

2002 National Mu Alpha Theta Convention
THETA DIVISION—FUNCTIONS TOPIC TEST

NOTA means “None Of The Above”

1. The table shows the number of hybrid cottonwood trees planted in tree farms in Oregon since 1987. Find a cubic function to model the data and use it to estimate the number of cottonwoods planted in 1998.

Years since 1987	1	3	5	7	9
Trees planted (in thousands)	0.4	10.2	43.2	113.8	236.4

- A. 428.5 thousand B. 419.1 thousand C. 425.4 thousand
D. 336.2 thousand E. NOTA
2. If the revenue function for a certain product is $R = 100x - 0.05x^2$, find the value of x that yields the maximum revenue.
- A. 1500 B. 2000 C. 1000 D. 4000 E. NOTA
3. A farmer has available 1044 feet of fencing and wishes to enclose a rectangular field. If x represents the width of the rectangle, for what value of x is the area largest?
- A. 262 feet B. 260 feet C. 259.5 feet D. 261 feet E. NOTA
4. Determine the domain of $\log_4(3x - 3)$.
- A. $(1, \infty)$ B. $(-\infty, \infty)$ C. $[1, \infty)$ D. $(0, \infty)$ E. **NOTA**
5. What is the maximum value of $z = 26x + 11y$ subject to the constraints $2x + 2y \geq 4$, $4x - y \leq 8$, and $-2x + 3y \leq 6$.
- A. 122 B. 140 C. 100 D. 147 E. NOTA
6. If $f(x) = 4^x$, then $f(x+2) - f(x+1) + f(x) = \underline{\hspace{2cm}}$.
- A. $21(4^x)$ B. $19(4^x)$ C. $15(4^x)$ D. $13(4^x)$ E. $5(4^x)$
7. If $f(x) = \frac{4}{x-1}$, $g(x) = 2x$, then the solution set of $f(g(x)) = g(f(x))$ is:
- A. $\{1/3\}$ B. $\{2\}$ C. $\{3\}$ D. $\{-1, 2\}$ E. $\{1/3, 2\}$
8. The length of a rectangular piece of cardboard is 2 inches more than its width. An open box is formed by cutting out 4 inch squares from each corner and folding up the sides. If the volume of the box is 672 cubic inches, find the dimensions of the original piece of cardboard.

- A. 10" X 12" B. 20" X 22" C. 16" X 18" D. 22" X 24" E. NOTA

9. Find b if $x-2$ is a factor of $x^3 + bx^2 - 13x + 10$.

- A. $b=3$ B. $b = -2$ C. $b = 2$ D. $b = 1$ E. NOTA

10. The graphs of $2y + 3 + x = 0$ and $3y + ax + 2 = 0$ are lines. Find the value of a if the lines are perpendicular.

- A. $1/6$ B. -6 C. 6 D. $-1/6$ E. NOTA

11. Given the function $a(x) = 2x^3 - 3x^2 + 156x - 321$, evaluate $a(-2)$.

- A. -5 B. -161 C. -661 D. π E. NOTA

12. Given $b(d) = 2d^2 - 4d + 1$ and $c(d) = 3d - 2$, evaluate $b(c(e))$, rounded to four decimal places. Note: e is the natural log base

- A. 52.14 B. 12.71 C. 6.155 D. 4.905 E. NOTA

13. The function $c(r) = -\frac{1}{3}r^2 + \frac{9}{4}r - 2$ models the path of an electron as it travels in air,

where " r " is time, and " c " is height. What is, to four decimal places, the absolute maximum height the electron achieves (assuming that it can go underground and have a negative height)?

