#1 Calculus – Hustle
MAΘ National Convention 2024

Evaluate:

$$\lim_{x\to\infty}\left(\sqrt{x^2+6x+8}-\sqrt{x^2+8x+6}\right)$$

Answer : _____

Round 1 2 3 4 5

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#2 Calculus – Hustle
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Find the nonzero coordinate of the y-intercept of the line normal to the curve $y=\frac{x^4}{2}-\frac{2x^3}{3}+4x-5$ at $x=1$.

Answer : ____________________

Round 1 2 3 4 5

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#3 Calculus – Hustle
MAΘ National Convention 2024

Find the slope of the tangent line to the curve $2x^2y + 3x^3y^2 - x = 7$ at the point $(1, -2)$.

Answer : ____________________

Round 1 2 3 4 5

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Answer : ____________________

Round 1 2 3 4 5

#4 Calculus – Hustle
MAΘ National Convention 2024

Evaluate:

$$\sum_{n=2}^{10} \frac{1}{n^2 - n}$$

Answer : _____

Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#5 Calculus – Hustle
MAΘ National Convention 2024

Evaluate:

$$\int_0^1 x^2\sqrt{1-x}\,dx$$

Answer : _____

Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#6 Calculus – Hustle
MAΘ National Convention 2024

If a particular solution to

$$x^2\frac{dy}{dx}+\frac{y-2}{x^3}=0$$

contains the points $(1,1)$ and $\left(\frac{1}{\sqrt{2}},n\right)$, find n.

Answer : _____

Round 1 2 3 4 5

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If a particular solution to

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Answer : _____

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#7 Calculus – Hustle
MAΘ National Convention 2024

Evaluate:

$$\lim_{x\to 1}\frac{x^3+5x^2+x-7}{x^4-3x^3+x^2+15x-14}$$

Answer : _____

Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#8 Calculus – Hustle
MAΘ National Convention 2024

Evaluate:

$$\sin\left(\int_3^4 \frac{dx}{\sqrt{25-x^2}}\right)$$

Answer : _____

Round 1 2 3 4 5

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Answer : _____

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#9 Calculus – Hustle
MAΘ National Convention 2024

Find the cosine of the acute angle formed by the intersection of $y = x^3 - x - 4$ and its reflection over the line $y = x$.

Answer : ____________________

Round 1 2 3 4 5

#9 Calculus – Hustle
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Answer : ____________________

Round 1 2 3 4 5

#10 Calculus – Hustle
MAΘ National Convention 2024

Find the sum of the integers in the interval of convergence for the series

$$\sum_{n=1}^{\infty} \frac{(x+3)^n}{n5^{n-1}}$$

Answer : _____

Round 1 2 3 4 5

#10 Calculus – Hustle
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Round 1 2 3 4 5

#11 Calculus – Hustle
MAΘ National Convention 2024

Find the area above the x-axis and under the parametric curve given by

$$x = t - \sin t$$
$$y = 1 - \cos t$$

for $0 \leq t \leq 2\pi$.

Answer : _____

Round 1 2 3 4 5

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#12 Calculus – Hustle
MAΘ National Convention 2024

The amount of water per minute dripping out of an inverted conical container with base radius 4 and height 12 is 4π units cubed per minute. When the height of the water is 4, find the number of units per minute that the height of the water is decreasing.

Answer : _____

Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#13 Calculus – Hustle
MAΘ National Convention 2024

Determine the coefficient of the x^3 term in the Maclaurin series expansion of $\frac{7}{x-1} + 24\cos\sqrt{x}$.

Answer : _____

Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#14 Calculus – Hustle
MAΘ National Convention 2024

The circle given by $x^2 + y^2 - 4x - 4y - 7 = 0$ is rotated about the line $4x + 3y + 6 = 0$. Find the volume of the solid formed.

Answer : ____________________

Round 1 2 3 4 5

#14 Calculus – Hustle
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The circle given by $x^2 + y^2 - 4x - 4y - 7 = 0$ is rotated about the line $4x + 3y + 6 = 0$. Find the volume of the solid formed.

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Answer : ____________________

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#15 Calculus – Hustle
MAΘ National Convention 2024

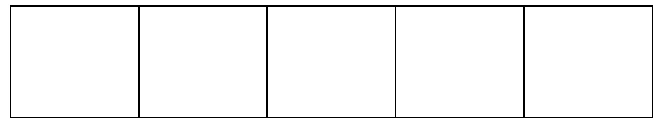
Gwen and Rachel want to enclose 5 identical rectangular regions for their pet greyhounds with 60 meters of fence (see below diagram). What is the maximum area for **one of the 5 regions**?

