1. Simplify the following expression, where defined: $\frac{x^3 y^{-\frac{1}{2}} z^{\frac{15}{16}}}{x^{-3}(y^3)^{\frac{1}{2}}\left(z^{\frac{1}{2}}\right)^{-\frac{1}{4}}}$

A. $\frac{z}{x^6 y^2}$ B. $\frac{x^6 z}{y^2}$ C. $\frac{x^6 z^{\frac{27}{16}}}{y^4}$ D. $\frac{z}{y^2}$ E. NOTA

2. Kus walks along a path that follows the equation $e^x + e^{-x} - 2 = y$. Tos walks along a path that follows the equation $y = \frac{e^x + 2}{2e^{-x} + 1}$. At what point do the paths of Kus and Tos intersect?

A. $(\ln 2, -\frac{1}{2})$ B. $(-\ln 2, -\frac{1}{2})$ C. $(-\ln 2, \frac{1}{2})$ D. $(-\ln \frac{1}{2}, \frac{1}{2})$ E. NOTA

3. $64^{\cot x} = 256^{\cos x}$. If $0 < x < \pi$, find the smaller value of $\sin x$.

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

4. Find the sum of the coefficients of the terms containing z^{-3} in the expansion of $(3x - 4y - \frac{1}{z})^6$

A. 500 B. 20 C. -500 D. -20 E. NOTA

5. $\frac{2}{\log_2 36} + \frac{1}{\log_3 36} + \frac{1}{\log_4 36} + \frac{2}{\log_9 36} + \frac{1}{\log_{12} 36} =$?

A. 3 B. 4 C. 12 D. 6 E. NOTA

6. Find the sum of all distinct real values of x that satisfy $29 * 10^x + 100 * 10^{-x} - 10^{2x} = 104$.

A. $2 \log 5$ B. 1 C. 2 D. $\log 50$ E. NOTA

7. Pa and Ul are the Egyptian gods of exponents and logs, respectively. They are currently engaged in the 3rd Egyptian Math War. To wage war, Pa throws exponentials at Ul, and Ul tries to counter those exponentials with logs. Pa can either throw $2^x, 3^x, 4^x, 5^x, 6^x, 7^x, 8^x, 9^x, 10^x$, or e^x. Ul can counter with either $\log_2 x$, $\log_3 x$, $\log_4 x$, $\log_5 x$, $\log_6 x$, $\log_7 x$, $\log_8 x$, $\log_9 x$, $\log_{10} x$, or $\ln x$. Ul wins if his counter composed with Pa's throw yields an integer multiple of x, and Pa wins otherwise. What is the probability that Ul wins?

A. $\frac{13}{100}$ B. $\frac{1}{10}$ C. $\frac{3}{20}$ D. $\frac{4}{25}$ E. NOTA

8. Compute $4^{\left(\frac{1}{\log_7 4}+\frac{1}{\log_{14} 2}+\frac{1}{\log_{17} 4}\right)}$.

A. 46648 B. 23324 C. 11662 D. 5831 E. NOTA

9. Approximate $\lim_{n\to\infty}\left(1+\frac{3}{n}\right)^n$ to the nearest integer.

A. 22 B. 20 C. 19 D. 21 E. NOTA

10. A right, conical tank is filled with water. Water fills the tank at a rate of $\log 27 \frac{m^3}{min}$. The radius of this particular tank at water is always $\frac{1}{3}$ of the height the water level from the bottom of the tank. How many minutes will it take for the depth of water in the tank to equal 3 *m*?

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

11. Let a ☺ b represent the operation $a^b - b^a$. Find (3 ☺ 2) ☺ 17.

A. -18 B. -4912 C. -1 D. -16 E. NOTA

12. Solve for x: $49^{3x+2} = 36^{9x+1}$

A. $\frac{\log 6+2\log 7}{3(\log 7+3\log 6)}$ B. $\frac{\log 6+2\log 7}{3(\log 7-3\log 6)}$ C. $\frac{\log 6-2\log 7}{3(\log 7+3\log 6)}$ D. $\frac{\log 6-2\log 7}{3(\log 7-3\log 6)}$ E. NOTA

13. Given that $f(x) = \log_5 x$ and $g(x) = \log_3 x$, find $f(g(g(3^{243})))$.

A. 1 B. 3 C. 6 D. 2 E. NOTA

14. Simplify $\log_7 1024 * \log_3 14641 * \log_{13} 16807 * \log_2 2197 * \log_{11} 59049$

A. 24000 B. 12000 C. 6000 D. 30000 E. NOTA

15. Find the slope of the line tangent to the graph of $f(x) = e^{sinx}$ at where $x = 0$.

The slope of this function can be found by plugging in an *x*-value into the function $f'(x) = cosx \cdot e^{sinx}$.

