Good Luck! :)

1. What is the sum of an infinite geometric series in which the 1st term is 1 and the common ratio is $-\sqrt{2}$?

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

2. How many values of K satisfy the equation $\frac{K^{K-3}}{K}=\frac{K}{K^{\frac{4}{K}}}$?

   A. 1 B. 2 C. 3 D. Infinitely many E. NOTA

3. The graph of $\frac{(x-3)(y-7)}{(x+1)(2y-5)}=\frac{1}{2}$ is a line with two holes. What is the slope of the line?

   A. $\frac{-9}{4}$ B. $\frac{-9}{8}$ C. -1 D. $\frac{-5}{7}$ E. NOTA

4. The first digit of a string of 2023 digits is 1. Any 2-digit number formed by consecutive digits within this string is divisible by Mr. Lu's 2 favorite prime numbers 19 or 31. What is the largest possible last digit in this string?

   A. 1 B. 7 C. 8 D. 9 E. NOTA

5. If L is an integer between 1 and 10 inclusive and U is an integer between 1 and 36 inclusive, how many ordered pairs of integers (L,U) exist such that $\sqrt{L+\sqrt{U}}$ is an integer?

   A. 6 B. 8 C. 9 D. 10 E. NOTA

6. Find the area of the region bounded by the lines with equations $x + y = 10$, $2x - 5y = 20$, and $2x + y = 8$.

A. 14 B. 30 C. 42 D. 84 E. NOTA

7. In trapezoid MRLU with MR parallel to LU, MR=7, and LU=10. Segment WF is drawn parallel to $\overline{MR}$ with W lying on $\overline{MU}$ and F lying on $\overline{RL}$. IF RF: FL=3:4, then WF = $\frac{Z}{7}$. What is Z?

A. 33 B. 49 C. 58 D. 65 E. NOTA

8. Mu-Lu's favorite arithmetic sequence is 130, 127,…13. J-Wigs favorite arithmetic sequence is 3,7,…139. How many numbers are in both sequences?

A. 8 B. 9 C. 10 D. 11 E. NOTA

9. How many integral values can $\frac{U}{L}$ take given the following inequality? $\frac{4}{2023} < \frac{L}{L+U} < \frac{5}{2023}$

A. 2 B. 4 C. 17 D. 101 E. NOTA

10. Evaluate: $\tan\left(\sec^{-1}\left(-\frac{13}{12}\right)\right) + \cos\left(2\sin^{-1}\left(-\frac{1}{6}\right)\right)$

A. $\frac{-2\sqrt{35}+5}{12}$ B. $\frac{2\sqrt{35}+5}{12}$ C. $\frac{19}{36}$ D. $\frac{49}{36}$ E. NOTA

11. In the binomial expansion of $(9x - y)^{1/2}$, what is the coefficient of the 3rd term?

A. $\frac{-1}{216}$ B. $\frac{-1}{8}$ C. $\frac{1}{216}$ D. $\frac{1}{8}$ E. NOTA

12. Evaluate $\sum_{j=1}^{\infty} \frac{j}{4^{j-1}}$.

A. $\frac{7}{4}$ B. $\frac{15}{8}$ C. $\frac{16}{9}$ D. $\frac{39}{22}$ E. NOTA

13. For what value of n will the graph of the equation $6x^2 - 19xy + 10y^2 + 7x - 12y = n$ form two intersecting lines?

A. -36 B. -20 C. -2 D. 2 E. NOTA

14. Let W and F be positive integers with F > W. Let M = (W, F), let R be the reflection of M over the line $y = x$, let U be the reflection of R across the y-axis, let L be the reflection of U across the x-axis, and let Z be the reflection of L across the y-axis. The area of pentagon MRZLU is 253. Find the value of W.

