Math Subject Test – Level 2 (harder) ~ Example 1

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

L2T1_1

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

L2T1_2

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

L2T1_3

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) $\frac{17}{3}$

L2T1_4

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

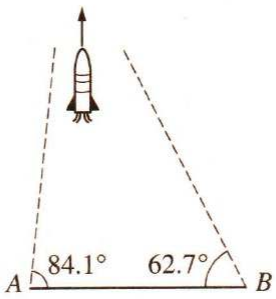
L2T1_5

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

L2T1_6



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

L2T1_7

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

L2T1_8

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

L2T1_9

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

(A) $\sqrt{x}$

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

(C) x

(D) x^2

(E) x^2+1

L2T1_10

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

L2T1_11

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

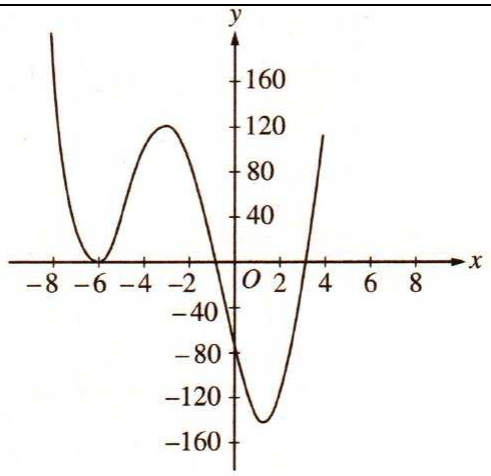
(A) empty
(B) a point
(C) a sphere
(D) a circle
(E) a plane

L2T1_12

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

L2T1_13



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

L2T1_14

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

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

L2T1_15

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

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

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

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

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

L2T1_16

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) $y = x + 2$

L2T1_17

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) $\frac{5}{2}$

L2T1_18

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) $s < 0$

L2T1_19

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) $a = b$

L2T1_20

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

L2T1_21

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°

L2T1_22

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

L2T1_23

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

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

L2T1_24

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

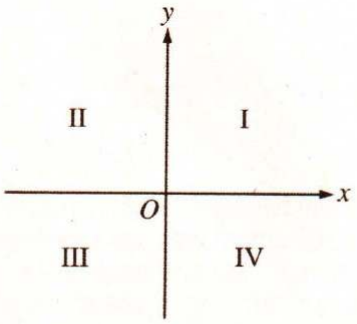
(A) 1, 5, 9
(B) 3, 5, 8
(C) 4, 5, 8
(D) 7, 8, 9
(E) 8, 8, 8

L2T1_25

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

L2T1_26



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.

L2T1_27

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) $(8, 3)$

L2T1_28

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.

L2T1_29

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

L2T1_30

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.

L2T1_31

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

L2T1_32

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

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

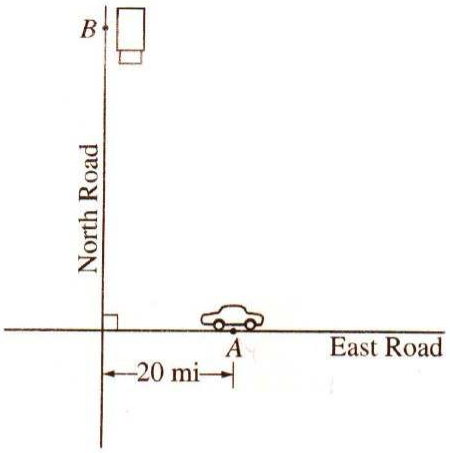
(B) $\frac{2}{3}$

(C) 2

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

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

L2T1_33



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 distanc 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

L2T1_34

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

L2T1_35

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

L2T1_36

37. If $0 \le x \le \frac{\pi}{2}$ 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

L2T1_37

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

L2T1_38

39. The Fibonacci sequence can be defined recursively as

$a_1 = 1$

$a_2 = 1$

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

What is the 10th term of this sequence?

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

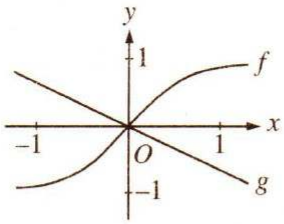
L2T1_39

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

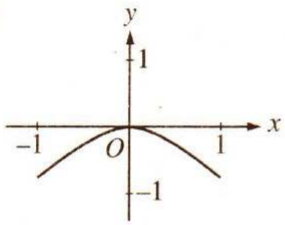
I. The function f is increasing for $x \geq 3$.
II. The equation $f(x) = 0$ has two nonreal solutions.
III. $f(x) \geq -16$ for all $x \geq 0$.

