

#0 Mu Cipheryng
MAΘ National Convention 2018

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#1 Mu Cipheryng
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Find the arc length of the curve defined parametrically by $x = 2 \cos^2 \theta$ and $y = 2 \sin \theta \cos \theta$ where $0 \leq \theta \leq \frac{\pi}{2}$.

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#2 Mu Ciphering
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Morty is flying a kite at a constant height of 60 ft. while the wind is blowing the kite horizontally away from him at a rate of 15 ft. per second. At what rate, in ft. per second, does Morty have to let out the string of the kite when the string is 109 ft. long?

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Find the volume of the solid formed by revolving the arc defined by $x^2 + y^2 = 1$ between the points $\left(\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$ and $(1, 0)$ around the x-axis.

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Find the value of

$$\int_{-1}^1 \frac{y^4(1-y)^4}{1+y^2} dy$$

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#5 Mu Cipheryng
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Find the radius of convergence of the power

series $\sum_{n=0}^{\infty} \frac{(-1)^n x^{2n+2}}{(3^n+2)(n^4+5)}$

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Rick is building his new headquarters on a 30m by 30m square base using square cross sections parallel to the base. Each cross section at a height h from the base has eastern and western sides at a horizontal distance d from the points above the eastern and western edges of the base, where distance is measured due east and due west. If $h = d^2$, find the volume of Rick's new headquarters in m^3 .

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Evaluate:

$$\lim_{x \rightarrow \infty} x(\sqrt[7]{x^7 + 7x^6} - \sqrt[13]{x^{13} + 13x^{12}})$$

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Find the maximum area bounded by the curves
 $y^2 = 4kx$ and $y = \frac{x}{k}$ where $1 \leq k \leq 2$.

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Find all positive real solutions to the equation:

$$x^{x^{x^{\dots x^3}}} = 3$$

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#10 Mu Ciphering
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$$F(a) = \int_0^1 \left(\prod_{b=1}^a (x + b) \right) \left(\sum_{c=1}^a \frac{1}{x + c} \right) dx$$

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$$\text{Given } f(x) = \sum_{n=0}^{\infty} \frac{x^n}{n!2^{\frac{n^2-n}{2}}}$$

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$$\lim_{x \rightarrow 0} \frac{f(x) - e^x}{1 - \cos x}$$

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In interval notation, find the range of

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If $f(x) = \sqrt{x - \sqrt{x - \sqrt{x - \sqrt{x} \dots}}}$ and
 $g(x) = f^{-1}(x)$, then find $g'(20)$.

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