#1 Calculus – Hustle
MAΘ National Convention 2010

\[ f'(x) = 6x^2 - 3x - 1 \] gives the derivative of \( f \) for all real values of \( x \). What is the least integer value of \( x \) for which the graph of \( y = f(x) \) is concave up?

Answer : _____________

Round 1 2 3 4 5

#2 Calculus – Hustle
MAΘ National Convention 2010

Evaluate

\[ \int_{0}^{\pi/4} \left( \frac{\sec^2 x}{\cot x} \right) dx. \]

Answer : _____________

Round 1 2 3 4 5

#3 Calculus – Hustle
MAΘ National Convention 2010

For \( f(x) = \sqrt{x^2 - 2x + 1} \) give the value of \( f'(0) \).

Answer : _____________

Round 1 2 3 4 5

#4 Calculus – Hustle
MAΘ National Convention 2010

Evaluate for \( x = -2 \):

\[ \lim_{h \to 0} \frac{2(x + h)^2 + 3(x + h) - 2x^2}{h} \]

Answer : _____________

Round 1 2 3 4 5
#5 Calculus – Hustle  
**MAΘ National Convention 2010**

The complete interval for which the graph of \( f(x) = x^2 e^{2x} \) is decreasing is \((a, b)\). Give the value of \(a\).

Answer : _____________

Round 1 2 3 4 5

#7 Calculus – Hustle  
**MAΘ National Convention 2010**

For the function over the domain [0, 3], \( f(x) = \sqrt{9 - x^2} \), \( g(x) = f^{-1}(x) \). Find value of \( g'(x) \) at the point \((1, 2\sqrt{2})\) on the graph of \(g\).

Answer : _____________

Round 1 2 3 4 5

#6 Calculus – Hustle  
**MAΘ National Convention 2010**

A particle is traveling along the curve \( y = 4x^2 \), and at a particular point on this curve \( \frac{dx}{dt} = 4\frac{dy}{dt} \). If \( \frac{dx}{dt}\frac{dy}{dt} \neq 0 \) then give the \(x\)-coordinate of this point.

Answer : _____________

Round 1 2 3 4 5

#8 Calculus – Hustle  
**MAΘ National Convention 2010**

\( f(x) = 2(g(x))^2 \) and for differentiable functions \(f\) and \(g\), \(g(2) = 4\) and \(g'(2) = 3\). Find the value of \(f'(2)\).

Answer : _____________

Round 1 2 3 4 5
#9 Calculus – Hustle
MAΘ National Convention 2010

Given \( f'(x) = 3x^2 + 3x - 6 \), the graph of \( f' \) is decreasing at a decreasing rate over a certain interval of \( x \). Give one integer value of \( x \) in that interval.

Answer: _____________

Round 1 2 3 4 5

#10 Calculus – Hustle
MAΘ National Convention 2010

The average value of \( f(x) = -\frac{3}{2}x + k \) over the interval \([0, 6]\) is \(-\frac{1}{2}\). Give the value of \( k \).

Answer: _____________

Round 1 2 3 4 5

#11 Calculus – Hustle
MAΘ National Convention 2010

The function
\[
f(x) = \begin{cases} 
ax^2 + 3x + b & \text{for } x \geq 1 \\
2ax - bx & \text{for } x < 1 
\end{cases}
\]
is continuous and differentiable for all real numbers. What is the value of \( |a + b| \)?

Answer: _____________

Round 1 2 3 4 5

#12 Calculus – Hustle
MAΘ National Convention 2010

Give the area in quadrant I bounded by the graphs of \( y = e^x \), \( y = e \) and the y-axis.

Answer: _____________

Round 1 2 3 4 5
#13 Calculus – Hustle
MAΘ National Convention 2010

For the differential equation \( \frac{dy}{dx} = \frac{1}{y} \),
The particular solution \( y = f(x) \)
contains the point \((-1,2)\). Give the value of \( f(5) \).

Answer : _____________

Round 1 2 3 4 5

#15 Calculus – Hustle
MAΘ National Convention 2010

The tangent lines to the curves
\( f(x) = 4x^2 + 3x + 1 \) and
\( g(x) = 9x - 8x^2 + 2 \) are parallel for a certain value of \( x \). Give that value.

Answer : _____________

Round 1 2 3 4 5

#14 Calculus – Hustle
MAΘ National Convention 2010

How many critical values exist for
\( f'(x) = |\sin x| \) over the interval \([0, 2\pi]\) ?

Answer : _____________

Round 1 2 3 4 5

#16 Calculus – Hustle
MAΘ National Convention 2010

\( f'(x) = (kx - 1)(x + 2k) \) for a real non-zero constant \( k \). Give the value of \( x \), in terms of \( k \), for the relative minimum of the graph of \( f \).

Answer : _____________

Round 1 2 3 4 5
#17 Calculus – Hustle
MAΘ National Convention 2010

Give all value(s) of $c$ which satisfy the conclusion of the Mean Value Theorem for derivatives, when $f(x) = x^3 - x^2$ is considered over $[-1, 1]$.

Answer: _____________

Round 1 2 3 4 5

#18 Calculus – Hustle
MAΘ National Convention 2010

Given that $\int_0^2 f(x)dx = 6$, give the value of $\int_0^2 (3f(x) + 4)dx$.

Answer: _____________

Round 1 2 3 4 5

#19 Calculus – Hustle
MAΘ National Convention 2010

When $\int_0^4 (3kx + 1)dx$ is approximated with a right-hand Riemann sum and 4 equal subdivisions, the result is 154. Give the value of $k$.

Answer: _____________

Round 1 2 3 4 5

#20 Calculus – Hustle
MAΘ National Convention 2010

Evaluate $\int_0^{\sqrt{3}} x\sqrt{x^2 + 1} \, dx$.

Answer: _____________

Round 1 2 3 4 5
#21 Calculus – Hustle  
**MAΘ National Convention 2010**

What is the $x$-intercept of the tangent line to $f(x) = 3x^2 - 6x + 1$ at the point on the curve of $f$ when $x = 2$?

**Answer:**

Round 1 2 3 4 5

#22 Calculus – Hustle  
**MAΘ National Convention 2010**

A curve $y = f(x)$ has slope at each point $(x, y)$ to be $\frac{2x}{y}$. If the point $(4, 3)$ is on the graph of $f$, then give the slope of the line normal to $f$ at $x = 4$.

**Answer:**

Round 1 2 3 4 5

#23 Calculus – Hustle  
**MAΘ National Convention 2010**

Evaluate $\int_0^8 |x - 4| \, dx$.

**Answer:**

Round 1 2 3 4 5

#24 Calculus – Hustle  
**MAΘ National Convention 2010**

For a twice-differentiable function $f$, $f''(x) = 1$ for all values of $x$, and $f(1) = 4$ and $f(-1) = 5$. Give the value of $f(0)$.

**Answer:**

Round 1 2 3 4 5
For \( f(x) = \cos x \), give the value of
\[
f^{(4)} \left( \frac{\pi}{6} \right).
\]

Answer: _____________

Round 1 2 3 4 5