

Good Luck! :)

1. Evaluate $\log_3 4 + \log_9 3 + \log_{27} \frac{1}{64}$.

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

2. Simplify $(11^{1+\log_{121} 64+\log_{11} 3})^2$

A. 14641 B. 69696 C. 73205 D. 139392 E. NOTA

3. Solve for x: $49^{5x+8} = 343^{6x-5}$.

A. $-\frac{34}{3}$ B. -7 C. $\frac{31}{8}$ D. 13 E. NOTA

4. Evaluate:

$$\sum_{p=1}^{126} \log_2 \left(\frac{p+2}{p+1} \right)$$

A. 4 B. 5 C. 6 D. 7 E. NOTA

5. What is the sum of the coefficients of the simplified expansion of $(3a + 4b - 9c + 5d)^3$

A. 27 B. 343 C. 625 D. 1331 E. NOTA

6. What is the units digit of 2093487^{203948} ?

A. 1 B. 3 C. 7 D. 9 E. NOTA

7. Let p be a real number such that $\frac{1}{\log_p 3 + \log_{(p^3)} 9} = 2$. What is the value of $\log_3(p^3)$?

A. 2 B. $\frac{10}{3}$ C. 6 D. 10 E. NOTA

8. Evaluate $\prod_{m=1}^{105} \log_{(m+2)}(m+3)$.
- A. $1 + \log_2 53$ B. $3 + \log_3 4$
 C. $\log 108$ D. $4 + \log_3 2$ E. NOTA
9. What is the smallest integer value of a in the domain of $\log_{11}(\log_3(\log_7 a))$?
- A. 1 B. 3 C. 7 D. 343 E. NOTA
10. If $M = \log_5(\sqrt{17} + 2\sqrt{3})$, then express $\log_5(\sqrt{17} - 2\sqrt{3})$ in terms of M .
- A. $\frac{M-1}{M}$ B. $\frac{5}{M}$ C. $1 - M$ D. $5 - M$ E. NOTA
11. The expression $\sqrt{24 - 6\sqrt{15}}$ can be written as $\sqrt{p} - \sqrt{q}$, where p and q are positive integers. What is the value of $pq + p + q$?
- A. 159 B. 164 C. 167 D. 168 E. NOTA
12. Find the sum of the solutions of $\log(a^{\log a}) - 5 \log(a) + 6 = 0$.
- A. 5 B. 50 C. 500 D. 5000 E. NOTA
13. Evaluate: $\begin{vmatrix} \log_2 \sqrt[3]{3} & \log_5 \frac{1}{49} \\ \log_{\sqrt{7}} 25 & \log_9 \frac{1}{16} \end{vmatrix}$
- A. $-\frac{26}{3}$ B. $-\frac{22}{3}$ C. $\frac{22}{3}$ D. $\frac{26}{3}$ E. NOTA
14. Which of the following is equivalent to $\sum_{n=1}^{2021} 2021^{2021}$?
- A. 2021^{2022} B. $2022 \cdot 2021^{2021}$
 C. $1011 \cdot 2021^{2022}$ D. 2021^{4042} E. NOTA

15. Find the sum of the solutions to $(x^2 + 5x + 5)^{(x^2 - 6x + 8)} = 1$.
A. -4 B. -1 C. 5 D. 6 E. NOTA
16. Let $a = \log 2$, $b = \log 3$, and $c = \log 7$. In terms of a , b , and c , express $\log_{63} 420$.
A. $\frac{ab+c+1}{bc}$ B. $\frac{a+c}{a+b}$ C. $\frac{1+a+c}{2c+b}$ D. $\frac{1+a+b+c}{2b+c}$ E. NOTA
17. Solve for x : $\log_2 x + \log_2(x - 2) = 3$
A. No Solutions B. -2 C. 4 D. $-2, 4$ E. NOTA
18. What is the domain of $y = 5 \log_2(2x^3 + 3x^2 - 11x - 6)$?
A. $(-\infty, -\frac{1}{2}) \cup (2, \infty)$ B. $(-3, -\frac{1}{2}) \cup (2, \infty)$
C. $(-\infty, -3) \cup (2, \infty)$ D. $(-3, 2)$ E. NOTA
19. What is the constant term in the expansion $(2x^2 - \frac{1}{x})^9$?
A. -672 B. 8 C. 84 D. 672 E. NOTA
20. Suppose $\frac{\log_b a}{\log_c a} = \frac{25}{24}$. Then, $\frac{c}{b}$ can be written as c^n , where n is a rational number. Find n .
A. -25 B. $\frac{1}{25}$ C. $\frac{24}{25}$ D. $\frac{25}{24}$ E. NOTA
21. Let $x = p$ and $x = q$ be the solutions to the equation $x^{\log_5 x} = \frac{x^4}{125}$. What is $\log_5(pq)$?
A. $-\frac{1}{5}$ B. 1 C. $\frac{3}{5}$ D. 4 E. NOTA

22. Find the number of digits in 5^{420} , assuming that $\log 2 \approx 0.3010$.
- A. 293 B. 294 C. 295 D. 296 E. NOTA

23. Evaluate $\sum_{i=1}^{10001} [\log i]$.
- A. 38889 B. 38892 C. 38893 D. 38894 E. NOTA

24. Let $3^x - 3^{-x} = 5$. What is $27^x - 27^{-x}$?
- A. 15 B. 110 C. 125 D. 140 E. NOTA

25. Simplify:

$${}_{12} \sqrt{\frac{x^5 \sqrt{yz}^{-\frac{1}{3}}}{\left(\frac{y^{20} z^{30}}{x^{1/7}}\right)}}$$

- A. $x^{\frac{5}{84}} y^{\frac{41}{24}} z^{\frac{89}{36}}$ B. $x^{\frac{35}{12}} y^{\frac{41}{24}} z^{-\frac{1}{90}}$ C. $x^{\frac{5}{84}} y^{\frac{5}{6}} z^{\frac{89}{36}}$ D. $x^{\frac{5}{84}} y^{\frac{41}{24}} z^{-\frac{1}{1080}}$ E. NOTA

26. Which of the following is equal to $2i^{84} - 3i^{57} + 5i^{22} + 7i^{69} - 11i^{422}$?
- A. $-4 - 4i$ B. $8 + 4i$ C. $8 + 10i$ D. $14 + 10i$ E. NOTA

27. Let x and y be real numbers such that $\log_{5x}(8y + 9) = 1$ and $\log_{3y}(2x + 3) = 1$. What is $x + y$?
- A. -84 B. -51 C. -33 D. 18 E. NOTA

28. a, b, c , and d form a geometric sequence in that order with a common ratio of 4. If $\log_a b + \log_c d = \frac{62}{21}$, find the largest possible value of d .
- A. 64 B. 128 C. 256 D. 512 E. NOTA

29. Order the following from greatest to least:

$$W = 2^{40}$$

$$X = 3^{30}$$

$$Y = 5^{25}$$

$$Z = 7^{15}$$

- A. Y, Z, X, W B. X, Y, W, Z C. Y, X, Z, W D. X, Z, Y, W E. NOTA

30. The minimum of $\frac{\log_x 2 + \log_y 256}{\log_{xy} 2}$ for $x, y > 1$ can be written in the form $p + \sqrt{q}$ for positive integers p, q . Find $p + q$.

- A. 39 B. 40 C. 41 D. 42 E. NOTA