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

1. If a and b are the two closest integers to $\log_5 678$ *and* $a < b$, *what is* $b^2 - a^2$?

A. 9   B. 11   C. 51   D. 271   E. NOTA

2. What is the sum of the x-intercepts of $g(t) = e^{2t} - e^{t+ln9} + 20$

A. -9   B. $\ln(20)$ C. 9   D. e^{20} E. NOTA

3. 2^{50} is between $10^x and\ 10^{x-1}$ where x is an integer. What is the value of x?

A. 10   B. 15   C. 16   D. 17   E. NOTA

4. If $\frac{a}{b}$ represents the solution (in simplest terms) to the equation $243^x = 9$, where a and b are positive integers, what is $a - b$?

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

5. How many and what type of solutions are there to the following equation:
$\sqrt{4x^2 - 3x + 2} = -\sqrt{x^2 - 5}$?

A. no real solutions   B. 1 positive real solution   C. 2 positive real solutions
D. 3 positive real solutions   E. NOTA

6. If the points (-1, 5) and (1, 20) are on the function $f(x) = ab^x$, where $b > 0$, what is a^b?

A. 64   B. 81   C. 100   D. 1024   E. NOTA

7. Which of the following is a solution to the equation: $\log_9(x^2) + [\log_3(9e^2)] = 2$?

A. $\frac{\sqrt{e}}{3}$ B. $\frac{e}{9}$ C. $\frac{1}{e}$ D. $\frac{1}{e^2}$ E. NOTA

8. If $f(x) = 3e^{x+2} - 1$ then $f^{-1}(x)$ has which of the following asymptotes?

A. x = -2   B. x = -1   C. y = 1   D. y = 2   E. NOTA

9. Solve for x in the following equation: $\log_9(\log_2(\log_3(\log_x e))) = 0$

A. No solution   B. $\frac{e}{3^{81}}$ C. $\sqrt[9]{e}$ D. e   E. NOTA

10. What is the perimeter of a triangle with sides of length $\log_{30} 8$, $\log_{30} 27$, and $\log_{30} 125$?

A. 3   B. $\sqrt[3]{30}$ C. $\log_{30} 160$ D. 900   E. NOTA

11. Which of the following is equivalent to $(\log_4 625)\,(\log_5 \frac{1}{7})\,(\log_{343} 8)$?

A. $-\frac{8}{3}$ B. -2   C. $\frac{1}{2}$ D. $\frac{8}{3}$ E. NOTA

12. What is the tens digit of 6^{578}?

A. 0   B. 1   C. 3   D. 9   E. NOTA

13. If $a = 3^{63}$, $b = 6^{42}$ and $c = 12^{31}$ which of the following represents the order of these numbers from least to greatest?

A. a, b, c   B. b, c, a   C. c, a, b   D. cannot be determined   E. NOTA

14. What is $\log(.2) - \log(2) + \log(20)$

A. $-\log(2)$ B. 0   C. $\log(2)$ D. $\log(8)$ E. NOTA

15. If a type of bacteria has a continuous exponential rate of growth such that, after 2 hours, an initial population of 891 has increased to 1584, how long will it take (in hours) to reach a population of 999,999?

A. $\log_{\frac{3}{4}} 10{,}101$ B. $\log_{\frac{4}{3}} 10{,}101$ C. $\log_{\frac{3}{4}} 101{,}010$ D. $\log_{\frac{4}{3}} 101{,}010$
E. NOTA

16. A game company wants to distribute 5,000 numerical game keys (with no restriction on the digits used or repeat digits) to their new game. What is the minimum number of digits these keys should have so that a blind guesser has less than a 1 in a trillion chance of guessing any of the game keys?

A. 9   B. 10   C. 12   D. 13   E. NOTA

17. $\sum_{i=1}^{n} \log_b \frac{i^n}{\sqrt[n]{n!}}$ is equivalent to which of the following expressions, where defined?

A. 0   B. $\log_b(n!)$ C. $\log_b[(n!)^{n-1}]$ D. $\log_b[(n!)^{\frac{n^2-1}{n}}]$ E. NOTA

18. If a, b, and c are integer side lengths of a right triangle (with c being the hypotenuse) and $\log_5 c = 2$, which of the following is a possible value for $a + b$?

A. 7   B. 14   C. 17   D. 31   E. NOTA

19. If a, b, and c are side lengths of a right triangle (with c being the hypotenuse) and $\log_7 a = 8$, what is $\log_{49}(b + c) + \log_{49}(c - b)$?

A. 4   B. 8   C. 16   D. cannot be determined   E. NOTA

20. $\sum_{n=3}^{98} \log \frac{n+4}{n+1}$ is equivalent to which of the following?

A. $\log \frac{18}{99!}$ B. $\log \frac{102!}{7!} - \log \frac{99!}{4!}$ C. $\log \frac{51}{2}$ D. $2 + \log 10{,}302$ E. NOTA

21. What is $\log_{a^3} \sqrt{a}$?

A. $\frac{1}{a}$ B. $\frac{1}{5}$ C. 5   D. a   E. NOTA

22. Solve for x in the following equation: $\log(x^5 + 10x^4 + 40x^3 + 80x^2 + 80x + 32) = 10$

A. 8   B. 48   C. 90   D. 98   E. NOTA

23. $-(i^i)^i$ is equivalent to which of the following?

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

24. Simplify $i^{1528} + 2i^{560} - 6i^{303}$

A. $6 - 3i$ B. $6 + 3i$ C. $3 - 6i$ D. $3 + 6i$ E. NOTA

25. Find the sum of all the solutions to the following equation:
$((2x + 5)^{x+7})^{x-3} = (24x - 72)^0$

A. -7 B. -6 C. -5 D. -2 E. NOTA

26. What is the positive difference between the two solutions for x to the following equation: $8x^{y-7} = 2x^{y-8}$, provided $y > 8$?

A. $\frac{1}{4}$ B. $\frac{15}{4}$ C. 4   D. 8   E. NOTA

27. Solve for x in the following: $16 * 2^{x-2} = 8^{x-6}$

A. -10 B. -4 C. $\dfrac{2}{3}$ D. 10   E. NOTA

Use the following information for problems 28-30: Let a, b, and c be integers such that $a^{bc} < -1 \ and \ 0 < b^{ac} < 1$

28. Based on the above, which of the following MUST be true:

A. c^{ab} is an integer   B. $c^{ab} < 0$ C. $0 < c^{ab} < 1$ D. $c^{ab} > 1$ E. NOTA

29. Based on the above, which of the following MUST be false:

A. a is odd   B. b is even   C. c > 0   D. two or more of the above   E. NOTA

30. Based on the above, a^a MUST be:

A. even   B. odd   C. positive   D. A and C   E. NOTA