A. 3 B. 4 C. 11 D. 23 E. NOTA

15. Find $\cos(x - y)$ if $\sin(x) = \frac{4}{5}$ and $\sin(y) = \frac{8}{17}$, with $0 \le x \le \frac{\pi}{2}$ and $\frac{\pi}{2} \le y \le \pi$

A. $\frac{-77}{85}$ B. $\frac{-13}{85}$ C. $\frac{13}{85}$ D. $\frac{77}{85}$ E. NOTA

16. The point on a line nearest to the origin has coordinates $(5,3)$. The point on a second line nearest to the origin has coordinates $(-4,1)$. The lines intersect at (x, y). Find $x + y$.

A. 5 B. 12 C. 22 D. 32 E. NOTA

17. Evaluate the determinant: $\begin{vmatrix} 3 & 4 & -2 & 1 \\ 5 & 1 & 0 & -1 \\ 0 & -3 & 2 & 3 \\ 4 & -1 & 0 & -5 \end{vmatrix}$

A. -66 B. -51 C. -33 D. 51 E. NOTA

18. Find the sum of the solutions to : $x^{\frac{4}{3}} - 45x^{\frac{2}{3}} + 324 = 0$.

A. 0 B. 45 C. 243 D. 324 E. NOTA

19. The sequence $\{a_i\} = \{-7, -6, 3, 26, 69, \ldots\}$ with $a_1 = -7$ can be represented by the rule $a_n = An^3 + Bn^2 + Cn + D$. What is the value of $A - B - C - D$?

A. -7 B. -3 C. 5 D. 9 E. NOTA

20. Compute the reference angle of 11.6, round to the nearest hundredth.

A. 0.61 B. 0.97 C. 2.18 D. 5.32 E. NOTA

21. Simplify: $\dfrac{\cot x\left(\sin^3 x+\cos^2 x\sin x\right)\csc x}{\sec x\left(\sec^2 x-\tan^2 x\right)\cos x}$, for $0<x<\dfrac{\pi}{6}$

A. $\sec x$ B. $\csc x$ C. $\cot x$ D. $\tan x$ E. NOTA

22. What is the shape of the graph $|z-1|+|z+i|=2$ in the complex plane?

A. parabola B. ellipse C. line D. Two points E. NOTA

23. Mr. Rovere messed up and passed out his 10 Alpha scantrons at random to his 10 Alpha's. The probability he passed out at least 8 scantrons to the correct Alpha is $\dfrac{N}{10!}$. What does N equal to?

A. 45 B. 46 C. 56 D. 90 E. NOTA

24. MRLU is a square with side lengths of 10 meters. ZLU is an isosceles triangle with base LU, and the area common to triangle ZLU and square MRLU is 80 square meters. What is the length of the altitude in meters to LU in triangle ZLU?

A. 15 B. 18 C. 24 D. 25 E. NOTA

25. Find the number of pairs of points M and U with positive integer coordinates that lie on the graph of $y=x^2$, M to the left and below U, such that the slope of $\overline{MU}$ is 2023.

A. 1 B. 1011 C. 2022 D. 2023 E. NOTA

26. Real numbers x, y satisfy $\log_8 x + \log_8 y = (\log_8 x)(\log_8 y)$ and $\log_x y = 3$. If $y = 2^L$, what does L equal to?

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

27. List the number of nonreal and real solution as an ordered pair (nonreal, real) that satisfy the equation $\frac{k^6 - 27}{k^2 - 3} - 27 = 0$

A. (2,0) B. (2,2) C. (0,2) D. (4,0) E. NOTA

28. The range of the function $f(x) = \frac{5}{2 + 3^x}$ can be expressed in interval notation as (a, b). What does $b - a$ equal to?

A. $\frac{5}{3}$ B. 2 C. 2.5 D. ∞ E. NOTA

29. How many negative integers greater than -10 satisfy the inequality $\frac{(x+3) + \frac{1}{x+3}}{(x-3)(x+2)} \geq \frac{2}{(x-3)(x+2)}$?

A. 1 B. 7 C. 8 D. 9 E. NOTA

30. Which of the following values is not in the domain of the function $f(x) = (\cos x)^x$?

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