

**2003 FAMAT STATE CONVENTION  
THETA INDIVIDUAL TEST**

For each question, for choice E, the abbreviation **NOTA** stands for “None of these answers.”

1. Solve for  $x$ :  $2x + 10 = 70$   
A.  $-40$       B.  $-30$       C.  $30$       D.  $40$       E. NOTA
2. What is the slope of the line  $4x - 2y = 7$ ?  
A.  $-2$       B.  $-0.5$       C.  $0.5$       D.  $2$       E. NOTA
3. Evaluate  $\sum_{n=1}^5 (n^2 + 2n + 1)$   
A.  $55$       B.  $60$       C.  $86$       D.  $225$       E. NOTA
4. What is the domain of  $f(g(x))$  if  $f(x) = x^4 + 5$  and  $g(x) = \sqrt[4]{x-5}$  over the set of real numbers?  
A.  $(-\infty, \infty)$       B.  $(-\infty, 5) \cup (5, \infty)$       C.  $[5, \infty)$       D.  $(5, \infty)$       E. NOTA
5. For values of  $a > 2$  and  $x > 2$ ,  $\log_a x^2 + \log_a x^3 + \log_a x^4 + \dots + \log_a x^{10} = 54$ . What is the value of  $\log_a x$ ?  
A.  $1$       B.  $2$       C.  $3$       D.  $4$       E. NOTA
6. Tom decided to make his own temperature scale using the conversion formula  $T = \frac{4}{11}(F + 16)^2$ , where  $F$  is the Fahrenheit temperature and  $T$  is Tom's temperature. What is Tom's temperature when it is 83 degrees Fahrenheit outside?  
A.  $123\frac{3}{11}$       B.  $1296$       C.  $2132\frac{92}{121}$       D.  $3564$       E. NOTA
7. What is the least common multiple of the numbers 75, 80, and 90?  
A.  $5$       B.  $7200$       C.  $36000$       D.  $540000$       E. NOTA
8. What is the degree of the polynomial  $xyz^8 + 2x^4y^5 - 6x^2y^3z^2$ ?  
A.  $7$       B.  $8$       C.  $9$       D.  $10$       E. NOTA

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9. Which of the following sets are closed under the operation given?
- I.  $\{-1, 0, 1\}$ , multiplication
  - II. real numbers, division
  - III. natural numbers greater than 1,  $@$  (where  $x @ y = (x-1)(y+1)$ )
- A. I only      B. III only      C. I and III only      D. I, II, and III      E. NOTA
10. Simplify under the set of complex numbers:  $(\sqrt{-25})^2 + i^{9876} - (3 + 4i)(3 - 4i)$ , where  $i = \sqrt{-1}$ .
- A. -49      B. -17      C. 1      D. 33      E. NOTA
11. What is the y-intercept of the line which contains the points (3, 9) and (12, -15)?
- A. -28      B. 1      C. 17      D. 27      E. NOTA
12. Three arithmetic means are inserted between the numbers 4 and 5184. Three geometric means are also inserted between 4 and 5184. Which of the following could be the sum of the largest arithmetic mean and the largest geometric mean?
- A. 1439      B. 2159      C. 3021      D. 4033      E. NOTA
13. Two red and one yellow fair six-sided dice are rolled at the same time. The “score” of the dice is defined as the sum of the values on the red dice and triple the value of the yellow die. What is the probability of getting a “score” of 16?
- A.  $\frac{1}{18}$       B.  $\frac{1}{3}$       C.  $\frac{1}{2}$       D.  $\frac{5}{9}$       E. NOTA
14. Six years ago, Glenda was  $\frac{7}{9}$  as old as Wendy. Nine years from now, Glenda will be  $\frac{6}{7}$  of Wendy’s age in nine years. The product of their ages now is
- A. 480      B. 546      C. 567      D. 891      E. NOTA
15. Find the sum of all real  $x$  which satisfy the equation  $(x^2 - 2x - 7)^{(x^2 - 9x + 20)} = 1$ .
- A. 2      B. 3      C. 7      D. 9      E. NOTA

