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MATHEMATICS LEVEL IIC

Time—60 minutes

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 oval on the answer sheet.

Notes: (1) A 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. The calculator you use must be at least a scientific calculator; programmable calculators and calculators that can display graphs are permitted.

(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.

(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 $\sqrt[5]{4 - 3x} = 3$, what is the value of x ?

- (A) -82.33
- (B) -79.67
- (C) -1.75
- (D) 0.92
- (E) 82.33

2. If $f(a, b) = \frac{a + b}{2}$, which of the following is equal to $f(4, 8)$?

- (A) $f(0, 6)$
- (B) $f(1, 6)$
- (C) $f(2, 4)$
- (D) $f(2, 16)$
- (E) $f(3, 9)$

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MATHEMATICS LEVEL IIC TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

3. $\frac{6!}{3!5!} =$

- (A) 60 (B) 24 (C) 6 (D) 1 (E)
- $\frac{1}{60}$

4. The graph of which of the following equations has a slope of $\frac{1}{2}$?

(A) $y = \frac{1}{2}$

(B) $y = 2x$

(C) $y = 2x + 1$

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

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

5. If $f(x) = x + \sqrt{x}$ and $g(x) = f(f(x))$, then $g(1.7) =$

(A) 1.7

(B) 3.0

(C) 4.7

(D) 6.9

(E) 9.0

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MATHEMATICS LEVEL IIC TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

6. For all $m \neq 0$, $\frac{1 - \frac{1}{m}}{\frac{1}{m}} =$

(A) 1

(B) $m - 1$

(C) $\frac{m - 1}{m}$

(D) $\frac{1 - m}{m}$

(E) $m - \frac{1}{m}$

7. The graph of $y = bx - 1$ has points in the first quadrant if and only if

(A) $b \neq 0$

(B) $b < -1$

(C) $-1 < b < 1$

(D) $0 < b < 1$

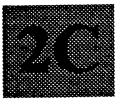
(E) $b > 0$

8. If $\tan x = 5$, then $\frac{\tan x}{\cot x} =$

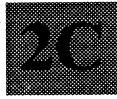
(A) $\frac{1}{5}$ (B) 1 (C) 5 (D) 10 (E) 25

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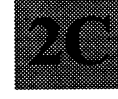
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MATHEMATICS LEVEL IIC TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

9. If $\frac{a + bc}{we + f} = g$ and if $efg \neq 0$, which of the following is equal to w ?

(A) $\frac{a + bc - fg}{eg}$

(B) $\frac{a + bc - g}{e}$

(C) $\frac{a - bc + fg}{eg}$

(D) $\frac{a + bc - f}{eg}$

(E) $\frac{a + bc - eg}{fg}$

10. If the probability of a certain event occurring is $\frac{4}{9}$, what is the probability of this event not occurring?

(A) $\frac{4}{13}$ (B) $\frac{4}{9}$ (C) $\frac{5}{9}$ (D) $\frac{9}{13}$ (E) $\frac{9}{4}$

11. If $x^4 - 19 = 19$ and $x \geq 0$, then $x =$

- (A) 0
(B) 2.08
(C) 2.48
(D) 4.36
(E) 6.16

**GO ON TO THE NEXT PAGE**

MATHEMATICS LEVEL IIC TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

12. In Figure 1, if $\theta = 38^\circ$, what is the value of t ?

- (A) 0.15
 (B) 0.20
 (C) 2.46
 (D) 3.13
 (E) 3.15

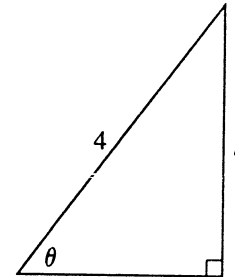


Figure 1

Note: Figure not drawn to scale.

13. Joe has a test average of 87 in mathematics. If his test average makes up 70 percent of his overall grade and the final exam makes up the remaining 30 percent, what must be his final exam score to give him an overall grade of exactly 90?

