For all questions, answer choice (E) NOTA means that none of the given answers is correct. Good Luck!

1. Find the area defined by the intersection of the solutions of the two inequalities:

$$x^2 - 6x + y^2 > 0$$
$$|x| + |y| < 3$$

   (A) $32 - 9\pi$ (B) $18 - 9\pi$ (C) $32 - \frac{9\pi}{4}$ (D) $18 - \frac{9\pi}{4}$ (E) NOTA

2. Given that $f(x) = \dfrac{x^3 - x^2 - x + 1}{x^3 + 2x^2 - x - 2}$, how many asymptotes does the graph of $f(x)$ have?

   (A) 0   (B) 1   (C) 2   (D) 3   (E) NOTA

3. Find the number of solutions to:

$$x - \frac{7}{x+5} = -5 - \frac{7}{x+5}$$

   (A) No solutions.
   (B) One integral solution.
   (C) Infinitely many solutions.
   (D) Two solutions.
   (E) NOTA

4. Find the determinant of the matrix: $\begin{bmatrix} 5 & 6 & 7 \\ 1 & 2 & 3 \\ 0 & 5 & 0 \end{bmatrix}$

   (A) -75 (B) 35   (C) 40   (D) -40 (E) NOTA

5. How many zeroes are at the end of $28^4 * 360^7$?

   (A) 28   (B) 7   (C) 4   (D) 5   (E) NOTA

6. Simplify the expression to remove any nested radicals: $\sqrt{5 + \sqrt{24}}$.

   (A) $1 + \sqrt{5}$ (B) $\sqrt{2} + \sqrt{3}$ (C) $\sqrt{6} + 2$ (D) Cannot be Reduced.   (E) NOTA

7. Identify the following conic:

$$16x^2 - 96x - 9y^2 + 18y + 135 = 0$$

   (A) Circle   (B) Non-Circular Ellipse   (C) Parabola   (D) Hyperbola   (E) NOTA

8. Calculate the number of digits in 2^{1024} given that $\log 2 = 0.301$.

   (A) 300   (B) 350   (C) 1024   (D) 512   (E) NOTA

9. What is the constant term of the expansion $\left(x - \dfrac{1}{x^3} \right)^8$?

   (A) 28   (B) 56   (C) 128   (D) 256   (E) NOTA

10. How many of the following numbers are transcendental: 0, i, π, $\sqrt{43}$, $\sqrt{2}$, $\sqrt{-2}$, e, 49, 36?

    (A) 3   (B) 2   (C) 1   (D) 0   (E) NOTA

11. Given that $\log_2 3 = a$ and $\log_5 3 = b$, which of the following is an expression for $\log_{12} 10$?

    (A) $\dfrac{ab}{a+b}$ (B) $\dfrac{a+b}{2a+1}$ (C) $\dfrac{a+b}{2b+ab}$ (D) $\dfrac{2a+1}{a+b}$ (E) NOTA

12. Solve for x: $\left(\dfrac{256}{2401}\right)^{x-2} = \left(\dfrac{343}{64}\right)^{5-2x}$.

    (A) $\dfrac{7}{2}$ (B) $\dfrac{9}{2}$ (C) $\dfrac{4}{3}$ (D) $\dfrac{49}{16}$ (E) NOTA

13. Find the area of the conic: $3x^2 - 12x + 4y^2 - 8y + 16 = 0$.

    (A) 12π (B) 24π (C) 6π (D) 3π (E) NOTA

14. Find the sum of the following series:

$$\sum_{k=1}^{\infty} \frac{1}{k^2 + 5k + 6}$$

    (A) 1   (B) $\dfrac{1}{2}$ (C) $\dfrac{1}{3}$ (D) $\dfrac{1}{4}$ (E) NOTA

15. Find the number of distinct permutations of the letters in the word "NINETEEN".

    (A) 40320   (B) 1120   (C) 3360   (D) $(8!)(3!)(3!)$ (E) NOTA

16. What is the remainder when $3x^3 - 5x^2 + 4x + 2$ is divided by $3x + 1$?

    (A) $3x - 6$ (B) 0   (C) 1   (D) $2x + 4$ (E) NOTA

17. Let $g(x) = 8x^3 + 1$ be the inverse function of $f(x)$. Find the value of $f(28)$.

    (A) $\dfrac{27}{8}$ (B) $\dfrac{3}{2}$ (C) $\dfrac{9}{8}$ (D) $\dfrac{3}{8}$ (E) NOTA

