Logs and Exponents – Theta
Mu Alpha Theta National Convention 2003

Each question on this test has answers labeled A - E, with choice **E. NOTA** ***denoting "None of the Above***". Each answer is exact unless otherwise stated.

1. Which one of the following is NOT true?

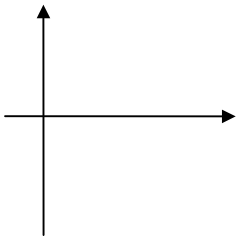
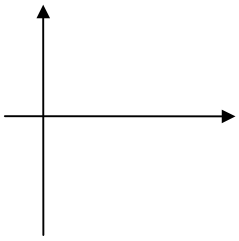
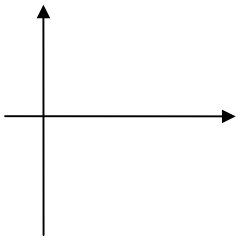
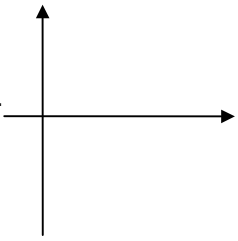
   a. $y = e^x$ is an increasing function.
   b. $e^{\ln x} = x$ and $\ln e^x = x$.
   c. The domain of $y = \ln x$ is $x \geq 0$.
   d. $2^x < e^x < 3^x$ for all $x > 0$.

A. a only B. b only C. c only D. d only E. NOTA

2. Evaluate: $\left(\log_{\frac{1}{9}} \frac{27 \cdot 81}{729}\right)^{-3}$

A. $\frac{2}{3}$ B. $-\frac{3}{2}$ C. 3 D. -8 E NOTA

3. Choose the sketch of $f^{-1}(x)$ if $f(x) = e^{x-1}$.

A.  B.  C.  D.  E. NOTA

4. Solve $2^{3x^2 - x} = 16^{x+3}$

A. $-\frac{4}{3}, 3$ B. $\frac{1 \pm \sqrt{10}}{3}$ C. $\frac{-1 \pm \sqrt{10}}{3}$ D. $\frac{4}{3}, -3$ E. NOTA

5. Find the solutions(s) of the equation: $\log (x + 3) - \log (x + 2) = \log x$

A. $\frac{-1 \pm \sqrt{11}}{2}$ B. $\frac{-1 \pm \sqrt{13}}{2}$ C. $\frac{-1 + \sqrt{11}}{2}$ D. $\frac{-1 - \sqrt{13}}{2}$ E. NOTA

6. For how many integral values of x is $\log_4 (16 - x^2)$ defined?

A. 5 B. 6 C. 7 D. 9 E. NOTA

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7. Simplify the expression: $\dfrac{16^{\frac{\sqrt{3}}{4}} \cdot 8^{2\sqrt{3}}}{2^{2\sqrt{3}} \cdot 4^{\frac{\sqrt{3}}{2}}}$.

A. $32^{\sqrt{3}}$ B. $64^{\sqrt{3}}$ C. $16^{\sqrt{3}}$ D. $4^{\sqrt{3}}$ E. NOTA

8. If log 2 = **a** and log 3 = **b**, solve for x in terms of **a** and **b** for $\sqrt{2^{x-5}} = 3^x$:

A. $\dfrac{-5a}{2b-1}$ B. $\dfrac{a \pm \sqrt{a^2 - 4ab}}{2b}$ C. $\dfrac{-5a}{2b+a}$ D. $\dfrac{5a}{a-2b}$ E. NOTA

9. Let P = sum of all valid x, and Q = smallest valid x, then find $\dfrac{P}{Q}$ where the values of x satisfy $2\log x + \log (x+1) = \log (8x^2 - 7x - 15)$.

A. -9 B. $\dfrac{8}{3}$ C. -8 D. 4 E. NOTA

10. If $(2\log_a b)(\log_5 a) = 6$, then **b** =?

A. 125 B. $\dfrac{5}{a}$ C. 243 D. 243 E. NOTA

11. In simplest form, find the numerical value of $\dfrac{1}{\log_4 6} + \dfrac{1}{\log_9 6}$.

A. 2 B. 1 C. $\dfrac{3}{2}$ D. $\dfrac{2}{3}$ E. NOTA

12. Solve for x in $4^x - 4^{x-1} = 48$, then evaluate -3^2x^{-1}.

A. $-\dfrac{1}{3}$ B. $\dfrac{1}{3}$ C. -3 D. 3 E. NOTA

13. If $\log_8 x + \log_8 y = \dfrac{1}{3}$, then x = ?

A. 2y B. $\dfrac{512}{y}$ C. $\dfrac{2}{y}$ D. $\dfrac{y}{2}$ E. NOTA

14. Evaluate: $\log_4 \left(2 \cdot 8^{\frac{1}{5}}\right) - \log_8 (.25)^{\frac{1}{3}}$.

A. $\dfrac{26}{45}$ B. $\dfrac{46}{45}$ C. $\dfrac{37}{45}$ D. $\dfrac{55}{45}$ E. NOTA

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15. Simplify: $\dfrac{a^{3x}\sqrt{a^7b^3}\,b^{\left(\frac{y-4}{7}\right)}}{a^{9x+4}\left(b^{\frac{5}{2}}\right)^{y}}$

