3 + 2x^2 - 9x - 18$, which of the following statements is true?
- (A) $f(x) = 0$ has three real solutions.
- (B) $f(x) \geq -18$ for all $x \geq 0$.
- (C) $f(x) \leq -18$ for all $x \leq 0$.
- (D) The function $f(x)$ is decreasing for $x \leq -3$.
- (E) The function $f(x)$ is increasing for $x \geq -3$.



23. If a least-squares linear regression is used to model data, as shown in the graph above, what is a reasonable y -value estimate for an x -value of 197?
- (A) 202
- (B) 245
- (C) 352
- (D) 459
- (E) 512

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24. If $f: (x, y) \rightarrow (x + y, 2y - x)$ for every coordinate pair in the xy -plane, for what points (x, y) is it true that $f: (x, y) \rightarrow (x, y)$?
- (A) The set of points (x, y) such that $x = 0$
 - (B) The set of points (x, y) such that $y = 0$
 - (C) The set of points (x, y) such that $x = y$
 - (D) The set of points (x, y) such that $x = 2y$
 - (E) $(0, 0)$ only
25. In Canada in 2014, the average wholesale price of soybeans was \$0.24 per pound. In 2015, the average wholesale price of soybeans was \$0.16 per pound. If a retailer purchased 20,000 pounds of soybeans in 2014 and in 2015, what was the percent change in the retailer's expenses from 2014 to 2015?
- (A) -8%
 - (B) -33%
 - (C) -50%
 - (D) 8%
 - (E) 33%
26. If $f^{-1}(x) = \sqrt{7x^3}$ for $x \geq 0$, then $f(6) =$
- (A) 0.6297
 - (B) 0.9499
 - (C) 1.7261
 - (D) 38.8844
 - (E) 136.0233

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27. The cross-sectional area of a uranium nucleus is 1 *barn*, or 10^{-28} square meters. The amount of area required to sustain a cow for a year is 1 *cow's grass*, or 2.48×10^4 square meters. How many barns are in 1 cow's grass?

- (A) 4.03×10^{-33}
- (B) 4.03×10^{-28}
- (C) 2.48×10^{-28}
- (D) 2.48×10^{28}
- (E) 2.48×10^{32}

$$A = \{-10, -5, -3, -1, 0, 1, 3, 5, 10\}$$

28. The elements of Set A , shown above, are multiplied by 2 to get Set B . Which of the following is true about Set B ?

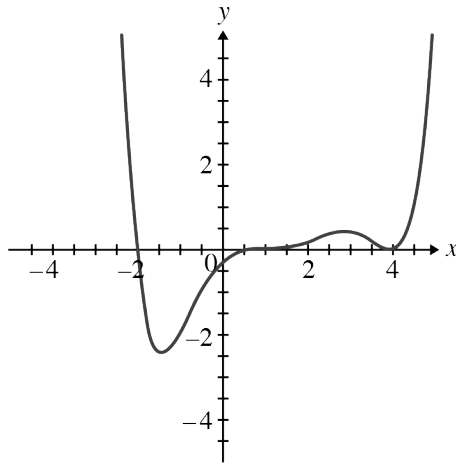
- (A) The mean of B is greater than the mean of A .
- (B) The median of B is greater than the median of A .
- (C) The median of B is less than the median of A .
- (D) The standard deviation of B is equal to the standard deviation of A .
- (E) The standard deviation of B is exactly twice the standard deviation of A .

29. If $f(2x) = x + 5$ and $f(g(6)) = 13$, then $2g(6) =$

- (A) 6
- (B) 16
- (C) 32
- (D) 36
- (E) 64

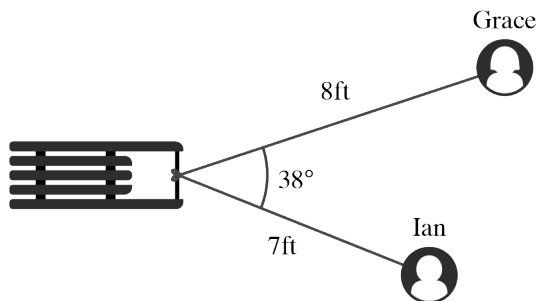
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30. Which of the following functions could produce the graph above?

