Mu Ciphering
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#0 Mu Ciphering
MAΘ National Convention 2023

Find the equation of the line tangent to the graph $y = \sin x + x$ at the point $(0, 0)$.

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#1 Mu Ciphering
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An ordered triple is randomly selected from all ordered triples of nonnegative integers (B, H, S) that satisfy $B + H + S = 22$. What is the probability that $B < H < S$?

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#2 Mu Ciphering
MAΘ National Convention 2023

$\int_1^2 \frac{9x+4}{x^5+3x^2+x}\,dx = ln\frac{L}{U}$, where L and U are relatively prime integers. Find $L + U$.

#2 Mu Ciphering
MAΘ National Convention 2023

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MAΘ National Convention 2023

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MAΘ National Convention 2023

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#3 Mu Ciphering
MAΘ National Convention 2023

The sum of the length of the base and the height of an isosceles triangle is 31 and its perimeter is 50. What is the sum of all the possible values for the height of this triangle?

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#4 Mu Ciphering
MAΘ National Convention 2023

A box with a square lid (shaped as a rectangular prism) has a volume of $224ft^3$. The material to build the lid costs $5 per square foot and the material to build the sides and bottom costs $2 per square foot. What is the height of the cheapest box that can be built?

#4 Mu Ciphering
MAΘ National Convention 2023

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MAΘ National Convention 2023

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MAΘ National Convention 2023

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#5 Mu Ciphering
MAΘ National Convention 2023

Find the number of integer values of k less than or equal to 2023 that satisfies

$$\frac{k+\sqrt{k}+4}{k-1}<2$$

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#6 Mu Ciphering
MAΘ National Convention 2023

Find the volume of the solid produced when the region bounded by the x-axis, $0 \leq x \leq 1$ and $y = 2x + 3 - 5x^{\frac{2}{3}}$ is rotated about the line $x = 2$

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MAΘ National Convention 2023

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#7 Mu Ciphering
MAΘ National Convention 2023

Given a circle K with center L and diameter $\overline{WF}$, Z is on K and U is on $\overline{WF}$ such that $\overline{ZU}$ bisects angle WZF. If WL=13, FZ=10, and $LU = \frac{X}{Y}$, where X and Y are relatively prime integers, what is X+Y?

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MAΘ National Convention 2023

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#8 Mu Ciphering
MAΘ National Convention 2023

The region L is bounded in Q1 by the x-axis and $y = 2x - x^2$. Region L is a solid with cross-sections perpendicular to the x-axis. The cross-sections are right isosceles triangles with hypotenuses on L. What is the volume of the solid?

#8 Mu Ciphering
MAΘ National Convention 2023

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MAΘ National Convention 2023

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MAΘ National Convention 2023

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#9 Mu Ciphering
MAΘ National Convention 2023

Nicholas's average on 10 quizzes is 7.8. Each score is an integer between 0 and 10 inclusive. He forgets a lot, but he remembers he had a least one 5, at least three 7's, at least two 9's and at least one 10. What is the sum of all the distinct possible values for Nicholas's median quiz score?

#9 Mu Ciphering
MAΘ National Convention 2023

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MAΘ National Convention 2023

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MAΘ National Convention 2023

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#10 Mu Ciphering
MAΘ National Convention 2023

The area of the intersection of the interiors of the graphs $r = 2 + 2\cos\theta$ and $r = 2 - 2\cos\theta$ is $L\pi - U$ for positive integers L, U. What is $L + U$?

#10 Mu Ciphering
MAΘ National Convention 2023

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MAΘ National Convention 2023

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MAΘ National Convention 2023

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#11 Mu Ciphering
MAΘ National Convention 2023

How many positive 4-dgit integers are not multiples of 1111 and have its digits form an arithmetic sequence in that order? (For example, 1234 qualifies, but 1235 and 2413 do not.)

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Question #12

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Question #12

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Question #12

#12 Mu Ciphering
MAΘ National Convention 2023

Evaluate:

$$\lim_{n\to\infty}\sum_{k=1}^{n}\frac{n}{n^2+k^2}$$

#12 Mu Ciphering
MAΘ National Convention 2023

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