

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

1. Simplify: $\frac{10^{2009} + 10^{2011}}{10^{2010} + 10^{2010}}$

- A) 0.01 B) 0.2 C) 1 D) 5 E) NOTA

2. What is the unit's digit of the sum $\sum_{k=1}^{10} (k!)^2$?

- A) 9 B) 7 C) 5 D) 3 E) NOTA

3. How many ordered triples (x, y, z) of positive integers satisfy $(x^y)^z = 64$?

- A) 2 B) 4 C) 8 D) 9 E) NOTA

4. Suppose $\frac{2}{A} = \sqrt{\frac{9B}{A} - 2B^2}$, where defined, for real numbers A and B . If $A = MB^N$, where M and N are real numbers, find the sum of all possible values of $M + N$.

- A) $\frac{1}{2}$ B) -3 C) $\frac{9}{2}$ D) $\frac{5}{2}$ E) NOTA

5. If $k^{\log_2 5} = 16$, what is the value of $k^{(\log_2 5)^2}$?

- A) 625 B) 256 C) 128 D) 32 E) NOTA

6. Evaluate $\left(x + \frac{1}{x}\right)^2$ when $x = \frac{\sqrt{42}}{7}$.

- A) $\frac{85}{42}$ B) $\frac{169}{42}$ C) $\frac{127}{42}$ D) 4 E) NOTA

7. If $A = \frac{(\log_3 1 - \log_3 4)(\log_3 9 - \log_3 2)}{(\log_3 1 - \log_3 9)(\log_3 8 - \log_3 4)}$, evaluate 3^A .

- A) $\frac{1}{3}$ B) $\frac{81}{16}$ C) $\frac{1}{9}$ D) $\frac{9}{2}$ E) NOTA

8. Find the sum of the real values of x that satisfy the equation $3 + 3\log_3(x^3 + 1) = 3^2$.

- A) 0 B) 2 C) 3 D) 4 E) NOTA

9. Evaluate: $\sqrt{2014 \cdot 2012 \cdot 2010 \cdot 2008 + 16}$

- A) 4,044,116 B) 4,044,146 C) 4,044,096 D) 4,044,121 E) NOTA

10. $e^2 - 5e + 6$ is closest in value to which of the following?

- A) -0.4 B) -0.2 C) 0 D) 0.2 E) 0.4

11. Find the sum of the digits of the product $2^{2009} \cdot 5^{2011}$ when written in decimal form.

- A) 10 B) 7 C) 11 D) 1 E) NOTA

12. How many of the elements of the set $\{7^1, 7^2, 7^3, \dots, 7^n, \dots, 7^{2011}\}$ have a unit's digit of 3?

- A) 670 B) 503 C) 402 D) 335 E) NOTA

13. The solutions to the equation $x^2 - ax + b = 0$ are the squares of the solutions to the equation $x^2 - cx + d = 0$. Express a in terms of c and d .

- A) $a = c^2 - 2d$ B) $a = \sqrt{c^2 - 4d}$ C) $a = c^2 + d^2$ D) $a = \sqrt{2c^2 - 8d}$ E) NOTA

14. Evaluate: $\sqrt{5 + \sqrt{5 + \sqrt{5 + \dots}}} + \frac{5}{1 + \frac{5}{1 + \frac{5}{1 + \dots}}}$

- A) 5 B) $\sqrt{21}$ C) 0 D) $\frac{1}{4}$ E) NOTA

15. Find the sum, where $i = \sqrt{-1}$: $\sum_{n=1}^{14} (1 + (-1)^n i)^n$

- A) $-25 - 127i$ B) $-25 + 127i$ C) $-129 - 77i$ D) $-129 + 77i$ E) NOTA

16. Find the domain of the function $y = \ln\left(\frac{x}{x^2 - 1}\right)$.

- A) $(1, \infty)$ B) $(-\infty, -1) \cup (1, \infty)$ C) $(-1, 1) \cup (1, \infty)$ D) $(-1, 0) \cup (1, \infty)$ E) NOTA

