

#0 Mu School Bowl
MAΘ National Convention 2011

$$A = \lim_{x \rightarrow \infty} (\tan^{-1} x)$$

$$B = \lim_{x \rightarrow 2} \frac{x^2 + 8x - 20}{x^3 - 8}$$

$$C = \lim_{x \rightarrow 0^+} x^x$$

$$D = \lim_{x \rightarrow \pi} \tan x$$

Find the value of $A+B+C+D$.

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#1 Mu School Bowl
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For the displacement function $f(t) = 2t^2 - 3t - 2$, let:

A = the average velocity over the interval $[1,2]$

B = the instantaneous velocity at $t = 1$

C = the average velocity over the interval $[2,3]$

D = the instantaneous velocity at $t = 2$

Find the value of $\frac{A-B}{C-D}$.

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#2 Mu School Bowl
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$$A = \lim_{x \rightarrow -1} \frac{x^3 + x + 2}{2x^4 + 3x + 1}$$

$$B = f''(-3), \text{ where } f(x) = \frac{x-2}{x+1}$$

$$C = \text{the maximum value of } f(x) = -7x^{3/2} + 21x - 18$$

$$D = -1 + \text{the number of points of inflection of } f(x) = x^2 - 2x + 2x \ln x$$

Find the value of $ABCD$.

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Find the value of $ABCD$.

#3 Mu School Bowl
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What is the minimum value of $2x + y$, given that $xy = n$ and x and y are both positive?

$A =$ the solution when $n = 50$

$B =$ the solution when $n = 128$

$C =$ the solution when $n = 162$

$D =$ the solution when $n = 288$

Find the value of $\frac{(A^2 + \sqrt{C})D}{B}$.

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#4 Mu School Bowl
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For the function $f(x) = x^3 - x^2 - x + 1$:

A = the sum of the x -intercepts of f

B = the sum of the x -coordinates of the relative extrema of f

C = the sum of the x -coordinates of the inflection points of f

D = the sum of the y -coordinates of all of the above points

Find the value of $(4A + 3B + 3C)\sqrt{D}$.

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Find the value of $(4A + 3B + 3C)\sqrt{D}$.

#5 Mu School Bowl
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A diver jumps from a diving board 32 feet above water, and his position in feet at time t is determined by the function $s(t) = -16t^2 + 24t + 32$.

A = the time t the diver hit the water

B = the time t the diver was at the peak of his dive

C = the diver's velocity on impact with the water

Find the value of $\lfloor \lfloor A \rfloor B \rfloor \left(\frac{C}{8} \right)^2$, where $\lfloor x \rfloor$ represents the greatest integer n with $n \leq x$.

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#6 Mu School Bowl
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For the function $f(x) = \frac{\ln x}{x-1}$, let $L(x)$ be the linear approximation to the graph of f at $x=e$.

A = the slope of $y=L(x)$

B = the x -intercept of $y=L(x)$

C = the y -intercept of $y=L(x)$

$D=L(1)$

Find the value of $\frac{A(B+e)}{CD}$.

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#7 Mu School Bowl
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$$A = \int_1^3 \frac{x}{x^2 + 1} dx$$

$$B = \int_{-2}^1 (x^3 - 4x^2 + 2x - 3) dx$$

$$C = \int_{-2}^2 \frac{\tan^{-1} x}{1 + x^2} dx$$

$$D = \int_0^1 \left(\sum_{n=1}^{37} (n+1)x^n \right) dx$$

Find the value of $\frac{Be^{2A}}{C+D}$.

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Find the value of $\frac{Be^{2A}}{C+D}$.

#8 Mu School Bowl
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Let $f(x) = \int_2^x (t^4 + 3t^3 - 2t^2 + 17t - 14) dt$. Find the value of $f(2) + \sum_{n=1}^{\infty} f^{(n)}(2)$.

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Let $f(x) = \int_2^x (t^4 + 3t^3 - 2t^2 + 17t - 14) dt$. Find the value of $f(2) + \sum_{n=1}^{\infty} f^{(n)}(2)$.

