For this test, E) NOTA means "None of These Answers." As usual, $i = \sqrt{-1}$ and all functions are restricted to their traditional domains and ranges unless otherwise specified. Good luck and have fun!

1) Simplify the following: $\log_4(256) \cdot \log_8(32768) \cdot \log_{1/2}(32)$.

A) -300 **B) -100** **C) 100** **D) 300** **E) NOTA**

2) Compute the product of the solutions for the equation: $[\log_9(x)]^2 - \log_{1/27}(x) + 5 = 0$.

A) $\log_3(12)$ **B) 12** **C) 3^{12}** **D) 3** **E) NOTA**

3) What is the maximum value of the function $y = \frac{13}{1+e^{-1.4x}}$?

A) 1.4 **B) $\ln(13)$** **C) 13** **D) Infinity** **E) NOTA**

4) How many integer values of x satisfy the following inequality: $2^{16} < 3^x < 2^{32}$? Hint: $\log_3 2 \approx 0.631$.

A) 0 **B) 2** **C) 5** **D) 10** **E) NOTA**

5) Consider the function $f(x) = 2\log_3(x-3)$. How many of the following statements are true?

I. The domain of f is $x \geq 3$

II. The range of f is all Real numbers

III. The inverse of f is $f^{-1}(x) = 3^{x/2} + 3$

A) 0 **B) 1** **C) 2** **D) 3** **E) NOTA**

6) For what value of x is the following equation true: $\sum_{n=0}^{\infty} 2^{nx} = \frac{3}{2}$?

A) -1 **B) $-\log_2(3)$** **C) -2** **D) $-\log_2(5)$** **E) NOTA**

7) Compute $i^{1+6145+312+48963-3012}$.

A) i **B) -1** **C) $-i$** **D) 1** **E) NOTA**

8) Compute the distance from the point $0 + 0i$ to $(3+4i)^4$.

A) -527 **B) -336** **C) 125** **D) 625** **E) NOTA**

9) How many times do the graphs of $y = 2^{|x^2-1|}$ and $y = 4^{1-x^2}$ intersect?

A) 0 **B) 1** **C) 2** **D) 3** **E) NOTA**

10) Given that $\log 5 \approx 0.699$, which of the following is closest to $\log(3125)$?

A) 2.401 **B) 3.495** **C) 5** **D) 9** **E) NOTA**

11) Which of the following intervals contains the value of $2000 \cdot \log 2000^5$? Note : $\log 2 \approx 0.301$

A) $[10^4, 2 \cdot 10^4]$ **B) $[2 \cdot 10^4, 3 \cdot 10^4]$** **C) $[3 \cdot 10^4, 4 \cdot 10^4]$**

D) $[4 \cdot 10^4, 5 \cdot 10^4]$ **E) NOTA**

12) Which of the following is the largest number: $6^{99}, 7^{75}, 8^{50}$?

A) 6^{99} **B) 7^{75}** **C) 8^{50}** **D) All equal** **E) NOTA**

13) Find the sum of the solutions for $4e^x + \frac{5}{e^x} = 9$.

A) 0 **B) $\frac{5}{4}$** **C) $\ln\frac{4}{5}+1$** **D) $\ln\frac{5}{4}+1$** **E) NOTA**

14) How many times do the graphs of $y = 2^x$ and $y = x^2$ intersect?

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

15) Which of the following conditions is **not** a restriction on the equation $y = \log_b(a)$?

A) $b > 0, b \neq 1$ **B) $a \geq 0$** **C) $y \in \mathbb{R}$** **D) All are true** **E) NOTA**

16) Compute the unique value of t such that $\sum_{n=0}^{t} \log_t(n+1) = 1 + \log_t(5040)$.

A) $t = 8$ **B) $t = 7$** **C) $t = 6$** **D) $t = 5$** **E) NOTA**

17) Compute the sum $\log\frac{1}{3} + \log\frac{2}{4} + \log\frac{3}{5} + \cdots + \log\frac{2020}{2022}$.