18. Two roots of the function $f(x)$ are 7 and 9. Which is a root of the function $f(x + 17)$?

    (A) -10 (B) 24   (C) 26   (D) -17 (E) NOTA

19. For $i = \sqrt{-1}$, $(i^{2017})^{2016} =$

    (A) i (B) 1   (C) -1 (D) $-i$ (E) NOTA

20. The roots of the equation $f(x) = x^3 - 3x^2 + x + 5$ are three complex numbers z_1, z_2, and z_3. What is the sum of the roots of $f(x)$ taken 2 at a time?

    (A) 1   (B) -3 (C) -1 (D) 5   (E) NOTA

21. The polynomial $f(x) = x^3 + 2x^2 + 3x + 4$ has roots a, b, and c. The polynomial $g(x)$ has roots a^2, b^2, and c^2. If $g(0) = 8$, compute $g(2)$.

    (A) 7   (B) 9   (C) 14   (D) 18   (E) NOTA

22. If $x - y = 2$ and $x^3 - y^3 = 20$, find $x^2 - y^2$.

    (A) $7\sqrt{3}$ (B) $4\sqrt{3}$ (C) $3\sqrt{7}$ (D) 8   (E) NOTA

23. Express $0.252525\ldots$ as a fraction.

    (A) $\dfrac{25}{9}$ (B) $\dfrac{25}{90}$ (C) $\dfrac{2}{9} + \dfrac{5}{9}$ (D) $\dfrac{25}{99}$ (E) NOTA

24. Find the equation of the directrix of the parabola $y^2 + 6y + 8x + 25 = 0$.

    (A) $y = 0$ (B) $x = 0$ (C) $x = 4$ (D) $y = 4$ (E) NOTA

25. Find the number of real integer solutions to $||x - 3| - |x + 1|| = 2$.

    (A) 0   (B) 1   (C) 2   (D) 4   (E) NOTA

26. If x is real, then find the maximum of $\dfrac{4x^2 + 4x + \frac{13}{4}}{4x^2 + 4x + \frac{5}{4}}$.

    (A) 9   (B) 8   (C) 5   (D) 4   (E) NOTA

27. Find the value of y given that $\dfrac{\log_m x}{\log_n x} = \dfrac{37}{101}$ and $\dfrac{m}{n} = n^y$.

    (A) 2   (B) $-\dfrac{64}{101}$ (C) $\dfrac{27}{37}$ (D) $\dfrac{64}{37}$ (E) NOTA

28. Find the complex number x such that $\dfrac{x}{2 + x} = -3 + 2i$.

    (A) $-3 + 2i$ (B) $\dfrac{-4 + i}{5}$ (C) $\dfrac{4 + i}{5}$ (D) $\dfrac{-8 + i}{5}$ (E) NOTA

29. What is the graph of the following equation in the Argand plane, given the complex number z?

$$|z + 8i| + |z - 4| = 2017$$

    (A) 2017-gon   (B) Non-Circular Ellipse (C) Hyperbola   (D) Cardioid   (E) NOTA

30. Sri shoots a lot of shots. However, he does not usually make them, only making them 20 percent of the time. What is the probability, when Sri shoots his shot 3 times, that he makes exactly 2 of the shots?

    (A) $\dfrac{1}{25}$ (B) $\dfrac{4}{25}$ (C) $\dfrac{1}{125}$ (D) $\dfrac{12}{125}$ (E) NOTA