Answer : ______________________

Round 1 2 3 4 5

#15 Calculus – Hustle
MAΘ National Convention 2024

Gwen and Rachel want to enclose 5 identical rectangular regions for their pet greyhounds with 60 meters of fence (see below diagram). What is the maximum area for **one of the 5 regions**?



Answer : ______________________

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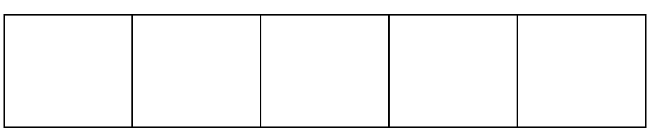

Answer : ______________________

Round 1 2 3 4 5

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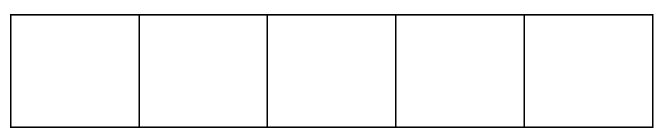

Answer : ______________________

Round 1 2 3 4 5

#16 Calculus – Hustle
MAΘ National Convention 2024

Evaluate:

$$\left(\sum_{n=0}^{\infty} \frac{(-1/3)^n}{2n+1}\right)^2$$

Answer : _____

Round 1 2 3 4 5

#16 Calculus – Hustle
MAΘ National Convention 2024

Evaluate:

$$\left(\sum_{n=0}^{\infty} \frac{(-1/3)^n}{2n+1}\right)^2$$

Answer : _____

Round 1 2 3 4 5

#16 Calculus – Hustle
MAΘ National Convention 2024

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Answer : _____

Round 1 2 3 4 5

#16 Calculus – Hustle
MAΘ National Convention 2024

Evaluate:

$$\left(\sum_{n=0}^{\infty} \frac{(-1/3)^n}{2n+1}\right)^2$$

Answer : _____

Round 1 2 3 4 5

#17 Calculus – Hustle
MAΘ National Convention 2024

Evaluate:

$$\int_3^7 \frac{\ln(x-2)}{\ln(10x-x^2-16)}\,dx$$

Answer : _____

Round 1 2 3 4 5

#17 Calculus – Hustle
MAΘ National Convention 2024

Evaluate:

$$\int_3^7 \frac{\ln(x-2)}{\ln(10x-x^2-16)}\,dx$$

Answer : _____

Round 1 2 3 4 5

#17 Calculus – Hustle
MAΘ National Convention 2024

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Round 1 2 3 4 5

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MAΘ National Convention 2024

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$$\int_3^7 \frac{\ln(x-2)}{\ln(10x-x^2-16)}\,dx$$

Answer : _____

Round 1 2 3 4 5

#18 Calculus – Hustle
MAΘ National Convention 2024

Find the volume of the figure formed by rotating the region between $y = x + 6$ and the x-axis between $x = 1$ and $x = 4$ over the line $y = -1$.

Answer : ____________________

Round 1 2 3 4 5

#18 Calculus – Hustle
MAΘ National Convention 2024

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Answer : ____________________

Round 1 2 3 4 5

#19 Calculus – Hustle
MAΘ National Convention 2024

Find the sum of the values of x that satisfy the Mean Value Theorem for Derivatives for the function $y = x^3 - 6x - 9$ over the range $[-3,3]$.

Answer : ____________________

Round 1 2 3 4 5

#19 Calculus – Hustle
MAΘ National Convention 2024

Find the sum of the values of x that satisfy the Mean Value Theorem for Derivatives for the function $y = x^3 - 6x - 9$ over the range $[-3,3]$.

Answer : ____________________

Round 1 2 3 4 5

#19 Calculus – Hustle
MAΘ National Convention 2024

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Answer : ____________________

Round 1 2 3 4 5

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MAΘ National Convention 2024

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Answer : ____________________

Round 1 2 3 4 5

#20 Calculus – Hustle
MAΘ National Convention 2024

Which is greater? (Give your answer as A or B)

$$A)\ \frac{1}{2022}+\frac{6}{2024}+\frac{1}{2026}$$

$$B)\ \frac{4}{2023}+\frac{4}{2025}$$

Answer : _____

Round 1 2 3 4 5

#20 Calculus – Hustle
MAΘ National Convention 2024

Which is greater? (Give your answer as A or B)

$$A)\ \frac{1}{2022}+\frac{6}{2024}+\frac{1}{2026}$$

$$B)\ \frac{4}{2023}+\frac{4}{2025}$$

Answer : _____

Round 1 2 3 4 5

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MAΘ National Convention 2024

