

Question #0

Calculus Ciphering

FAMAT State Convention 2021

Find the 2020th derivative of $f(x)$
evaluated at 0, given

$$f(x) = \frac{e^x - e^{-x}}{\ln(10 + x^2) \cos(x)}$$

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Find the derivative of $e^{f(x)}$ at $x = \pi$, if
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Question #2

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Find the equation of the line tangent to $x^2 + xy + y^2 = 3$ at the point $(1, 1)$. Give your answer in standard form.

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Question #3

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Water is being poured at a rate of $12 \text{ in}^3/\text{s}$ into a spherical container of radius 3 in. At the instant that the height of the water in the container is 1.5 in, what is the rate of change of the height in in/s?

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Evaluate:

$$\int_0^1 \frac{dx}{x + x^{-2020}}$$

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Find the integer that's closest to

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Question #6

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Given that

$$\int_0^1 \frac{f(x)}{x} dx = 10$$

Evaluate

$$\int_0^1 \frac{f(x^{2020})}{x} dx$$

Question #6

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Given that

$$\int_0^1 \frac{f(x)}{x} dx = 10$$

Evaluate

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Let A_n denote the first-quadrant area bounded by lines $x = 0$, $x = 3$ and the curve $y^{2n} - x^{2n} = xy$. Find

$$\lim_{n \rightarrow \infty} A_n$$

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Question #8

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For a differentiable function f ,

$$f(x) + \ln f'(x) = 2$$

Given $f(0) = 0$, solve for $f(1)$.**Question #8**

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Question #9

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There exist unique real coefficients a_n such that for all positive x less than $\pi/4$,

$$x = \sum_{n=0}^{\infty} a_n \tan^n(x)$$

Find a_7 .**Question #9**

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Question #10

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Find the following limit:

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