#0 Mu Ciphering
MAΘ National Convention 2017

Evaluate: $\lim_{x\to -1} \frac{-3x^2+7x-5}{2x^2+8x+9}$

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Find the equation, in slope-intercept form, of the tangent to $y = 4x^3 - 2x + 12$ at the point where $x = 2$.

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A rectangle is inscribed in the parabola with equation $y = x^2$, on or below the line with equation $y = 147$. Find the area enclosed by the largest such rectangle.

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Find the domain of the real-valued function $f(x)=\sqrt{1-\sqrt{2-\sqrt{3-x}}}$, written in interval notation.

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#5 Mu Ciphering
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A continuous, real-valued function *f* satisfies $f(3x)=5f(x)$ for all *x*. Given that $\int_0^2 f(x)dx=8$, find the value of $\int_2^6 f(x)dx$.

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#6 Mu Ciphering
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A positive, real-valued function *f* has domain $[0,\infty)$. A solid is generated by revolving the region bounded by *f* and the *x*-axis between $x=0$ and $x=a$, where $a>0$, about the *x*-axis, resulting in a volume of a^2. Find the value of $f(\pi)$.

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Let a_n be the *n*th term of a sequence defined recursively in the following way: $a_1 = 2$, $a_2 = 5$, and for any integer $n \geq 3$, $a_n = 5a_{n-1} - 6a_{n-2}$. Find the value of a_{10}.

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Evaluate:

$$\lim_{n\to\infty}\left(-\frac{1}{n}\sum_{i=0}^{n-1}\left(5-8\left(\frac{\left(1-\frac{i}{n}\right)+\left(1-\frac{i+1}{n}\right)}{2}\right)^3\right)\right)$$

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#10 Mu Ciphering
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If $\int_0^{\sqrt{2}} \frac{1-x^2}{1+x^4}dx$ can be written in the form $\frac{\sqrt{2}}{4}\ln b$, where $b>0$ is real, find the value of *b*.

(HINT: $1+x^4=\left(1+\sqrt{2}x+x^2\right)\left(1-\sqrt{2}x+x^2\right)$)

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Find the inflection point of the function $y = 3x^5 + 5x^4 - 80x^3 - 360x^2 + 1400x + 72$, written as an ordered pair.

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#12 Mu Ciphering
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The volume of the solid obtained by revolving the region bounded by $y=\sqrt{2}e^{x}$, $y=\sqrt{3}x$, $x=0$, and $x=1$ about the *x*-axis can be written in the form $A\pi$, where *A* is real. Find the value of *A*.

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