- (A) 91
 (B) 93
 (C) 95
 (D) 97
 (E) 99

14. An operation is defined on pairs of integers by $(a, b) \nabla (c, e) = (a - c, b - e)$. If $[(1, 2) \nabla (-3, 6)] \nabla (x, y) = (1, 1)$, then $(x, y) =$

- (A) $(5, -5)$
 (B) $(3, -7)$
 (C) $(3, -5)$
 (D) $(3, 5)$
 (E) $(-3, 5)$

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MATHEMATICS LEVEL IIC TEST—Continued

USE THIS SPACE FOR SCRATCHWORK.

15. If $\cos t = \frac{5}{6}$, what is the value of $\cos 2t$?

- (A) 0.92
- (B) 0.39
- (C) 0.28
- (D) 0.15
- (E) -0.83

16. Which of the following is a zero of $f(x) = 2x^2 - 3x - 1$?

- (A) -1.00
- (B) 0.28
- (C) 0.50
- (D) 1.78
- (E) 3.56

17. What is the number of digits in the number obtained by multiplying 12,121,212 by 3,579?

- (A) 4
- (B) 9
- (C) 10
- (D) 11
- (E) 12

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MATHEMATICS LEVEL IIC TEST—*Continued*

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18. If $\log_x 3 = 9$, then $x =$

- (A) 0.50
- (B) 1.13
- (C) 1.22
- (D) 2.00
- (E) 2.08

19. Which of the following is a point at which the ellipse

$$\frac{x^2}{5} + \frac{y^2}{15} = 1$$
 intersects the x -axis?

- (A) (2.2, 0)
- (B) (3.9, 0)
- (C) (4.5, 0)
- (D) (5.0, 0)
- (E) (15.0, 0)

20. The function f is given by $f(x) = x - [x]$, where $[x]$ is defined to be the greatest integer that is less than or equal to x . If $1 \leq x < 2$, then f is also given by $f(x) =$

- (A) $x - 2$
- (B) $x - 1$
- (C) x
- (D) $x + 1$
- (E) $x + 2$

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MATHEMATICS LEVEL IIC TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

21. In Figure 2, $r \sin \theta =$

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

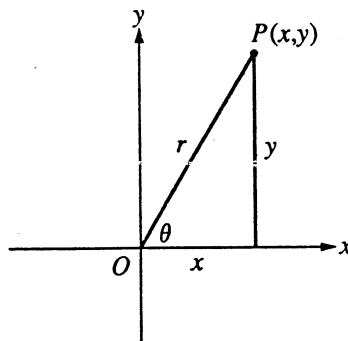


Figure 2

22. What is the remainder when $2x^4 - 3x^2 - x + 3$ is divided by $x + 1$?

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

23. In Figure 3, what is the length of segment AC ?

- (A) 4.47
- (B) 5.00
- (C) 5.39
- (D) 6.23
- (E) 9.00

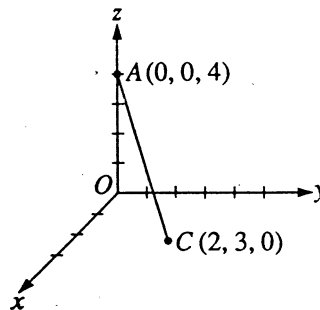


Figure 3

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MATHEMATICS LEVEL IIC TEST—Continued

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24. What is a value of $\cos(\arcsin 0.90)$?

- (A) 0.44
- (B) 0.58
- (C) 0.67
- (D) 0.71
- (E) 0.90

25. What is the area of a triangle whose vertices are $(\sqrt{2}, 0)$, $(2, \sqrt{10})$, and $(5, 0)$?

- (A) 3.59
- (B) 5.67
- (C) 7.91
- (D) 11.18
- (E) 11.34

26. If $x = \sqrt{t} - 1$ and $y = t^2$, what is y in terms of x ?

- (A) $(x + 1)^4$
- (B) $(x - 1)^4$
- (C) $(x + 1)^2$
- (D) $(x - 1)^2$
- (E) $x^2 + 1$

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MATHEMATICS LEVEL IIC TEST—Continued

USE THIS SPACE FOR SCRATCHWORK.

