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CALCULUS

QUESTION 1 March Regional

$$A = \lim_{x \rightarrow 1} \frac{x-1}{\frac{\pi}{2} - \arcsin x} \quad B = \lim_{h \rightarrow 2} \frac{h^3 - 8}{h - 2} \quad C = \lim_{x \rightarrow 0} \frac{-\cos x - x^2 + 1}{x^3 + 12x^2} \quad \text{Find } \frac{A+B}{C}$$

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QUESTION 2

March Regional

Find the exact volume of the solid formed by rotating the quadrant I portion of the graph of

$$y = \frac{\ln x}{\sqrt{x}} \text{ on } [1, e] \text{ about the } x\text{-axis.}$$

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QUESTION 3

March Regional

Suppose the temperature (T) inside a house satisfies the differential equation $\frac{dT}{dt} = \frac{3}{4}(35 - T)$ where t is the number of hours the furnace is off. If the temperature in the house is 70 at $t = 0$, how many hours does it take for the house to cool to 40 if the furnace is left off. (Give your answer correct to the nearest thousandth.)

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QUESTION 4

March Regional

Find all values of x on $[0, 4]$ which satisfy the conclusion of the Mean Value Theorem (for Derivatives) for the function $f(x) = 2^x - x^2$. (Give answers to the nearest thousandth.)

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QUESTION 5

March Regional

Assume that f and g are differentiable functions, and suppose that the values of $f, f', g,$ and g' are given in the table. Determine $h'(1)$ if $h(x) = f\left(\frac{g(x)}{x^2 + 1}\right)$.

x	$f(x)$	$f'(x)$	$g(x)$	$g'(x)$
1	3	12	2	4
2	5	11	0	7

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QUESTION 6

March Regional

Let $f(x) = \ln(2 + \cos x)$. Find the y -coordinate(s) of each inflection point of the graph of function f .

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QUESTION 7

March Regional

A fastball leaves a pitcher's hand traveling horizontally, with initial speed 150 ft/sec and initial height 5 feet. Ignoring wind resistance, at what speed does the ball cross the plate, 60.5 feet away? (Give your answer to the nearest thousandth in feet per second and use -32ft/sec as the gravitational constant of acceleration.)

CALCULUS QUESTION 8 March Regional

Find the maximum value of $f(x) = x^2(x+1)^{1.3}$ on $(-1, \infty)$. (Express your answer in exact simplified radical form.)

CALCULUS QUESTION 9 March Regional

The base of a solid is on the x - y plane bounded by the x -axis and the graph of $y = x^{0.6}$ on the interval $[0, 4]$. Cross sections perpendicular to the x -axis are isosceles right triangles with hypotenuse in the x - y plane. Find the volume of the solid correct to the nearest thousandth.

CALCULUS QUESTION 10 March Regional

Evaluate $\int_0^{\pi/28} \frac{7}{\cos(7x)} dx + \int_0^2 \frac{x}{x^2 + 4} dx$ and express your answer in the form $\ln k$. Find the value of k .

CALCULUS QUESTION 11 March Regional

If $f(x) = \cos^2(2-x)$, find the exact value of $f'(\pi)$ in the form $a \sin b$, where a and b are integers.

CALCULUS QUESTION 12 March Regional

Sand is being dumped on a pile in such a way that it always forms a cone whose diameter equals its height. If the sand is being dumped at a rate of 10 cubic feet per minute, at what rate is the height of the pile increasing when there is 144π cubic feet of sand in the pile?

CALCULUS QUESTION 13 March Regional

Use differentials to approximate the change in $\arcsin x$ if x changes from 0.2 to 0.16. Give the answer in simplified radical form.

CALCULUS QUESTION 14 March Regional

A tangent line to the graph of $y = 3x^2 + 4x - 6$ is parallel to the line $4x - 2y - 1 = 0$. Find the x and y coordinates of its point of tangency.

CALCULUS QUESTION 15 March Regional

Evaluate: $\int \frac{1}{x + \sqrt{x}} dx$