#9 Mu School Bowl
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Given the system of parametric equations $\begin{cases} x = -t + \cos t \\ y = t^2 + \sin t \end{cases}$, find the value of $\frac{dy}{dx}\bigg|_{t=\frac{\pi}{2}} + \frac{d^2y}{dx^2}\bigg|_{t=\frac{\pi}{2}} + \frac{d^3y}{dx^3}\bigg|_{t=\frac{\pi}{2}}$.

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Given the system of parametric equations $\begin{cases} x = -t + \cos t \\ y = t^2 + \sin t \end{cases}$, find the value of $\frac{dy}{dx}\bigg|_{t=\frac{\pi}{2}} + \frac{d^2y}{dx^2}\bigg|_{t=\frac{\pi}{2}} + \frac{d^3y}{dx^3}\bigg|_{t=\frac{\pi}{2}}$.

#10 Mu School Bowl
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Let $f(x) = \frac{1}{4}x^2$ and $g(x) = 2x - 3$.

A = the area bounded between f and g

B = the volume obtained by rotating the region bounded by f and g about the x -axis

C = the volume obtained by rotating the region bounded by f and g about the y -axis

Find the value of $\frac{AB}{C}$.

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Find the value of $\frac{AB}{C}$.

#11 Mu School Bowl
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Consider the differential equation $\frac{dy}{dx} = 2x - y$ with initial condition $y(0) = 1$. For each of the following, estimate the value of $y(0.4)$, using Euler's Method with given step size:

$A =$ solution with step size $\Delta x = 0.4$

$B =$ solution with step size $\Delta x = 0.2$

$C =$ solution with step size $\Delta x = 0.1$

Find the value of $A + B + C$, written as a decimal.

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Find the value of $A + B + C$, written as a decimal.

#12 Mu School Bowl
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List the letters of the series that converge.

$$A: \sum_{n=1}^{\infty} \frac{n}{n^3 + 1}$$

$$D: \sum_{n=1}^{\infty} \left(\frac{\pi}{4}\right)^n$$

$$B: \sum_{n=0}^{\infty} \frac{\cos(n\pi)}{n+1}$$

$$E: \sum_{n=1}^{\infty} (-1)^n e^{-n^2}$$

$$C: \sum_{n=1}^{\infty} \frac{(-3)^n}{(2n+1)!!}$$

$$F: \sum_{n=2}^{\infty} \frac{1}{\ln n}$$

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#13 Mu School Bowl
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$$\text{Let } f(x) = \frac{\ln x}{x}.$$

$$A = f'(1)$$

$$B = \int_1^e f(t) dt$$

$$C = f'(e^2)$$

$$D = \int_1^{e^4} f(t) dt$$

Find the value of $\frac{ABD}{C}$.

#13 Mu School Bowl
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$$A = f'(1)$$

$$B = \int_1^e f(t) dt$$

$$C = f'(e^2)$$

$$D = \int_1^{e^4} f(t) dt$$

Find the value of $\frac{ABD}{C}$.

#14 Mu School Bowl
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Let $f(x) = e^{1-x}$.

$A = f'(2011)$

$B = f''(2011)$

$C = f'''(2011)$

$D = f^{(4)}(2011)$

Find the value of $\frac{A}{B} + \frac{A}{C} + \frac{A}{D} + \frac{B}{A} + \frac{B}{C} + \frac{B}{D} + \frac{C}{A} + \frac{C}{B} + \frac{C}{D} + \frac{D}{A} + \frac{D}{B} + \frac{D}{C}$.

#14 Mu School Bowl
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Let $f(x) = e^{1-x}$.

$A = f'(2011)$

$B = f''(2011)$

$C = f'''(2011)$

$D = f^{(4)}(2011)$

Find the value of $\frac{A}{B} + \frac{A}{C} + \frac{A}{D} + \frac{B}{A} + \frac{B}{C} + \frac{B}{D} + \frac{C}{A} + \frac{C}{B} + \frac{C}{D} + \frac{D}{A} + \frac{D}{B} + \frac{D}{C}$.

