

Question #0 – Theta Seat – 2025 MAO Nationals Convention Relay

Get ready for a Musical Adventure! The number of songs Mauithedog10 🐕 listens to over time can be modeled by $f(x) = 2x - 1$. Let A be the value of x where $f(x)$ intersects the line $g(x) = x + 1$

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Consider the musical artist Phoebe B. and imagine you are arranging the letters PHOEBEB. Let A be the number ways are there to arrange the letters in PHOEBEB such that the P and H are next to each other.

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Bad Bunny hops according to a strange sequence. Let

$$A = \frac{1}{\ln(2^{15})} (\ln(2^0) + \ln(2^1) + \ln(2^2) + \cdots + \ln(2^9))$$

Note that A **must be expressed as an integer**.

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Olivia Rodrigo has déjà vu! She keeps doing the same processes over and over again: She first starts with an equilateral triangle with side length 1. This triangle has area A_0 . She then creates a new triangle by halving the length of all the side lengths. This triangle has area A_1 . She then continues this to get A_2, A_3 and so on to infinity. Let $A = A_0 + A_1 + A_2 + A_3 + \dots$, or the infinite sum of all the areas of the triangles.

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Question #4 – Calculus Seat – 2025 MAO Nationals Convention Relay

Sabrina Carpenter is getting a Taste of the fundamentals of Calculus. Consider the following function f given by the table:

x	$f(x)$	$f'(x)$
-1	0	-1
0	-1	-2
1	-2	-3

Assume that f^{-1} exists and is continuous on $[-1, 1]$. Let A be the approximation of $f^{-1}(1)$ using the value of $\int_{-1}^1 (f^{-1})'(x) dx$, approximated by a left Riemann sum with 2 sub-intervals of length 1.

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Question #5 – Calculus Seat – 2025 MAO Nationals Convention Relay

Billie Eilish wants to be THE GREATEST at calculus. Help her with the following problem: Let $A = V/\pi$, where V is the volume of the solid obtained from rotating the function $f(x) = 2xe^{-x+1}$ on the domain $[1, \infty)$ around the x -axis. **Note that A is not the value of the volume.**

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Question #6 – Calculus Seat – 2025 MAO Nationals Convention Relay

Not all questions can be music themed, and not all integrals can be solved without useful bounds.

$$\pi \ln(k) = \int_0^\pi \frac{x |\cos(x)|}{1 + \sin(x)} dx$$

Let $A = k$. Note A is not the value of the whole integral.

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Question #7 – Alpha Seat – 2025 MAO Nationals Convention Relay

Avril Lavigne always makes things too complicated! If $Re(z)$ and $Im(z)$ gives the real and imaginary parts of complex number z respectively, let

$$A = |Re(\sqrt{3-4i})| + |Im(\sqrt{3-4i})|$$

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In order to test her true Solar Power, Lorde is studying orbits and considers the following (possibly degenerate) conic:

$$3Ax^2 + xy + 2Ay^2 - 3Ax + 2y - 5A = 0$$

The conic is then rotated counterclockwise by an acute angle θ so that the conic no longer has an xy term. Given that $\cos(4\theta) = 3/5$, and that A is **positive**, find A .

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Question #9 – Alpha Seat – 2025 MAO Nationals Convention Relay

The 1975 had a Change of Heart, and are more interested in maximization than regular Precalculus. If (x, y, z) lies on a sphere of radius 3, let A be the maximum value of $xy + xz + yz$.

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