27. What is the maximum value of $f(x) = 4 - (x - 1)^2$?
- (A) 1
 - (B) 3
 - (C) 4
 - (D) 5
 - (E) 16
28. If a certain product now worth \$450 increases in value at the rate of 8 percent per year, how much will it be worth 6 years from now?
- (A) \$630
 - (B) \$661
 - (C) \$666
 - (D) \$714
 - (E) \$771
29. The 1st term of an arithmetic sequence is 3 and the 5th term is 17. What is the 150th term of the sequence?
- (A) 420.2
 - (B) 521.5
 - (C) 524.5
 - (D) 528.0
 - (E) 698.3

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MATHEMATICS LEVEL IIC TEST—Continued

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30. The cosine of an angle is one-half the sine of the same angle. What is the tangent of this angle?
- (A) 0
 (B) $\frac{1}{2}$
 (C) 1
 (D) 2
 (E) It cannot be determined from the information given.

31. The graph in Figure 4 could be a portion of the graph of which of the following functions?
- I. $f(x) = x^3 + ax^2 + bx + c$
 II. $g(x) = x^5 + ax^3 + bx + c$
 III. $h(x) = x^7 + ax^6 + bx^5 + cx^4 + dx^3 + ex^2 + fx + g$
- (A) I only
 (B) II only
 (C) III only
 (D) II and III only
 (E) I, II, and III

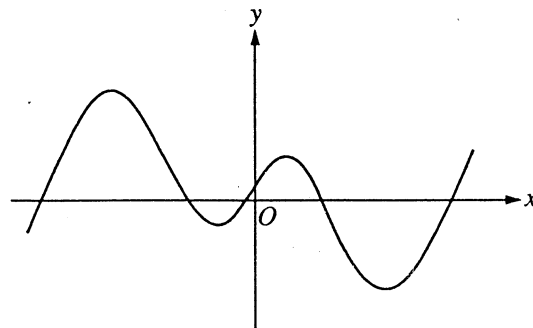


Figure 4

32. A right circular cylinder has radius 3 and height 3. If A and B are two points on its surface, what is the maximum straight-line distance between A and B ?
- (A) $3\sqrt{6}$ (B) $3\sqrt{5}$ (C) 6 (D) $3\sqrt{3}$ (E) $3\sqrt{2}$

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MATHEMATICS LEVEL IIC TEST—Continued

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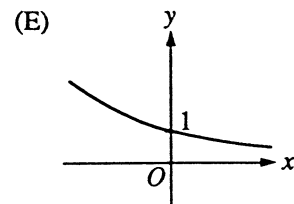
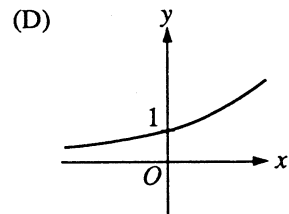
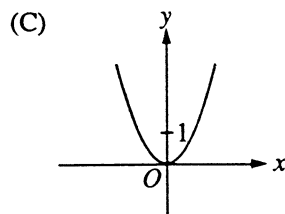
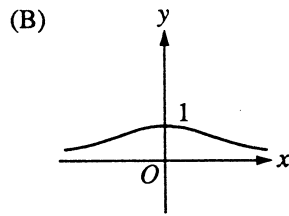
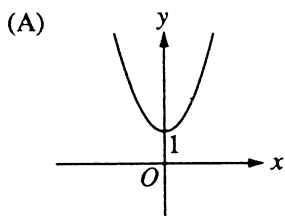
33. What is the degree measure of the smallest positive angle θ for which $6 \sin^2 \theta - \sin \theta - 2 = 0$?