- (A) $f(x) = 0.01(x - 1)(x - 4)(x + 2)$
 (B) $f(x) = 0.01(x + 1)^3(x + 4)^2(x - 2)$
 (C) $f(x) = 0.01(x + 1)^2(x + 4)^3(x - 2)^2$
 (D) $f(x) = 0.01(x - 1)^3(x - 4)^2(x + 2)$
 (E) $f(x) = 0.01(x - 1)^2(x - 4)^3(x + 2)^2$



31. Grace and Ian are working together to pull a sled, as shown in the figure above. If the angle between their ropes is 38° , what is the distance between them, to the nearest foot?

- (A) 4
 (B) 5
 (C) 6
 (D) 7
 (E) 8

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32. If $f(x) = 2x^3 + kx^2 - 2x - 3$ and $x - 1$ is a factor of $f(x)$, then $k =$

- (A) -1
- (B) 0
- (C) 2
- (D) 3
- (E) 5

33. How many different possible committees of 5 people can be chosen from a group of 15 people?

- (A) 75
- (B) 120
- (C) 225
- (D) $3,003$
- (E) $3,628,800$

34. If matrix A has dimensions 2×7 and matrix B has dimensions 7×5 , what are the dimensions of the product matrix AB ?

- (A) 2×2
- (B) 2×5
- (C) 5×2
- (D) 7×7
- (E) The product AB does not exist.

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35. For which of the following functions is the range equal to all real numbers?

(A) $f(x) = \frac{1}{2}x\left(x^3 - \frac{1}{5}x\right)$

(B) $f(x) = x(3x^5 + 2x)$

(C) $f(x) = 112x^{14} - 23x^8 - 14x$

(D) $f(x) = \frac{2}{3}x^3(10x^3)(12x^3)$

(E) $f(x) = (3x^2 - x)\left(\frac{5}{13}x^2\right)$

36. $\frac{\log_3 1,000,000}{\log_3 1,000} =$

(A) 1,000

(B) 100

(C) 20

(D) 10

(E) 2

37. A positive integer n is called “powerful” if, for every prime factor p of n , p^2 is also a factor of n . An example of a powerful number is

(A) 240

(B) 297

(C) 300

(D) 336

(E) 392

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38. The first three terms of a geometric sequence are $a_1 = 1$, $a_2 = -3$, and $a_3 = 9$. What is the formula for the n^{th} term in the sequence?

- (A) $a_n = 3^n$
- (B) $a_n = 3^{n-1}$
- (C) $a_n = (-3)^n$
- (D) $a_n = (-3)^{n-1}$
- (E) $a_n = (-3)^{2n-1}$

39. $(i + 1)(5 - 5i)(5 + 5i) =$

- (A) $50 + 50i$
- (B) $50 - 50i$
- (C) $25 + 25i$
- (D) $25 - 25i$
- (E) 0

40. If the distance between point $R(a, a, a)$ and point $J(6, -2, 0)$ is 10, then the value of a could be

- (A) $\frac{10}{3}$
- (B) 4
- (C) 5
- (D) 6
- (E) 10

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41. Under which of the following conditions must $\frac{a+b}{a-b}$ be negative?

- (A) $b = -a$
- (B) $b < 0 < a$
- (C) $a < 0 < b$
- (D) $|b| < |a|$
- (E) $|a| < |b|$

42. A circle passes through the points (3, 4) and (5, 7). Which of the following points CANNOT lie on the circle?

- (A) (-2, -1)
- (B) (3, 2)
- (C) (5, 5)
- (D) (6, 4)
- (E) (-1, -2)

43. If $\cos(2x) = \frac{1}{2}$, what is a possible value for x ?

- (A) 420°
- (B) 60°
- (C) -45°
- (D) -150°
- (E) -720°

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44. What expression can replace a in the equation

$$(\sqrt[3]{64})(\sqrt[3]{64}) = a\sqrt{64}?$$

- (A) $x + y$
(B) $x - y$
(C) $\frac{1}{x + y}$
(D) $\frac{1}{\frac{1}{x} + \frac{1}{y}}$
(E) $\frac{1}{x} + \frac{1}{y}$

45. At what value of x does the function $f(x) = x + 5 - \frac{x-3}{x^2-1}$ intersect its oblique asymptote?

- (A) -3
(B) 1
(C) 3
(D) 5
(E) $f(x)$ does not intersect any of its asymptotes.

