

For all questions, choice E is NOTA meaning “None of These Answers.”

1. Let x and y be positive real numbers. Which of the following is equivalent to

$$\left(\frac{3^{\frac{-6}{5}} x^{\frac{1}{2}} y^{\frac{4}{3}}}{2^3 x^{\frac{-5}{2}} y^{\frac{1}{3}}} \right)^{\frac{-2}{3}}$$

- A) $\frac{4\sqrt[5]{81}}{x^2 y^{\frac{10}{9}}}$ B) $\frac{x^{\frac{4}{3}} \sqrt[5]{81}}{4y^{\frac{10}{9}}}$ C) $\frac{4\sqrt[5]{81}}{x^2 y^{\frac{2}{3}}}$ D) $\frac{\sqrt[5]{81}}{4x^{\frac{7}{3}} y^{\frac{2}{9}}}$ E) NOTA

2. Find the sum of the solutions to the equation $x^{\frac{2}{3}} - 15x^{\frac{1}{3}} + 44 = 0$.

- A) -44 B) -15 C) 15 D) 343 E) NOTA

3. Which of the following is NOT equivalent to $\log_8 9$?

- A) $2 \log_8 3$ B) $\frac{3}{2} \log_2 3$ C) $\frac{2}{\log_3 8}$ D) $\frac{1}{3} \log_2 9$ E) NOTA

4. Find the sum of the solutions to $\left(x^2 - x - \frac{11}{4}\right)^{(x^2 - x - 20)} = 1$

- A) -2 B) 0 C) 1 D) 2 E) NOTA

5. $\sqrt{20 + \sqrt{20 + \sqrt{20 + \dots}}} = ?$

- A) 4 B) 5 C) $4\sqrt{5}$ D) ∞ E) NOTA

6. Which of the following describe(s) $(-\sqrt{2})^{2-\sqrt{2}}$?

- I. Complex II. Real III. Nonreal IV. Irrational
 A) II (only) B) I, II (only) C) I, II, IV (only) D) I, III, IV (only) E) NOTA

7. Solve for x : $\log_2 \left(\log_3 \left(\log_{\frac{1}{2}} x \right) \right) = 1$

- A) $\frac{1}{1024}$ B) $\frac{1}{512}$ C) $\frac{1}{256}$ D) $\frac{1}{8}$ E) NOTA

8. If $\log_2 3 = a$ and $\log_9 16 = b$, which of the following is equivalent to $\log_4 \frac{16}{9} + \log_3 2$?

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

9. Solve: $64^{\frac{x}{6}-2} = \left(\frac{1}{4}\right)^{\frac{x^2}{2}}$

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

10. For $j > 1$, simplify: $216^{\log_{36} j}$

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

11. What is the units digit of $1^{2007} + 3^{2008} + 3^{2009} + 7^{2010}$?

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

12. Let $x = 99.9^{256}$. How many digits to the left of the decimal (units, tens, hundreds etc.) does x have? ($\log .999 \approx -.0004$)

- A) 511 B) 512 C) 513 D) 514 E) NOTA

13. Calculate: $\prod_{n=2}^{10} (1 + \log_{n!} (n+1))$

- A) 11 B) $\log_2 11!$ C) $1 + \log_2 11!$ D) $11!$ E) NOTA

14. Simplify $6^6 + 6^6 + 6^6 + 6^6 + 6^6 + 6^6$

- A) 6^7 B) 6^8 C) 6^{12} D) 6^{36} E) NOTA

15. Find the value of $j - k$ if j and k are the solutions to the equation $e^x + \frac{36}{e^x} = 15$ and $j > k$

- A) $\ln 3$ B) $\ln 4$ C) 9 D) 15 E) NOTA

16. Let 3, $\ln 4$, and x be the lengths of the sides of triangle ERF. If $s < x < y$ is the interval of all possible values of x , find $y - s$.

- A) 0 B) 1 C) $\ln 16$ D) 6 E) NOTA

17. $\log_4 16 + \log_2 16 = ?$

- A) 4 B) 6 C) 8 D) 12 E) NOTA

18. Let n be a constant real number greater than 1. Evaluate $\sum_{p=1}^{\infty} \frac{\log(n^p)}{n^p}$
- A) $\frac{\log n}{(n-1)}$ B) $\frac{n \log n}{(n-1)^2}$ C) $\frac{n \log n}{(n-1)}$ D) $n \log n$ E) NOTA
19. Find the constant term in the expansion of $\left(9x^2 - \frac{1}{2x}\right)^6$.
- A) $-\frac{1215}{16}$ B) $-\frac{81}{16}$ C) $\frac{81}{16}$ D) $\frac{1215}{16}$ E) NOTA
20. Solve for x , a real number: $x^{1+x^{1+x^{1+x\dots}}} = 2$
- A) $\frac{1}{2}$ B) $\sqrt[3]{2}$ C) $\sqrt{2}$ D) \emptyset E) NOTA
21. Which quadrants does the function $f(x) = \log x^2$ pass through?
- A) I (only) B) I, II (only) C) I, IV (only) D) I, III, IV (only) E) NOTA
22. Simplify $i^{86} + 41i^{75} - 17i^{30} + 2i^9$ into $a + bi$ form ($i = \sqrt{-1}$).
- A) $409 - 18i$ B) $409 - 16i$ C) $-18 - 409i$ D) $16 - 409i$ E) NOTA
23. If $256(\log_b a)^8 + \frac{(\log_a b)^8}{256} = 47$, what is the positive value of $8(\log_b a)^3 + \frac{(\log_a b)^3}{8}$?
(Assume that a and b are both greater than 1).
- A) $2\sqrt{5}$ B) $3\sqrt{5} - 2$ C) $3\sqrt{5}$ D) $4\sqrt{5}$ E) NOTA
24. Which of the following is greater than e^5 ?
- A) $\sqrt{1020}$ B) $\left(\frac{5}{2}\right)^5$ C) $\frac{e^6}{2}$ D) $243 \log 1$ E) NOTA
25. If $f(x) = \sqrt{x+2}$ and $f(g(x)) = g(f(x)) = x$ for all $x \geq -2$, find $g(4)$.
- A) 2 B) $\sqrt{6}$ C) 14 D) 18 E) NOTA

26. If $m\Delta u = m^{(u-m)}$ then $2\Delta(1^{(3\Delta 4)}) = _? _$
 A) $\frac{1}{2}$ B) 1 C) 2 D) 4 E) NOTA
27. Find the equation of the vertical asymptote of the function $h(x) = 2 - \log_4(x - 11)$
 A) $x = -11$ B) $x = 0$ C) $x = 11$ D) $x = 27$ E) NOTA
28. If $j(x) = \frac{x}{\sqrt[3]{x^2}}$ then what is the sum of the values of x such that $j(x)$ is a positive integer less than 5?
 A) 6 B) 10 C) 30 D) 100 E) NOTA
29. Let p and q be distinct members of the set $\{2, 4, 6, 8, 10\}$. If a is the probability that $\log_p q > 1$ and b is the probability that $\log_p q < 1$, find $a^2 - b^2$.
 A) 0 B) $\frac{1}{4}$ C) $\frac{1}{2}$ D) $\frac{3}{4}$ E) NOTA
30. Let $f(2x) = \frac{4^x - 1}{2^x + 1}$. Find $2\log_{31}(f(10)) - \log_{63}(f(12))$.
 A) 0 B) 1 C) 2 D) 3 E) NOTA