

Choose the letter of the correct answer for each problem. NOTA means "none of these answers."

1. Let A be the slope of the line  $4x - 2y = 4$ , let (B, C) be the vertex of the parabola  $y = x^2 + 4x - 1$ , and let D be the length of the major axis of the ellipse  $9x^2 + 4y^2 = 36$ . Find the value of  $A + B + C + D$ .

A) 5                      B) -1                      C) -3                      D) 1                      E) 7

2. Let  $x = 1 + \frac{1}{2 + \frac{1}{3}}$ ,  $y = 1 + \frac{1}{2 + \frac{1}{3 + \frac{1}{4}}}$ , and  $z = 1 + \frac{1}{2 + \frac{1}{3 + \frac{1}{4 + \frac{1}{5}}}}$ . Which of the following is correct?

A)  $x < y < z$                       B)  $x < z < y$                       C)  $y < z < x$                       D)  $y < x < z$   
E) NOTA

3. Identify the domain and the range of the following:  $y = 3 + \sqrt{x + 1}$ .

A) D:  $x \geq -1$                       B) D:  $x \geq -1$                       C) D:  $x \geq 3$                       D) D:  $x \geq 1$                       E) NOTA  
R:  $y \geq 3$                       R:  $y \leq 3$                       R:  $y \geq 1$                       R:  $y \geq 3$

4. Solve the equation:  $\sqrt{-5 - 5m} = 2 + \sqrt{3 - m}$

A) -6                      B) -6, 2                      C) -6, -10                      D) -1, -6                      E) NOTA

5. The minute hand on Big Ben in London is 8 feet long. What is the arc length traversed by the tip of the minute hand in 38 minutes?

A)  $\frac{19\pi}{675}$  ft.                      B)  $\frac{76\pi}{45}$  ft.                      C)  $\frac{76\pi}{15}$  ft.                      D)  $\frac{152\pi}{15}$  ft.                      E) NOTA

6. Find all solutions to the polynomial equation  $x^3 + 2x^2 - 19x - 20 = 0$ .

A) -5, -1, 4                      B) -5, 1, -4                      C) 5, -1, 4                      D) 5, 1, -4                      E) NOTA

7. How many times will the graph of  $y = \sin 4x$  intersect the x-axis on the interval  $[0, 4\pi]$ ?
- A) 8                      B) 12                      C) 15                      D) 17                      E) NOTA
8. What figure is obtained when  $r = 3 + 3 \cos \theta$  is graphed?
- A) limaçon              B) lemniscate              C) rose                      D) cardioid              E) NOTA
9. What is the probability of drawing a red face card or a king from a standard deck of 52 cards?
- A)  $\frac{7}{52}$                       B)  $\frac{2}{13}$                       C)  $\frac{9}{52}$                       D)  $\frac{5}{26}$                       E) NOTA
10. What is the sum of the units digits in  $8^{2019}$ ,  $3^{2019}$ , and  $7^{2019}$ ?
- A) 27                      B) 22                      C) 12                      D) 8                      E) NOTA
11. Find the sum of the values of  $x$  that make  $(x^2 + 6x + 6)^{x^2 - 7x + 6} = 1$ .
- A) 13                      B) 11                      C) 1                      D) 0                      E) NOTA
12. The Gateway Arch in St. Louis is 630 feet tall at its center and 630 feet wide at its base. John is standing one-third of the way from one foot of the arch to the other. Assuming the arch is parabolic, how far above ground is the arch directly above John?
- A) 560 ft.              B) 530 ft.              C) 420 ft.              D) 350 ft.              E) NOTA
13. What is the  $y$  coordinate of the hole in the graph of  $f(x) = \frac{x^2 + 4x - 12}{x^2 - 36}$ ?
- A)  $\frac{3}{2}$                       B) 1                      C)  $\frac{3}{4}$                       D) 0                      E) NOTA