- (A) 9.6°
 (B) 19.5°
 (C) 30°
 (D) 41.8°
 (E) 90°

34. The graph of $x^2 - y^2 - 2x - 4y - 4 = 0$ is a hyperbola centered at

- (A) $(-1, -2)$
 (B) $(-1, 2)$
 (C) $(1, -2)$
 (D) $(1, 2)$
 (E) $(2, 1)$

35. Which of the following could be a portion of the graph of $f(x) = \frac{e^x + e^{-x}}{2}$?



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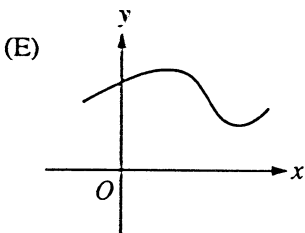
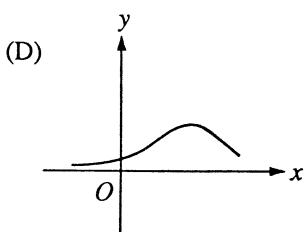
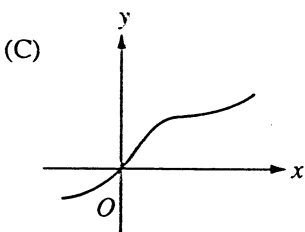
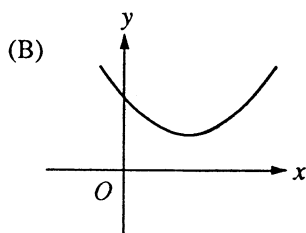
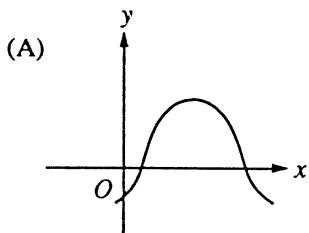
MATHEMATICS LEVEL IIC TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

36. If $\frac{p}{r}$ is an integer, which of the following must also be an integer?

(A) $p - r$ (B) $p + 2r$ (C) $\frac{r}{p}$ (D) pr (E) $\frac{2p}{r}$

37. A function f has the property that whenever $x_2 > x_1$, then $f(x_2) \geq f(x_1)$. Which of the following could be the graph of f ?



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MATHEMATICS LEVEL IIC TEST—*Continued*

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38. The two circles $x^2 + y^2 = 1$ and $(x - \sqrt{2})^2 + (y - \sqrt{2})^2 = 1$ are tangent to each other.

What are the coordinates of the point of tangency?

- (A) (0, 0.71)
(B) (0.5, 0.5)
(C) (0.71, 0)
(D) (0.71, 0.71)
(E) (1.41, 1.41)

39. What is $\lim_{x \rightarrow -2} \frac{2x^2 + 3x - 2}{x^2 - 4}$?

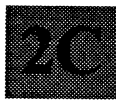
- (A) 1.25
(B) 1.0
(C) 0.5
(D) 0
(E) The limit does not exist.

40. A function f is an even function if, for all values of x in the domain, $f(-x) = f(x)$. Which of the following is an even function?

- (A) $f(x) = 2^x$
(B) $f(x) = x^2 + x$
(C) $f(x) = x$
(D) $f(x) = \sin x$
(E) $f(x) = \cos x$

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MATHEMATICS LEVEL IIC TEST—*Continued*

USE THIS SPACE FOR SCRATCHWORK.

41. Two cars start from the same point P and travel along separate straight highways. If these two highways originate at P , forming an angle of 80° , how many miles apart are the two cars after each has traveled 110 miles?