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

16. Given that $lnx = \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n}(x-1)^n$ for $x \in (0,2]$, find the value of

$\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{ne^{2n}}(1-e^2)^n$.

A. 1 B. -2 C. 2 D. e^2 E. NOTA

17. $\sqrt{16256 - \sqrt{16256 - \sqrt{16256}}}$ ... =?

A. 124 B. 128 C. 126 D. 127 E. NOTA

18. Find the number of digits in the expansion of 6^{2017}.

A. 1570 B. 1569 C. 1568 D. 1567 E. NOTA

19. Which of the following is equivalent to $\frac{1}{2}\sin(2x)$?

A. $\frac{e^{2ix}+e^{-2ix}}{-4i}$ B. $\frac{e^{2ix}-e^{-2ix}}{4i}$ C. $\frac{e^{2ix}+e^{-2ix}}{4i}$ D. $\frac{e^{-2ix}-e^{2ix}}{4i}$ E. NOTA

20. Which of the following is a seventh root of $-64\sqrt{3}-64i$?

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

21. The number of real solutions to $e^x - x = x^e$ is a. The number of real solutions to $x^{2e} - e^{2x} = -2x - 2$ is b. Find a^b.

A. 9 B. 27 C. 8 D. 4 E. NOTA

22. Determine the product of the real values of x for which $\log_2(3x-4) - \log_8(x-2) = 0$.

A. 1 B. 4 C. -1 D. $\frac{62}{27}$ E. NOTA

23. What digit occupies the billionths place in the decimal representation of e?

A. 1 B. 8 C. 2 D. 4 E. NOTA

24. Three cubes have side lengths $\log_{11} 17$, $\log_{289} 169$, and $\log_{13} 121$. Find the product of the lengths of their diagonals.

A. 6 B. $6\sqrt{3}$ C. $12\sqrt{3}$ D. 9 E. NOTA

25. Compute $\lim_{x\to 0} e^x$.

A. 1 B. 0 C. e D. 2 E. NOTA

26. Find the sum of the positive real solutions of x: $x^2 = 2^x$.

A. 2 B. 3 C. 4 D. 6 E. NOTA

27. The solution to the following system is in the form (x, y), where x and y are positive integers:

$$\begin{cases} x^2 + y^2 = 125712 \\ xy = 216^2 \end{cases}$$

Find the prime factorization of $x + y$.

A. $2 * 3^3 * 13$ B. $2^4 * 3 * 13$ C. $2^2 * 3^2 * 13$ D. $2^2 * 3^3 * 13$ E. NOTA

28. Determine $\tan(\operatorname{arccsc}\frac{e^x}{2\ln x})$, where $x > 1$.

A. $\frac{\sqrt{e^{2x}-4(\ln x)^2}}{2\ln x}$ B. $\frac{2\ln x}{\sqrt{e^{2x}-4(\ln x)^2}}$ C. $\frac{2\ln x}{\sqrt{e^{2x}+4(\ln x)^2}}$ D. $\frac{\sqrt{e^{2x}+4(\ln x)^2}}{2\ln x}$ E. NOTA

29. $f(x) = \log(x)$. Find the domain of $f^{-1}(x)$.

A. $(-\frac{\pi}{2}, \frac{\pi}{2})$ B. $(0, \infty)$ C. $(-1,1)$ D. $(-\infty, 0)$ E. NOTA

30. Congratulations! Since you have reached the final question, I'll make it an easy one. There is a number x for which $e^x = x^e$. Pick the answer choice equivalent to that number.

A. $\lim_{x\to\infty}\left(1-\frac{1}{x}\right)^x$ B. $\ln(\ln(\ln(\ln(\ln e^{e^{e^{e^e}}}))))$ C. 2.71828 D. $(e^{\frac{1}{e}})^e$ E. NOTA