A. $a^{\frac{-6x+11}{4}}\,b^{\frac{6y-1}{14}}$ B. $a^{\frac{-12x-1}{2}}\,b^{\frac{13-33y}{14}}$ C. $a^{\frac{12x-1}{2}}\,b^{\frac{-13-33y}{14}}$ D. $a^{\frac{-12x+1}{2}}\,b^{\frac{13+33y}{14}}$ E. NOTA

16. Find a solution for $\log_{x^3} 64 = -\dfrac{1}{2}$.

A. -2^{-4} B. $-\left(\dfrac{1}{2}\right)^{-4}$ C. $\left(\dfrac{1}{2}\right)^{-4}$ D. $\left(\dfrac{1}{4}\right)^{-2}$ E. NOTA

17. Find $f^{-1}(0)$ if $f(x) = e^x - e^{-x}$

A. ln 3 B. ln 2 C. ln 1 D. log e E. NOTA

18. If $\log_3 a = b$ and $\log_a 2 = c$, then $\log_a 48 = ?$

A. $\dfrac{4bc+1}{b}$ B. $\dfrac{4c+b}{b}$ C. 4c + b D. 4bc + 1 E. NOTA

19. Find the product of all values of x which satisfy $\log x + \dfrac{1}{\log x} = \dfrac{5}{2}$.

A. 1 B. $\dfrac{5}{2}$ C. 10 D. $10^{\frac{5}{2}}$ E. NOTA

20. The number of algae in a pond is given by $N(x) = 3000e^{.2x}$, where x is time in days. About how many days will it take for the number of algae reach 27,000?

A. 10 days B. 12 days C. 11 days D. 14 days E. NOTA

21. If $\log_{\frac{1}{.4}} \dfrac{9}{4} = 3x$, then x = ?

A. $\dfrac{1}{3}$ B. $\dfrac{3}{2}$ C. $\dfrac{4}{9}$ D. 2 E. NOTA

22. Write in simplest exponential form: $.5\ln(x-3) + 3\ln x^4 - \dfrac{1}{3}\ln(64)$

A. $\ln\dfrac{(x^7)\sqrt{x-3}}{4}$ B. $\ln\dfrac{(x^4)^3\sqrt{x-3}}{4}$ C. $\ln\dfrac{x^{\frac{4}{3}}\,\frac{x-3}{2}}{4}$ D. $\ln\dfrac{3x^4\sqrt{x-3}}{64}$ E. NOTA

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23. Simplify: $4^{\log_4 25 - \log_4 5}$

A. 75 B. 125 C. 100 D. 5 E. NOTA

24. Find the value of x if $\log_x 9 = 4$.

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

25. As the due date for Patrick's term paper approached, his stress level increased exponentially. When he first learned of the assignment, his stress level was only 3. Twenty days later, it was 24. What was his stress level to the nearest hundredth 50 days after the paper's assignment.

A. 543.06 B. 543.05 C. 543.07 D. 181.02

26. $(\log_9 3)^2 + (\log_9 3)^3 + \ldots + (\log_9 3)^{n+1} + \ldots =$ __?__

A. $\frac{1}{2}$ B. $\frac{3}{2}$ C. 1 D. 2 E. NOTA

27. Use logarithms to simplify: $\frac{\sqrt[6]{525{,}000}}{6300^{1.5}}$

A. $\frac{\log 525{,}000}{6} - \frac{2(\log 6300)}{3}$ B. $(\log 525 + 3)^{\frac{1}{6}} - (\log 63 + 2)^{\frac{2}{3}}$ C. $.1\overline{6}(\log 525 + 3) - 1.5(\log 63 + 2)$

D. $(\log 525 + 3)^{\frac{1}{6}} - (\log 63 + 2)^{\frac{3}{2}}$ E. NOTA

28. What is the domain of $f(x) = \log_5 |x^2 - 4|$?

A. All real numbers B. $(4, \infty)$ C. $(5, \infty)$ D. $(-\infty, 2) \cup (2, \infty)$ E. NOTA

29. Solve for x: $\log [\log_6 (\log_3 x)] = 0$

A. 2 B. 729 C. 216 D. 6 E. NOTA

30. Evaluate: $(\log_{3125} 7776)(\log_{216} 243)(\log_3 4096)(\log_{32} 15625)$

A. 120 B. 60 C. 24 D. 8 E. NOTA