NMAθ 2002
MU State Bowl

Round # ______

A = ___________________

B = ___________________

C = ___________________

Final answer:

CODE: __________________

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Final answer:

CODE: __________________

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Round 1

Part 1
State the discontinuities of

$$f(t)=\begin{cases}\sqrt{t}-\sqrt{t-1}, & t\ge 1\\ \dfrac{1-t}{t-2}, & t<1\end{cases}$$

A = the sum of the value(s) of discontinuity

Part 2
An object in motion along the x-axis has velocity $v(t)=\left(t+e^{t}\right)\sin(t^{2})$ *for* $1\le t\le 3.$
How many times is the object at rest during this time interval?

B = number of times object at rest

Part 3
Evaluate $\int_{2}^{\infty}\frac{1}{x^{3}}dx$

C = the numerical area

Final answer = $A\sqrt{BC}$

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Round 2

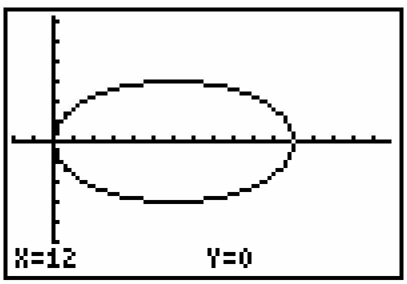
Part 1

For $1 < x < y < x + y$, let $S = \{1,\ x,\ y,\ x + y\}$. What is the difference between the mean and the median of S?

A = the difference

Part 2

Write the equation of the ellipse.



B = first coordinate of the foci located on the right side of the center

Part 3

The curve of $y = \dfrac{1-x}{x-3}$ is concave up over what interval(s)?

C = maximum value for x in the solution interval(s)

Final: $4A + B - 2C$

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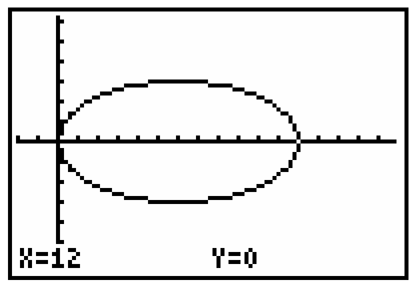

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Round 3

Part 1

Find $\lim_{h \to 0} \frac{\ln(2+h) - \ln 2}{h}$

A = the limit

Part 2

Find the area of the region bounded by the graphs of $f(x) = x^3 - 3x + 2$ and $g(x) = x + 2$.

B = the total area

Part 3

Find the point/slope form of the equation of the tangent line to the curve $\left(x^2 - y^2\right)^{\frac{1}{2}} = x + y - 6$ at (5,4).

C = sum of slope and y-intercept

Final: $\frac{AB}{C}$

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Round 4

Part 1
Solve for x:
$\log_2(x-10) - \log_2(x^2-5x-50) = -7$

A = sum of the digits of x

Part 2
Find $\frac{d^2y}{dx^2}$, given $y = \frac{x+2}{x+3}$

B = the numerator in simplest form

Part 3
Find all extrema in the interval $[0, 2\pi]$ if
$y = \sin x + \cos x$

C = the smallest extremum

Final: $\frac{C}{\pi}(A+B)$

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Round 5

Part 1
Find the corresponding unit vector with initial point (-2, 3, 5) and terminal point at (0, 4, 8).

A = radicand - sum of the coefficients of the vector before it became a unit vector

Part 2
Find $\lim_{x\to\infty}\left(1+\frac{3}{x}\right)^x$

B = the limit

Part 3
Find the first four terms of the Taylor series about x = 0 of $\sqrt{1+x}$

C = the coefficient of the fourth term

Final: $CA - B$

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Round 6

Part 1
A particular solution of a differential equation $\frac{dy}{dx} = x + y$ passes through the point (2,1). Using Euler's method with $\Delta x = 0.1$, estimate its y-value at x = 2.2.