- (A) 86
 (B) 141
 (C) 156
 (D) 191
 (E) 220

42. The shaded portion in Figure 5 shows the graph of

- (A) $(y - \frac{1}{2}x)(y + x) \geq 0$
 (B) $(y - 2x)(y + x) \leq 0$
 (C) $(y - 2x)(y + x) \geq 0$
 (D) $(y + 2x)(y - x) \leq 0$
 (E) $(y + 2x)(y - x) \geq 0$

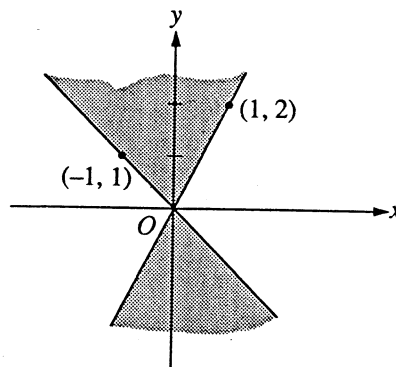


Figure 5

43. If $f(n) = \frac{1}{e^n}$, what is the least integer n such that $f(n) < 0.0001$?

- (A) 9
 (B) 10
 (C) 11
 (D) 12
 (E) 13

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MATHEMATICS LEVEL IIC TEST—Continued

USE THIS SPACE FOR SCRATCHWORK.

44. In right $\triangle ABC$ in Figure 6, $\frac{\sin A + \cos B}{\cos B}$ is equal to which of the following?

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

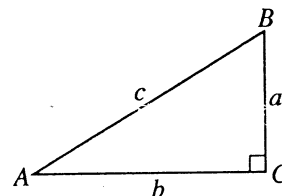


Figure 6

45. What is the volume, in cubic centimeters, of a rectangular solid that has faces with areas 2, 4, and 8 square centimeters?

(A) 128 (B) 64 (C) 32 (D) 16 (E) 8

46. For every positive number t , a function f_t is defined by

$$f_t(x) = \begin{cases} 1, & x < 0 \\ 1 - \left(\frac{1}{t}\right)x, & 0 \leq x \leq t \\ 0, & x > t. \end{cases}$$

If $t > 5$, then $f_t(2) =$

(A) 0 (B) 1 (C) $\frac{5-t}{t}$ (D) $\frac{t+5}{t}$ (E) $\frac{t-2}{t}$

47. In Figure 7, $ABCDE$ is a regular pentagon with side of length 2. What is the x -coordinate of D ?

(A) 2.62
(B) 3.62
(C) 3.73
(D) 3.90
(E) 4.90

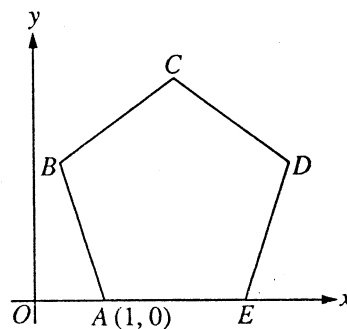


Figure 7

MATHEMATICS LEVEL IIC TEST—*Continued*

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48. If f is the function with domain $[0, 12]$ and range $[0, 1]$ whose graph is the line segment shown in Figure 8, what is $f^{-1}(0.4)$?

- (A) 30
 (B) 4.8
 (C) 2.5
 (D) 0.25
 (E) 0.033

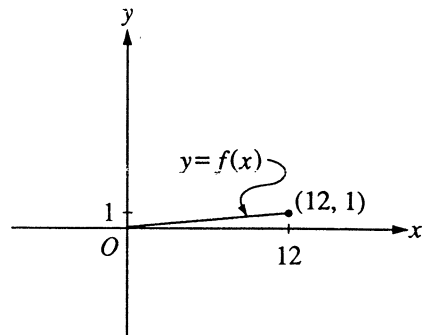


Figure 8

49. What does $|3 + 5i|$ equal?

- (A) 0.80
 (B) 1.67
 (C) 3.97
 (D) 5.83
 (E) 8.00

50. A committee of 3 mathematics majors and 4 history majors is to be chosen from a group of 20 mathematics majors and 16 history majors, respectively. How many different committees can be formed?

- (A) 12
 (B) 320
 (C) 2,960
 (D) 2,074,800
 (E) 2.86×10^{15}

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.

(6/93)

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