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16. Which value is restricted from the range of  $y = \frac{4x-3}{5x+2}$ ?
- A.  $-\frac{4}{5}$       B.  $-\frac{2}{5}$       C.  $\frac{2}{5}$       D.  $\frac{4}{5}$       E. NOTA
17.  $\frac{\sqrt{18+\sqrt{308}}}{\sqrt{20+\sqrt{336}}} = \frac{\sqrt{T} + \sqrt{U} - \sqrt{V} - 7\sqrt{2}}{-8}$ . Find  $T + U + V$ .
- A. -46      B. -10      C. 206      D. 262      E. NOTA
18. What are the asymptotes of the graph of  $y = \frac{4x^2-7}{9-x^2}$ ?
- A.  $x = 3, x = -3$       B.  $x = 3, x = -3, y = \frac{4}{9}$       C.  $x = 3, x = -3, y = 4$   
D.  $x = 3, x = -3, y = -4$       E. NOTA
19. Betsy opens an account at 5<sup>th</sup> Third National Bank with a \$3000 deposit. Leesa puts an initial deposit of \$3000 at 1<sup>st</sup> Fourth National Bank. Both banks have an interest rate of 2.5%, but 5<sup>th</sup> Third compounds the interest quarterly, while 1<sup>st</sup> Fourth compounds interest continuously. After 4 years, the banks round the account balances to the nearest penny. How much more money does Leesa have than Betsy?
- A. \$0.26      B. \$1.03      C. \$2.55      D. \$4.07      E. NOTA
20. Consider a regular polygon with  $n$  sides, where  $n$  is an even integer greater than 3. A diagonal is chosen at random from this polygon (assume all diagonals are equally likely to be chosen). What is the probability that no other diagonal of the polygon is longer than the diagonal selected?
- A.  $\frac{1}{n}$       B.  $\frac{1}{n-1}$       C.  $\frac{1}{n-2}$       D.  $\frac{1}{n-3}$       E. NOTA
21.  $6^{x-3} = 4^{x+5}$ . If  $x$  is written as a decimal, what is the 6<sup>th</sup> digit after the decimal point?
- A. 0      B. 1      C. 6      D. 8      E. NOTA

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22.  $f(x) = 14x^{2003} - 3x^{555} + 6x^2 + 3x$ . What is the remainder when  $f(x)$  is divided by  $x+1$ ?
- A. -20      B. -8      C. 8      D. 20      E. NOTA
23. When proving a mathematical formula (written in terms of  $n$ ) true using mathematical induction, there are 3 steps. First, show the formula is true for  $n = 1$ . Next, assume the formula is true for  $n = k$ , where  $k$  is a positive integer. To prove the formula true, show that it is true for which of the following?
- A.  $n = k + 1$       B.  $n = k - 1$       C.  $n = 2k$       D.  $n = k^2$   
E. NOTA
24. The points  $(1, 12)$ ,  $(2, 25)$ , and  $(3, 44)$  all lie on the curve  $y = Mx^2 + Nx + P$ , where  $M > 0$  and  $M, N$ , and  $P$  are relatively prime integers. What is  $M(N)(P)$ ?
- A. 30      B. 42      C. 50      D. 60      E. NOTA
25. What is the sum of the terms of  $Z^{-1}$  if  $Z = \begin{bmatrix} 2 & 1 & 0 \\ 1 & -1 & 3 \\ 0 & -2 & 1 \end{bmatrix}$ ?
- A.  $\frac{1}{9}$       B.  $\frac{2}{9}$       C.  $\frac{4}{9}$       D.  $\frac{5}{9}$       E. NOTA
26. Underwater basket weaving, rock climbing, and pottery are the only three elective classes offered at Public School #51213. The school has 139 new students coming in, and many of them have enrolled for one or more of these classes. Of these 139 students, 101 students are taking pottery, 79 are taking rock climbing, and 11 are taking none of the electives. 80 students are enrolled in underwater basket weaving and pottery, while 61 are signed up for rock climbing and pottery, and 57 are taking underwater basket weaving and rock climbing. 45 students plan to take all 3 classes. How many students are enrolled in ONLY underwater basket weaving?
- A. 5      B. 6      C. 9      D. 11      E. NOTA
27. If  $f(x) = x^3 + 3x + 4$ , find  $f(x-1)$ .
- A.  $x^3 + 3x + 3$       B.  $x^3 + 3x^2 + 6x + 2$       C.  $x^3 + 3x$   
D.  $x(x^2 - 3x + 6)$       E. NOTA

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28. If the sum of the absolute values of the roots of the equation  $(x^2 + 1)^2 - 7x^2 + 5 = 0$  is written as a decimal, the fifth digit after the decimal point is

- A. 2      B. 3      C. 5      D. 6      E. NOTA

29. For which type of conic is the eccentricity always greater than 1?

- A. circle      B. ellipse      C. hyperbola      D. parabola      E. NOTA

30.  $\frac{(27^{x+2})(9^{2x-5})(3^x)}{(81^{3x-2})(243^{5x+3})} = 3^y$ . Let  $y = Mx + N$ , where  $M$  and  $N$  are integers.

What is  $M + N$ ?

- A. -40      B. -18      C. 18      D. 40      E. NOTA