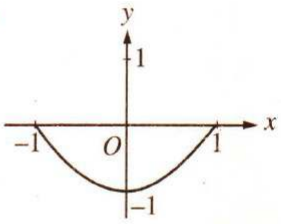
(A) I only
(B) II only
(C) I and II
(D) I and III
(E) II and III

L2T1_40



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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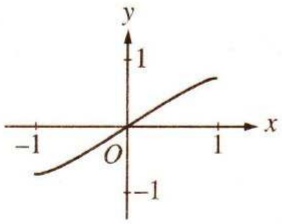

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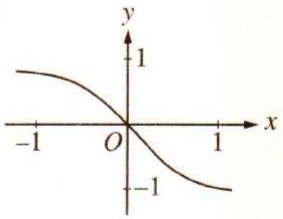

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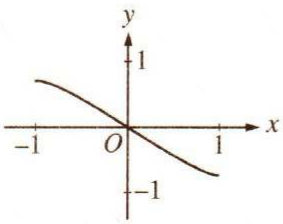
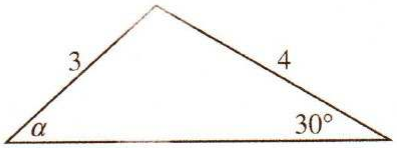


L2T1_41

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

L2T1_42



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) $\frac{4}{5}$

L2T1_43

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

L2T1_44

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

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

L2T1_45

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

L2T1_46

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

L2T1_47

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%

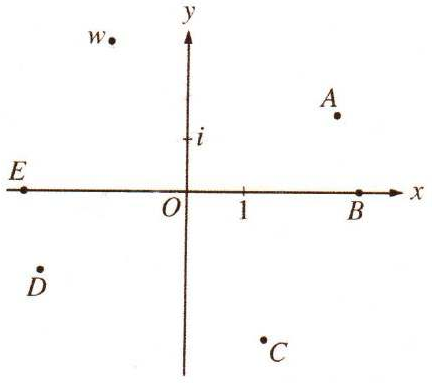
L2T1_48

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

L2T1_49



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

L2T1_50

Test	Section	Item No.	Difficulty	Correct Answer
Level 2	Test 1	1	88	d
Level 2	Test 1	2	91	c
Level 2	Test 1	3	90	d
Level 2	Test 1	4	87	a
Level 2	Test 1	5	90	c
Level 2	Test 1	6	54	e
Level 2	Test 1	7	62	c
Level 2	Test 1	8	93	d
Level 2	Test 1	9	85	d
Level 2	Test 1	10	89	b
Level 2	Test 1	11	84	e
Level 2	Test 1	12	54	c
Level 2	Test 1	13	87	b
Level 2	Test 1	14	75	d
Level 2	Test 1	15	88	a
Level 2	Test 1	16	67	b
Level 2	Test 1	17	62	b
Level 2	Test 1	18	70	a
Level 2	Test 1	19	76	d
Level 2	Test 1	20	72	d
Level 2	Test 1	21	82	c
Level 2	Test 1	22	67	c
Level 2	Test 1	23	70	c
Level 2	Test 1	24	66	b
Level 2	Test 1	25	60	e
Level 2	Test 1	26	85	d
Level 2	Test 1	27	70	b
Level 2	Test 1	28	65	c
Level 2	Test 1	29	47	e
Level 2	Test 1	30	73	d
Level 2	Test 1	31	54	c
Level 2	Test 1	32	72	d
Level 2	Test 1	33	23	d
Level 2	Test 1	34	62	c
Level 2	Test 1	35	57	b
Level 2	Test 1	36	51	d
Level 2	Test 1	37	63	e
Level 2	Test 1	38	52	c
Level 2	Test 1	39	52	c
Level 2	Test 1	40	48	d
Level 2	Test 1	41	42	a
Level 2	Test 1	42	33	b
Level 2	Test 1	43	63	c
Level 2	Test 1	44	54	b
Level 2	Test 1	45	46	a
Level 2	Test 1	46	46	b
Level 2	Test 1	47	44	e
Level 2	Test 1	48	35	a
Level 2	Test 1	49	25	d
Level 2	Test 1	50	26	a