- A. 3.375 B. -13.39 C. -2.000 D. 1.797 E. NOTA

14. Decompose $\frac{3x-5}{x^2-5x+6}$ into $\frac{2a}{x-2} + \frac{b}{x-3}$. Calculate $-a^2$.

- A. $1/4$ B. 2 C. $-1/4$ D. -2 E. NOTA

15. Which of the following are odd functions?

- I. $f(x) = |x|$ II. $g(x) = x^3 - x$ III. $h(x) = x^2 + x$ IV. $j(x) = x^5$

- A. I only B. II, III C. I, III D. II, IV E. NOTA

16. If $k(x) = \frac{2x-3}{4x+2} + 4$, which of the following is this function's inverse?

- A. $k^{-1}(x) = \frac{-4x+2}{2x+3}$ B. $k^{-1}(x) = \frac{-2x-1}{4x-18}$ C. $k^{-1}(x) = \frac{4x+2}{2x-3} + \frac{1}{4}$
 D. $k^{-1}(x) = \frac{-2x+5}{4x-18}$ E. NOTA

17. Over what interval(s) for a would the function $ax^2 + 5x - 6 = a$ have complex non-real roots?

- A. $\left(-3 - \frac{\sqrt{11}}{2}, -3 + \frac{\sqrt{11}}{2}\right)$ B. $\left(-\infty, -3 - \frac{\sqrt{11}}{2}\right) \cup \left(-3 + \frac{\sqrt{11}}{2}, +\infty\right)$
C. $\left(-\infty, -\frac{25}{24}\right)$ D. $\left[-\frac{25}{24}, +\infty\right)$ E. NOTA

18. If $v(x) = \frac{x^3 - 3x^2 - 3x + 9}{x^2 - 9}$, find the equations of all the asymptotes of $v(x)$.

- A. $x = 3, x = -3$ B. $x = -3, y = x - 3$ C. $x = 3, x = -3, y = 0$ D. $x = 3, y = x + 3$
E. NOTA

19. The equation of a parabola that contains the points $(4, 1)$, $(2, 3)$, and $(-5, 4)$ can be written in the form $x = Ay^2 + By + C$. Find $A + B + C$.

- A. 2 B. 4 C. 6 D. 8 E. NOTA

20. If $B(x)$ is an odd function such that $B(1) = 2$, $B(3) = 5$, and $B(-5) = -1$, then what is the value of $B(B(B(-3)))$?

- A. -5 B. -2 C. 2 D. 5 E. NOTA

21. The product of the zeros of $C(x) = 3x^3 + 10x^2 - 60x - 9$ is:

- A. 3 B. -3 C. 2.88 D. $-10/3$ E. NOTA

22. Find how many natural numbers are solutions of $9x - 39 < 94$. When you write out (in letters) the number (of natural-numbered solutions), how many distinguishable permutations are there of that word?

- A. 40320 B. 24 C. 20160 D. 10080 E. NOTA

23. Find the equation of the axis of symmetry of the graph of $x = y^2 - 6y + 2$.

- A. $y = -3$ B. $y = 3$ C. $x = -7$ D. $y = -7$ E. NOTA

24. A candy store manager has 20 pounds of candy that costs him \$0.60 per pound and 10 pounds that costs him \$0.72 per pound. How many pounds of nuts at \$0.40 per pound must the manager mix with the candy in order to sell the mixture at \$0.60 per pound and make a profit that is $\frac{1}{14}$ of the cost?

A. 15 B. 5 C. 30 D. 12 E. NOTA

25. Find the difference between the larger root and the smaller root of

$$x^2 - px + \frac{p^2 - 1}{4} = 0$$

A. 1 B. p C. 0 D. 4p E. NOTA

TIEBREAKER; WORK IN THE WHITE PORTION ON THE BACK OF THE SCANTRON SHEET

Find all real values of x that satisfy $(x^2 - 5x + 5)^{(x^2 - 9x + 20)} = 1$

**THETA DIVISION—FUNCTIONS TEST
ANSWER KEY**

1. C
2. C
3. D
4. A
5. A
6. D
7. A
8. B
9. C
10. B
11. C
12. A
13. D
14. C
15. D
16. D
17. A
18. B
19. B
20. B
21. A
22. C
23. B
24. A
25. A

TIEBREAKER: MUST HAVE ALL THESE ANSWERS: 1, 2, 3, 4, 5