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$$A)\ \frac{1}{2022}+\frac{6}{2024}+\frac{1}{2026}$$

$$B)\ \frac{4}{2023}+\frac{4}{2025}$$

Answer : _____

Round 1 2 3 4 5

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MAΘ National Convention 2024

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$$A)\ \frac{1}{2022}+\frac{6}{2024}+\frac{1}{2026}$$

$$B)\ \frac{4}{2023}+\frac{4}{2025}$$

Answer : _____

Round 1 2 3 4 5

#21 Calculus – Hustle
MAΘ National Convention 2024

Evaluate:

$$\lim_{n\to\infty}\sum_{i=0}^{n-1}\frac{16i}{n^2}\sqrt{16-\left(\frac{4i}{n}\right)^2}$$

Answer : _____

Round 1 2 3 4 5

#21 Calculus – Hustle
MAΘ National Convention 2024

Evaluate:

$$\lim_{n\to\infty}\sum_{i=0}^{n-1}\frac{16i}{n^2}\sqrt{16-\left(\frac{4i}{n}\right)^2}$$

Answer : _____

Round 1 2 3 4 5

#21 Calculus – Hustle
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$$\lim_{n\to\infty}\sum_{i=0}^{n-1}\frac{16i}{n^2}\sqrt{16-\left(\frac{4i}{n}\right)^2}$$

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Round 1 2 3 4 5

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MAΘ National Convention 2024

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Answer : _____

Round 1 2 3 4 5

#22 Calculus – Hustle
MAΘ National Convention 2024

Find the length of the arc given by $r = 2e^{2\theta}$ between $\theta = \ln \pi$ and $\theta = \ln(2\pi)$.

Answer : _____

Round 1 2 3 4 5

#22 Calculus – Hustle
MAΘ National Convention 2024

Find the length of the arc given by $r = 2e^{2\theta}$ between $\theta = \ln \pi$ and $\theta = \ln(2\pi)$.

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Answer : _____

Round 1 2 3 4 5

#23 Calculus – Hustle
MAΘ National Convention 2024

Evaluate:

$$\int_0^{\arcsin(\pi/6)} e^{\sin(\sin x)} \sin(2\sin x)\cos x \; dx$$

Answer : _____

Round 1 2 3 4 5

#23 Calculus – Hustle
MAΘ National Convention 2024

Evaluate:

$$\int_0^{\arcsin(\pi/6)} e^{\sin(\sin x)} \sin(2\sin x)\cos x \; dx$$

Answer : _____

Round 1 2 3 4 5

#23 Calculus – Hustle
MAΘ National Convention 2024

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Answer : _____

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MAΘ National Convention 2024

Evaluate:

$$\int_0^{\arcsin(\pi/6)} e^{\sin(\sin x)} \sin(2\sin x)\cos x \; dx$$

Answer : _____

Round 1 2 3 4 5

#24 Calculus – Hustle
MAΘ National Convention 2024

a, b, and c are positive integers such that the function

$$f(x) = \begin{cases} ax^2 + bx + c, & x < 1 \\ 2cx^2 - 3ax + 2b, & x \geq 1 \end{cases}$$

is differentiable everywhere. If $5c - 3a = 30$, find $a + b + c$.

Answer : _____

Round 1 2 3 4 5

#24 Calculus – Hustle
MAΘ National Convention 2024

a, b, and c are positive integers such that the function

$$f(x) = \begin{cases} ax^2 + bx + c, & x < 1 \\ 2cx^2 - 3ax + 2b, & x \geq 1 \end{cases}$$

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a, b, and c are positive integers such that the function

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is differentiable everywhere. If $5c - 3a = 30$, find $a + b + c$.

Answer : _____

Round 1 2 3 4 5

#25 Calculus – Hustle
MAΘ National Convention 2024

Given that $\int_a^b 2x\ dx = 2023$ for positive integers a and b, find the minimum possible value of a.

Answer : _____

Round 1 2 3 4 5

#25 Calculus – Hustle
MAΘ National Convention 2024

Given that $\int_a^b 2x\ dx = 2023$ for positive integers a and b, find the minimum possible value of a.

Answer : _____

Round 1 2 3 4 5

#25 Calculus – Hustle
MAΘ National Convention 2024

Given that $\int_a^b 2x\ dx = 2023$ for positive integers a and b, find the minimum possible value of a.

Answer : _____

Round 1 2 3 4 5

#25 Calculus – Hustle
MAΘ National Convention 2024

Given that $\int_a^b 2x\ dx = 2023$ for positive integers a and b, find the minimum possible value of a.

Answer : _____

Round 1 2 3 4 5