14. For what value of  $k$  does the system  $\begin{cases} 2x - y + 3z = 4 \\ 7x - 2y + kz = 7 \\ 5x - 2y + z = 11 \end{cases}$  have no solution?
- A) -9      B) -1      C) 1      D) 9      E) NOTA
15. What is the rectangular equation of the polar equation  $r = 3 \cos \theta$ ?
- A)  $x^2 + y^2 = 9y$       B)  $x^2 + y^2 = 3x$       C)  $x^2 + y^2 = 3$   
D)  $x^2 + y^2 = 3y$       E) NOTA
16. When the polynomial  $x^3 - 3$  is divided by the polynomial  $x^2 - 2x$ , the remainder is
- A) 3      B) -3      C)  $4x - 3$       D)  $-4x - 3$       E) NOTA
17. What is  $2019_{12}$  when written in base 5?
- A)  $112402_5$       B)  $102402_5$       C)  $103302_5$       D)  $121212_5$       E) NOTA
18. Evaluate  $(1 + i)^8$ .
- A) 16      B) -4      C)  $8 - 8i$       D)  $-8i$       E) NOTA
19. Find the domain of the function  $f(x) = \frac{\sqrt{4-x^2}}{x+1}$ .
- A)  $[-2, -1) \cup (-1, 2]$       B)  $(-\infty, -2] \cup [2, \infty)$       C)  $[-2, 2]$   
D)  $(-\infty, -1) \cup (-1, \infty)$       E) NOTA
20.  $1 - 4i$  is a zero of  $f(x) = x^4 - 4x^3 + 18x^2 - 29x - 51$ . What is the product of the other three zeros of the function?
- A)  $2 + 8i$       B)  $\frac{51+204i}{15}$       C)  $-3 - 12i$       D)  $\frac{-17-68i}{5}$       E) NOTA

21. Evaluate  $\sin\left[\operatorname{Arctan}\left(-\frac{3}{4}\right) + \operatorname{Arcsin}\left(\frac{5}{13}\right)\right]$ .
- A) 63/65      B) 56/65      C) 33/65      D) -16/65      E) NOTA
22. If  $(\log x)^2 = \log x^2$  has solutions  $r_1$  and  $r_2$ , what is  $r_1 + r_2$ ?
- A) 2      B) 4      C) 100      D) 101      E) NOTA
23. Find the sum of the solutions of  $\sin x \tan x - \sin x + \tan x - 1 = 0$  over  $[0, 2\pi]$ .
- A)  $3\pi$       B)  $\frac{5\pi}{2}$       C)  $\frac{7\pi}{4}$       D)  $\frac{3\pi}{2}$       E) NOTA
24. What is  $xy$  if  $x^2 + y^2 = 15$  and  $x^3 + 3x^2y - x + y^3 + 3xy^2 - y = 0$ ?
- A) -14      B) -7      C) 14      D) 22      E) NOTA
25. Solve:  $x^3 - 11x^2 + 31x - 21 > 0$
- A)  $1 < x < 3$  or  $x > 7$       B)  $x < 1$  or  $3 < x < 7$       C)  $1 < x < 7$   
D)  $-7 < x < -3$  or  $x > 1$       E) NOTA
26. What is the period of  $f(x) = 6 \sin x \cos x$ ?
- A)  $4\pi$       B)  $2\pi$       C)  $\pi$       D)  $\pi/3$       E) NOTA
27. When you solve the triangle with  $a = 4$ ,  $b = 6$ , and  $\angle A = 30^\circ$ , how many solutions are possible?
- A) 0      B) 1      C) 2      D) infinitely many      E) NOTA

28. Simplify:  $(\sec 60^\circ)(\tan 240^\circ)(\cos 300^\circ)(\sin 150^\circ)$

- A)  $\frac{\sqrt{3}}{4}$       B)  $\frac{\sqrt{3}}{2}$       C)  $\frac{1}{2}$       D) -2      E) NOTA

29. The polar coordinate  $(3, 150^\circ)$  is equivalent to all of the following except which one?

- A)  $(3, 510^\circ)$       B)  $(-3, 330^\circ)$       C)  $(3, -210^\circ)$   
D)  $(-3, -30^\circ)$       E) NOTA

30. If  $2^{2x} + 2^{x+1} - 15 = 0$ , what is  $\log_3 8$ ?

- A)  $x^3$       B)  $x/3$       C)  $3/x$       D)  $1/x^3$       E) NOTA

ANSWERS:

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