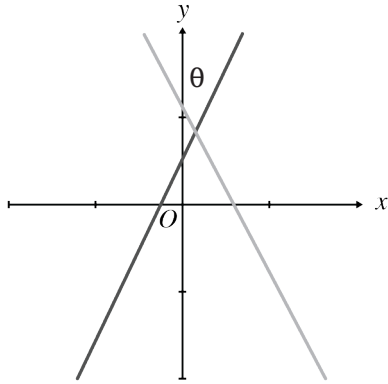
46. The shape of the graph represented by the equations

$$\begin{cases} x = \cos t \\ y = \sin t \end{cases}, \text{ for } 0 \leq t \leq \pi, \text{ is}$$

- (A) a circle
(B) a semicircle
(C) a sigmoid
(D) a parabola
(E) a line

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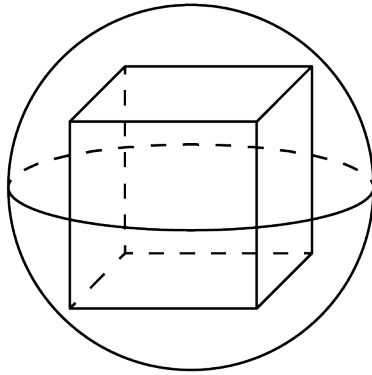


47. The graph above shows the lines $y = 2x + 7$ and $y = -2x + 12$. What is the measure of angle θ , in degrees?
- (A) 30.00
(B) 36.87
(C) 45.00
(D) 53.13
(E) 126.9
48. A meteorologist reports that there is a 30% probability of rain and no sun. If there is a 40% probability of no rain, then the probability of both rain and sun is
- (A) 0.16
(B) 0.24
(C) 0.30
(D) 0.50
(E) 0.60

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USE THIS SPACE FOR SCRATCHWORK.

49. Alex grows an initial culture of 100 *Rhizopus stolonifer* fungi on a sample of bread. She wants to model the growth of the fungi according to the exponential equation $A = Pe^{rt}$, where A is the final number of fungi, P is the initial number, r is the growth rate, and t is time elapsed in hours. If after 5 hours she measures the number of fungi to be 750, what is the value of r ?
- (A) 0.403
(B) 0.863
(C) 2.015
(D) 4.317
(E) 7.500



50. What is the surface area of a cube inscribed in a sphere with a radius of 8, as shown above?
- (A) 85.3
(B) 512.0
(C) 768.0
(D) 788.3
(E) 804.3

STOP

If you complete this test before the end of your allotted time, you may check your work.

Answers and Scoring

Answers and Scoring

Answers

1. C	11. C	21. A	31. B	41. E
2. C	12. D	22. A	32. D	42. E
3. A	13. E	23. C	33. D	43. D
4. D	14. E	24. E	34. B	44. D
5. A	15. C	25. B	35. D	45. C
6. A	16. A	26. C	36. E	46. B
7. E	17. A	27. E	37. E	47. D
8. D	18. B	28. E	38. D	48. C
9. B	19. D	29. C	39. A	49. A
10. B	20. C	30. D	40. D	50. B

Raw Scores

To score your test, first use the answer key to mark each of your responses as correct or incorrect. Don't mark or count questions you left blank. Then, calculate your **raw score** for each section by subtracting one fourth the number of incorrect responses from the number of correct responses. Scores should be rounded to the nearest whole number, with .5 and above rounding up. Use the tables below to help you calculate your scores:

Raw Score	
Number Correct	_____ -
Number Incorrect	_____ / 4 = _____
Raw Score	= _____

Scaled Scores

Once you have found your raw score for the test, convert it into an approximate **scaled test score** using the following chart. To find your scaled test score, find the row in the Raw Score column which corresponds to your raw score, then check the column next to it for the scaled score. For example, if you had a raw score of 31, your scaled score would be 680. Keep in mind that these scaled scores are estimates only. Your actual SAT Subject Test in Mathematics Level 2 score will be scaled against the scores of all other students at your grade level taking the test on your test date.

Scaled Score							
Raw Score	Scaled Score	Raw Score	Scaled Score	Raw Score	Scaled Score	Raw Score	Scaled Score
50	800	34	710	18	560	2	440
49	800	33	700	17	560	1	430
48	800	32	690	16	550	0	410
47	800	31	680	15	540	-1	390
46	800	30	670	14	530	-2	370
45	800	29	660	13	530	-3	360
44	800	28	650	12	520	-4	340
43	800	27	640	11	510	-5	340
42	790	26	630	10	500	-6	330
41	780	25	630	9	500	-7	320
40	770	24	620	8	490	-8	320
39	760	23	610	7	480	-9	320
38	750	22	600	6	480	-10	320
37	740	21	590	5	470	-11	310
36	730	20	580	4	460	-12	310
35	720	19	570	3	450		

Use the space below to record your scaled score:

Scaled Score: _____