

"For all questions, answer choice "E. NOTA" means none of the above answers is correct."

1. Which of the following represents the equation for a rose curve with 6 petals of length 2?

- A.  $r = 2\cos(3\theta)$       B.  $r = 2\cos(6\theta)$       C.  $r = 6\cos(2\theta)$   
 D.  $r = 3\cos(2\theta)$       E. NOTA

2. If  $h(x) = ab^x$ , where  $a$  and  $b$  are real, and  $h(5) = 4$  and  $h(8) = 500$ , find  $h(7) + h(4)$ .

- A.  $\frac{504}{5}$       B. 120      C.  $\frac{12,504}{5}$       D. 2520      E. NOTA

3. For exactly one ordered pair  $(m,b)$  of real numbers the following system has infinitely many solutions:

$$\begin{aligned} y &= 3x - 6 \\ 2y + mx &= b \end{aligned}$$

Find  $m/b$ .

- A. -1      B.  $-\frac{1}{2}$       C.  $\frac{1}{2}$       D. 1      E. NOTA

In problems 4-6 Solve for  $x$ .

4. 
$$\frac{[\sin(x-9) + \cos(9-x)]^2 - 1}{1 - [\cos(x-9) - \sin(9-x)]^2} = x$$

- A. -1      B. 0      C. 1      D.  $\pi$       E. NOTA

5.  $\sin(\arctan(\frac{24}{x})) = \frac{12}{13}$

- A. 5      B. 10      C. 13      D. 26      E. NOTA

6.  $[\sin(x) + \cos(x)]^2 = \frac{-1}{2}$

- A.  $\frac{\pi}{6} + 2\pi n$       B.  $\frac{\pi}{6}, \frac{11\pi}{6} + 2\pi n$       C.  $\frac{\pi}{6}, \frac{7\pi}{6} + 2\pi n$       D.  $\frac{5\pi}{6}, \frac{7\pi}{6} + 2\pi n$       E. NOTA

7. Give the range for the function given by the following equation:  $f(x) = 4e^{-(x-2)^2} - 1$

- A.  $(-3, -1)$       B.  $(-1, 3]$       C.  $(-1, \infty)$       D.  $(-\infty, \infty)$       E. NOTA

8. Given the following system:

$$\begin{aligned} 9 + b^2 &= c^2 \\ b^2 + 36 - 12b \cos(A) &= 9 \\ 9 + c^2 - 3c &= b^2 \end{aligned}$$

where all values are positive, find  $bc \cdot \sin(A)$

- A.  $\frac{9}{2}$       B. 9      C.  $\frac{9\sqrt{3}}{2}$       D.  $9\sqrt{3}$       E. NOTA

9. What is the product of all solutions to the equation  $2^{x-2} = 8^{x^2-5x-37}$ ?

- A.  $-109$       B.  $-\frac{111}{3}$       C.  $-\frac{109}{3}$       D.  $-\frac{37}{3}$       E. NOTA

10. What is the sum of all the solutions on the interval  $[0, 2\pi]$  for the equation

$$3 \sin(\theta)\cos(\theta) + \tan(\theta) = \frac{\sin^2(\theta)+1}{\cot(\theta)}$$

- A. 0      B.  $\frac{4\pi}{3}$       C.  $\frac{5\pi}{3}$       D.  $4\pi$       E. NOTA

11. Given the following system:

$$\begin{aligned} wx + y + z &= 4 \\ w + xy - z &= 18 \\ -w - x + yz &= 7 \\ x - y + wz &= 1 \end{aligned}$$

Find  $wx + xy + yz + wz$ .

- A. 7.5      B. 15      C. 30      D. 60      E. NOTA

12. Find  $a^3 + b^3$  where  $a$  and  $b$  are the solutions to the following equation:  $\frac{x^3 - 13x + 12}{x - 1} = 18$

- A.  $-91$       B.  $-37$       C. 37      D. 91      E. NOTA

For problems 13-15 use the following function:  $f(x) = A\sin(2Bx + C) + D$

13. Give an expression for C so that  $f(x) = A\sin(-2Bx) + D$  for any value of x.

- A.  $\pi$       B.  $2\pi$       C.  $\frac{\pi}{B}$       D.  $\frac{2\pi}{B}$       E. NOTA

14. Give an expression for C so that  $f(x) = -A\cos(2Bx) + D$  for any value of x.

- A.  $\frac{\pi}{2}$       B.  $\frac{3\pi}{2}$       C.  $\frac{\pi}{2B}$       D.  $\frac{3\pi}{2B}$       E. NOTA

15. Find the product ABD such that a full period of  $f(x)$  has two consecutive maxima at the points (2, 5) and (10, 5) and a minimum at the point (6, -3). A, B, and D should all be positive.