A) $-\log(2,043,231)$ **B) $-2\log(2022)$** **C) $-\log(2022 \cdot 2023)$**

D) $-\log(4044 \cdot 2021)$ **E) NOTA**

18) If $a = \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \cdots$ and $b = \frac{1}{2} + \frac{2}{4} + \frac{3}{8} + \frac{4}{16} + \cdots$, compute $3^a 5^b$.

A) 3 **B) 15** **C) 75** **D) 125** **E) NOTA**

19) For how many values of $0 < x < 2022$ is $\left(1 + i\sqrt{3}\right)^x$ an integer?

A) 666 **B) 673** **C) 674** **D) 689** **E) NOTA**

20) Given that $2022^{1/2}$ lies on the interval $(n, n+1)$, find the sum of the digits of $11n$.

A) 3 **B) 4** **C) 8** **D) 12** **E) NOTA**

21) Find the sum of the solutions of $(x^2 - 9x + 15)^{x^2+4x+4} = 1$.

A) 9 **B) 7** **C) 4** **D) 0** **E) NOTA**

22) What is the units digit of $1^{2022} + 2^{2022} + 3^{2022} + 4^{2022}$?

A) 0 **B) 3** **C) 8** **D) 9** **E) NOTA**

23) How many ways are there to scramble the letters of the word LOGARITHM?

A) 5,040 **B) 40,320** **C) 362,880** **D) 3,628,800** **E) NOTA**

24) Which of the following interest models gains the most interest over time?

A) Simple Interest $(\boldsymbol{A = PRT})$ **B) Compound Annually** $(\boldsymbol{A = P(1+r)^t})$

C) Compound Monthly $\left(\boldsymbol{A = P\left(1 + \frac{r}{12}\right)^{12t}}\right)$ **D) Compound Continuously** $(\boldsymbol{A = Pe^{rt}})$ **E) NOTA**

25) Speaking of interest, suppose Brighten puts \$10,000 in an interest account that is compounded annually (see answer choice B from last problem) with a 10% annual interest rate. Assuming he doesn't deposit or withdraw any money during this time, how much money will he have after 4 years?

A) \$13,310 **B) \$14,641** **C) \$16,105.10** **D) \$ 19,487.17** **E) NOTA**

26) Austin sends her math teacher email asking about the homework in an exponential pattern. On the first day, she sends 1 message, on the second day she sends 3 messages, 9 messages on the third day and so on. How many messages does she send in all the first seven days?

A) 2,187 **B) 6,561** **C) 1,093** **D) 3,280** **E) NOTA**

27) Solve the equation: $8^x + 3 \cdot 4^x 3^x + 3 \cdot 2^x 9^x + 27^x = 2197$

A) 1 **B) $\sqrt{2}$** **C) $\sqrt{3}$** **D) 2** **E) NOTA**

28) A right triangle has hypotenuse 5 and sides equal to x and $\ln x$. How many values of x make such a triangle possible?

A) 0 **B) 1** **C) 2** **D) 3** **E) NOTA**

29) Given that $\sqrt{11 + 4\sqrt{7}}$ can be written in the form $a + \sqrt{b}$, for integers a and b, find $b^2 - a^2$

A) 33 **B) 45** **C) 48** **D) 60** **E) NOTA**

30) The Fundamental Theorem of Algebra states that a polynomial function with real coefficients and degree n will have n complex roots (not necessarily distinct). Given that $f(x)$ is a 4th degree polynomial with two distinct roots and one double root, what are the nature of the roots of $f(x)^3$?

A) 12 total roots, the two distinct roots are now triple roots, the double root is now a sextuple root.

B) 12 total roots, all distinct.

C) 64 total roots, all distinct.

D) 7 total roots, no way to know if they are distinct.

E) NOTA