A = the y value

Part 2
A solid is cut out of a sphere of radius 2 by two parallel planes each 1 unit from the center.

B = the volume of the solid

Part 3
A point moves along the curve $y = x^2 + 1$ so that the x-coordinate is increasing at the constant rate of $\frac{3}{2}$ units per second. The rate, in units per second, at which the distance from the origin is changing when the point has coordinates (1,2) is equal to

= C

Final: $\frac{B}{\pi}\left(\frac{C}{\sqrt{5}}\right) + A$

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Round 7

Part 1
By differentiating term-by-term the series
$$(x-1)+\frac{(x-1)^2}{4}+\frac{(x-1)^3}{9}+\frac{(x-1)^4}{16}+\ldots$$
the interval of convergence obtained is ?

A = average of the upper and lower bounds of the interval

Part 2
The length of the arc of $y=\frac{1}{2}x^2-\frac{1}{4}\ln x$ from x = 1 to 4 is ?

B = m (where m comes from the reduced form of the answer as m + ln n)

Part 3
The base of a solid is the region bounded by $x^2=4y$ and the line y=2, and each plane section perpendicular to the y-axis is a square. The volume of the solid is

= C

Final: $(A+B)\left(\frac{C}{5}\right)$

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= C

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Round 8

Part 1
An object initially at rest at (3,3) moves with acceleration $a(t)=(2,e^{-t})$. Where is the object at t = 2?

A = the constant added to the e^{-t} component in the answer

Part 2
The acceleration at time t of a particle moving on the x-axis is $4\pi\cos t$. If the velocity is 0 at t = 0, what is the average velocity of the particle over the interval $0\le t\le\pi$?
B = average velocity

Part 3
A sequence is defined as $a_1=10$ and

$$a_n=\begin{cases}\dfrac{a_{n-1}}{2} & if\ \ a_{n-1}\ is\ even\\ 3(a_{n-1})+1 & if\ a_{n-1}\ \ is\ \ odd\end{cases},$$

find the 10th term.

C = the 10th term

Final: $A^C\bullet B$

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Final: $A^C\bullet B$

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Round 9

Part 1
During a recent span of time, eleven days had some rain. A morning rain was always followed by a clear afternoon, and an afternoon rain was always preceded by a clear morning. In all, nine mornings and twelve afternoons were clear.

A = number of days with no rain at all

Part 2
Given all X's are Y's, but only some Y's are Z's. Which of the following statements are true?
(1) No X's can be Z's
(2) If something is not a Y, then it is not an X.
(3) If something is a Z, then it is not an X.

B = the number (or the sum of the numbers) of the true statement(s)

Part 3
a + b + c + d = 72, where a, b, c and d are four distinct numbers. If five is added to a, subtracted from b, multiplied by c and divided into d, the value of each resulting expression is the same. Find the four distinct numbers.

C = sum of the digits of the four distinct numbers

Final: $\frac{C}{B}+A$

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Round 10

Part 1
First find the roots of
$x^3+4x^2-7x-10=0$ then use that answer to determine the roots of
$(x-3)^3+4(x-3)^2-7(x-3)-10=0$

A = the smallest three digit number, disregarding any signs

Part 2
An urn contains 100 black and 100 white marbles. Repeatedly, 3 marbles are removed and replaced as follows:

Marbles removed	replaced with
3 black	1 black
2 black, 1 white	1 black, 1 white
1 black, 2 white	2 white
3 white	1 black, 1 white

B = the probability that all are white when fewer than 3 marbles remain

Part 3
The fraction below contains the nine digits 1, 2, 3, 4, 5, 6, 7, 8, and 9. Find the appropriate positions of the remaining digits.

$$\frac{\bullet\ 6 \bullet \bullet}{\bullet \bullet 3 \bullet \bullet}=\frac{1}{2}$$

C = the digit in the units position of the denominator

Final: $C-2B+\sqrt{A}$

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