#0 Mu Bowl
MAΘ National Convention 2017

Let A represent the sum of the x-intercepts of the following conic: $9x^2 + 54x + 16y^2 = 63$

Let B represent the length of the major axis of $r = \dfrac{9}{6 + 2\cos\theta}$.

What is $\dfrac{A}{B}$?

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$A = \lim_{x \to 10} \frac{2x^2 - 3x + 5}{50 + 4x^2}$

$B(a) = \lim_{h \to 0} \frac{\sqrt[3]{a^3 + h} - a}{h}$

$C = \lim_{x \to 0} \frac{2^x - 1}{4^x - 1}$

Find $B(C) + A$. (That's B of C, not B times C)

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#2 Mu Bowl
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$A =$ The derivative of the inverse of $f(x)$ evaluated at 0, given that $f(x)=\dfrac{x-1}{x+2}$.

$B =$ The value of $\dfrac{d^2y}{dx^2}$ at the point $(1,-1)$ given $2x+3xy+8y=-9$.

$C = y(p)+y''(p)$ given that $y=\cos x+e^{-2x}$.

Find $B\cdot\left(A+8\right)^2-\ln\left(\dfrac{C}{5}\right)$.

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#3 Mu Bowl
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The function $y = \dfrac{Ax+B}{(x-9)(x-1)}$ has a relative maximum at the point $\left(3, -\dfrac{3}{4}\right)$.

The relative minimum value of the derivative of function $y = x^4 + 8x^3 + 18x^2$ occurs at $x = C$.

The function $y = \dfrac{2x}{(2-x)^2}$ has an inflection point at $x = D$.

Find $e^B + \dfrac{DA}{C}$.

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Find $e^B + \dfrac{DA}{C}$.

#4 Mu Bowl
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Let $A =$ the average value of the function $\sqrt{5x+4}$ on the interval $[0,12]$.

Let $B =$ the value of $f''(2)$ given that $f(x) = \int_4^{2x} \sqrt[3]{t^2-8}\,dt$.

Let $C\sqrt{D}+E$ represent the most simplified answer (i.e., D is not divisible by the square of an integer) to the x-coordinate that satisfies the Mean Value Theorem for the function $f(x)=\dfrac{x}{x+2}$ on the interval $[1,4]$.

Find $5A+3B+C^{D+E}$

#4 Mu Bowl
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#5 Mu Bowl
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$A =$The shortest distance from the point $(0,3)$ to the function $f(x)=1+x^2$.
$B =$The shortest distance from the point (0,5) to the curve $x=f\left(y\right)=1+y^2$.

Find A^2+B^2

#5 Mu Bowl
MAΘ National Convention 2017

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Find A^2+B^2

#6 Mu Bowl
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An inverted cone-shaped tank (base parallel to floor) of water is leaking at a constant rate of $1m^3/hr$. The tank has a base radius of 5 meters and a height of 7 meters.

$A =$ the rate of change of the depth of the water in the tank when the depth of the water is 6 meters.

$B =$ the rate at which the radius of the top of the water is changing when the radius of the water is 3 meters.

Find $\frac{B}{A}$.

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#7 Mu Bowl
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Bill was asked to approximate y when $x = 4$ using Euler's method given the differential equation $\frac{dy}{dx} = 2(x - 1)$ and an initial value of $(1, 0)$. He was asked to use step sizes of $dx = 0.5$, but after the first iteration, he accidentally increased each successive step size by 0.5. Once Bill finished he realized his mistake and re-worked the problem correctly. He found that one of his approximations was better than the other. What was the positive difference between his best approximation and the true value of $f(4)$?

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#8 Mu Bowl
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$$A = \lim_{n\to\infty}\sum_{i=1}^{n}\left(\frac{\frac{i^2}{n^2} - \frac{5i}{n} + 6}{i - 2n}\right)$$

$$B = \int_0^1 \frac{x^2}{x^2+1}\,dx$$

$$C = \int_0^5 \left|x^2 + 4x - 12\right| dx$$

$$D = \int_0^{\frac{1}{3}} \sin^{-1}(3x)\,dx$$

Find $2A+4B+3C+6D$

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#9 Mu Bowl
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$A = y\left(\frac{3p}{4}\right)$ given the differential equation $y' - y = 2\sin(t)$ and the initial value $y(0) = 0$.

$B = y(2)$ given the differential equation $y' + 7x = 0$ and the initial value $y(0) = 3$.

$C = r(\sqrt[3]{e})$ given the differential equation $\frac{dr}{dq} = \frac{r^2}{q}$ and the initial value $r(1) = 2$.

Find $C^2 \ln(A) - B$

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#10 Mu Bowl
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$A =$ The area bounded by the curve $y = 4 - |x - 1|$ and the lines $x = 2$ and $y = -2x - 3$.

$B =$ The area bounded by the line $y = 1$ and the curve $y = |x^2 - 6x + 8|$ between $x = 2$ to $x = 4$.

$C =$ The area bounded by the curves $x = -y^2 + 1$ and $x = y^2 + 8y + 7$.

$D =$ The area bounded by the inner loop of $r = 1 + 2\cos\theta$.

Find $A\pi + D \cdot \frac{C}{B}$.

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#11 Mu Bowl
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Let R =the region enclosed by the curved $y = 4 - 2|x - 2|$ and the x-axis.

A =The volume generated by rotating region R about the line $y = 4$.
B =The volume generated by rotating region R about the line $x = 4$.

Find $\frac{A}{B}$.

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Find $\frac{A}{B}$.

#12 Mu Bowl
MAΘ National Convention 2017

List the letters of the divergent series.

$$A=\sum_{n=0}^{\infty}\left(\frac{4n-2n^3}{9n^3+2}\right)^n \qquad B=\sum_{n=2}^{\infty}\frac{n^2}{(n-2)!} \qquad C=\sum_{n=0}^{\infty}\frac{(-1)^{n-4}\sqrt{n}}{n+2} \qquad D=\sum_{n=0}^{\infty}\frac{n}{n-\cos^2 n} \qquad E=\sum_{n=3}^{\infty}\frac{3}{n\ln n}$$

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#13 Mu Bowl
MAΘ National Convention 2017

Let $A =$the 2nd degree Taylor Polynomial for $f(x) = \dfrac{1}{x^2}$ about $x = -1$.

Let $B =$the 1st order Taylor Polynomial for $g(x) = 10x^2 - x^3 - 6$ about $x = 3$.

Find the sum of the x-coordinates of the two intersection points of polynomials A and B.

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#14 Mu Bowl
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Find the Riemann Sum for $\int_1^5 (x^3+1)\,dx$ with 4 equal subintervals using the following methods:

$A =$ Midpoint Rule
$B =$ Trapezoidal Rule
$C =$ Simpson's Rule

Calculate $3C-(A+B)$

#14 Mu Bowl
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