17. Given that $\log 2 = .301$, how many digits are in the solution to the equation

$$\log_5(\log_4(\log_3(\log_2 x))) = 0?$$

- A) 21 B) 23 C) 25 D) 27 E) NOTA

18. Find the inverse of the function $f(x) = \log_5(3x) - 1$.

- A) $f^{-1}(x) = \frac{5}{3}(5^x)$ B) $f^{-1}(x) = \frac{1}{3}(5^x + 1)$ C) $f^{-1}(x) = \log_5\left(\frac{1}{3x}\right) - 1$
D) $f^{-1}(x) = \frac{1}{\log_5(3x) - 1}$ E) NOTA

19. A bacteria culture with initial population 10 grows exponentially to a population of 160 after 8 hours. Find the bacteria population one hour later, rounded to the nearest whole number.

- A) 198 B) 226 C) 274 D) 320 E) NOTA

20. Find the sum of the y -values of the points of intersection of the graphs of $y = \log_6 x^2$ and $y = \log_6(x + 6)$.

- A) 2 B) $\log_6 12$ C) 1 D) $\log_6 9$ E) NOTA

21. Let M be the number of lattice points on the line segment whose endpoints are

$\left(-\frac{7}{3}, \frac{5}{9}\right)$ and $\left(\frac{173}{3}, \frac{185}{9}\right)$. Find the smallest positive integer K such that

$\log_2(M - K)$ is an integer

- A) 1 B) 2 C) 3 D) 4 E) NOTA

22. Find the coefficient of a^2b^{-3} in the expansion of $\left(a^2b^{-1} - b^{\frac{1}{2}}a^{-3}\right)^6$

- A) 15 B) -15 C) 20 D) -20 E) NOTA

23. Find the largest value of $\log_x 3$ that satisfies the equation $\log_x 3 + \log_3 x = 3$.

- A) $\frac{5+\sqrt{5}}{2}$ B) $\frac{5-\sqrt{5}}{2}$ C) $\frac{3+\sqrt{5}}{2}$ D) $\frac{3-\sqrt{5}}{2}$ E) NOTA

24. Evaluate: $\left(\frac{\sqrt{6}-\sqrt{2}}{4} + \frac{\sqrt{6}+\sqrt{2}}{4}i \right)^{2011}$

- A) $\frac{\sqrt{6}-\sqrt{2}}{4} - \frac{\sqrt{6}+\sqrt{2}}{4}i$ B) $\frac{\sqrt{6}+\sqrt{2}}{4} - \frac{\sqrt{6}-\sqrt{2}}{4}i$ C) $-\frac{\sqrt{6}-\sqrt{2}}{4} + \frac{\sqrt{6}+\sqrt{2}}{4}i$
 D) $-\frac{\sqrt{6}+\sqrt{2}}{4} + \frac{\sqrt{6}-\sqrt{2}}{4}i$ E) NOTA

25. Simplify: $\sqrt{\sum_{n=0}^2 (n+\sqrt{2})^2}$

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

26. Evaluate: $\sqrt{8 + \frac{8}{\sqrt{8 + \frac{8}{\sqrt{8 + \frac{8}{\dots}}}}}}$

- A) $-1+\sqrt{5}$ B) -2 C) $1+\sqrt{5}$ D) 2 E) NOTA

27. Find the value of the sum $\sum_{n=1}^{2011} \lceil \sqrt{2n+0.25} - 0.5 \rceil$, where $\lceil x \rceil$ represents the least integer greater than or equal to x .

- A) 85,596 B) 89,565 C) 85,029 D) 88,998 E) NOTA

28. What integer is closest to $(\sqrt{3} + \sqrt{2})^6$?

- A) 968 B) 970 C) 972 D) 974 E) NOTA

29. Find the value(s) of x that satisfy the equation $\log x + \log(x - 2) = \log(x^2 - 2x)$.

- A) $x < 0$ B) $0 < x < 2$ C) $x > 2$ D) all real numbers E) NOTA

30. Find the sum of the solutions to the equation $3^{4x} - 3^{2x + \log_3 12} + 27 = 0$.

- A) 0 B) $\frac{1}{2}$ C) 1 D) $\frac{3}{2}$ E) NOTA