- A.  $\frac{1}{2}$       B. 1      C.  $\frac{\pi}{2}$       D.  $\pi$       E. NOTA

For #16-18, find the sum of all real solutions for x:

16.  $((2x + 5)^{x+7})^{x-3} = (15x - 72)^0$

- A. -9      B. -6      C. -5      D. -4      E. NOTA

17.  $2x^3 + 2x^2 - x - 1 = 0$

- A. -1      B.  $1 - \sqrt{2}$       C. 1      D.  $1 + \sqrt{2}$       E. NOTA

18.  $\sqrt{x^4 - 6x^2 + 9} = 2x$

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

Use the table below for the 4<sup>th</sup> degree polynomial  $f(x)$  with rational coefficients in problems 19-20:

x	-1	1	2	3	4
f(x)	144	-12	-6	0	-6

19. Find the y-intercept of  $f(x)$ .

- A. 18      B. 21      C. 24      D. 27      E. NOTA

20. If  $f(x) = x^4 - ax^3 + bx^2 - cx + d$ , find  $a + b + c - d$

- A. 89      B. 90      C. 108      D. 109      E. NOTA

21. If  $f(x) = x^5 - 10x^4 + 40x^3 - 80x^2 + 80x - 32$ , find  $f^{-1}(x)$ .

A.  $f^{-1}(x) = \frac{1}{x^5 - 10x^4 + 40x^3 - 80x^2 + 80x - 32}$       B.  $f^{-1}(x) = \frac{1}{x^5} - \frac{10}{x^4} + \frac{40}{x^3} - \frac{80}{x^2} + \frac{80}{x} - 32$

C.  $f^{-1}(x) = \sqrt[5]{x} + 2$       D.  $f^{-1}(x) = \sqrt[5]{x + 2}$       E. NOTA

22. If a and b are solutions to the equation:  $\sec\left(\frac{181\pi}{6} - \theta\right) = 2$  that satisfy  $0 < \theta < 2\pi$ , find  $\sin^2(3a) + \cos^2(18b)$

- A. 0      B. 1      C. 2      D. cannot be determined      E. NOTA

23. Find the sum of all solutions for  $\theta$  on the interval  $[0, \pi]$  in the following equation:

$$2\sin(2\theta)\cos(2\theta) + \cos^2(\theta) = \frac{1 - \cos(2\theta)}{2}$$

- A.  $\frac{5\pi}{2}$       B.  $5\pi$       C.  $9\pi$       D.  $18\pi$       E. NOTA

24. Find the positive value of  $c$ , given the following system:

$$\begin{aligned}a + b + c &= 6 \\ab + bc + ac &= 13 \\a^2 + b^2 &= 2\end{aligned}$$

- A.  $2\sqrt{2}$       B.  $\sqrt{21}$       C. 8      D. 21      E. NOTA

25. Which of the following is the rectangular form of the equation:  $r = \sec(\theta)\tan(\theta)$ ?

- A.  $y = \sec(x)\tan(x)$       B.  $y = x^2$       C.  $x = y^2$       D.  $x = 1$       E. NOTA

26. A circle and a hyperbola have the same center  $(2,3)$ . The circle has a radius of 5 and the hyperbola has a vertex on the  $x$ -axis and both foci on the circle. Give the coordinates of the point of intersection between these two conics closest to the origin.

- A.  $(-\frac{6}{5}, -\frac{4}{5})$       B.  $(-\frac{6}{5}, \frac{34}{5})$       C.  $(-\frac{16}{5}, -\frac{4}{5})$       D.  $(-\frac{6}{5}, -\frac{34}{5})$       E. NOTA

27. Find  $a^2 + b^2 + c^2 + 2ab + 2bc + 2ac$  given the following system:

$$\begin{aligned}-a + b + c &= 3 \\a - b + c &= 5 \\a + b - c &= -2\end{aligned}$$

- A. -30      B. -24      C. -1      D. 36      E. NOTA

For problems 28-30 give the product of all real solutions for  $x$ .

28.  $9^x - 28 \cdot 3^{x-1} + 3 = 0$

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

29.  $\sqrt{x+2} + \sqrt{x} = \sqrt[5]{32}$

- A.  $-\frac{1}{16}$       B.  $-\frac{1}{4}$       C.  $\frac{1}{4}$       D.  $\frac{1}{2}$       E. NOTA

30.  $9 \ln(\sqrt{x+1}) [\log_3(e^2)] = 1$

- A.  $\sqrt[9]{e} - 1$       B.  $\sqrt[9]{3} - 1$       C.  $\sqrt[3]{e} - 1$       D.  $\sqrt[3]{3} - 1$       E. NOTA