#1 Calculus – Hustle
MAΘ National Convention 2007

A particle moves according to the equations:

$x(t) = 4t^3 + 6t^2 - 24t - 24$

$y(t) = 2t^3 + 3t^2 - 12t + 12$

$z(t) = t^3 + 6t^2 + 12t + 20$

At what instant(s) of time [value(s) of t] is the particle not moving?
NOTE: Time can be negative.
If no such instant of time, write none.

Answer : _____

Round 1 2 3 4 5

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Round 1 2 3 4 5

#2 Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $\sum_{n=1}^{\infty} \frac{(i\pi)^n}{n!}$

Answer : _____

Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#3 Calculus – Hustle
MAΘ National Convention 2007

For the equation $x^3 + y^3 + 3x^2y - 3x^2 + 3xy^2 = -11$, using implicit differentiation find dy/dx at the point $(2,-1)$.

Answer : ______________

Round 1 2 3 4 5

#3 Calculus – Hustle
MAΘ National Convention 2007

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Answer : ______________

Round 1 2 3 4 5

#4 Calculus – Hustle
MAΘ National Convention 2007

Let A be the number of infinite discontinuities and B be the number of removable discontinuities in the function $f(x) = \dfrac{x^4 - 2x^2 + 1}{x^3 - x}$.
What is $A - B$?

Answer : _____

Round 1 2 3 4 5

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MAΘ National Convention 2007

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Round 1 2 3 4 5

#5 Calculus – Hustle
MAΘ National Convention 2007

Given $24\,m^2$ of cardboard, you are to construct an open box (that is, a box with no top). In cubic meters, what is the largest volume this box can occupy?

Answer : _____

Round 1 2 3 4 5

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#6 Calculus – Hustle
MAΘ National Convention 2007

What is the tangent line approximation of $\sqrt{14}$, using $\sqrt{16} = 4$?

Answer : _____

Round 1 2 3 4 5

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#7 Calculus – Hustle
MAΘ National Convention 2007

A circle's radius is growing at a rate of $3\ m/s$. At time $t = 0\ s$ the radius of the circle is $1\ m$. How fast is the area of the circle growing (in m^2/s) at time $t = 3\ s$?

Answer : _____

Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#8 Calculus – Hustle
MAΘ National Convention 2007

Let $A = \begin{pmatrix} \frac{1}{2}e^{2\cdot\ln x} & 2x-3 & x-1 \\ 0 & 3 & x^2 \\ -2 & \ln(4x) & (2x-3)^3 \end{pmatrix}$.

Now replace every entry in A with its derivative with respect to x, call this new matrix B. What is the determinant of B?

Answer : _____

Round 1 2 3 4 5

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#9 Calculus – Hustle
MAΘ National Convention 2007

Let $f(x) = \sin(ix)$, what is $f^{(19)}(x)$?
(NOTE: i is the imaginary unit)

Answer : _____

Round 1 2 3 4 5

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A particle moves with acceleration $a(t) = \cos\left(\frac{t}{2}\right)$. The velocity of this particle is zero at time $t = 0$. What is the particle's speed at time $t = 3\pi$?

Answer : _____

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Answer : _____

Round 1 2 3 4 5

#11 Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $\lim_{h\to\infty}\left(1+\frac{3}{h}\right)^{h}$

Answer : _____

Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#12 Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $\int_3^6 \frac{2}{x^2-1}\,dx$

Answer : _____

Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#13 Calculus – Hustle
MAΘ National Convention 2007

Let $f(x) = x^2 + 1$,
$g(x) = \int f'(f(x)) \cdot f'(x)\,dx$
and $g(0) = 2$, what is $g(x)$?

Answer : _____

Round 1 2 3 4 5

#13 Calculus – Hustle
MAΘ National Convention 2007

Let $f(x) = x^2 + 1$,
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Answer : _____

Round 1 2 3 4 5

#14 Calculus – Hustle
MAΘ National Convention 2007

For $f(x) = e^{2x} - 10e^{x} + 12x$, what is the greatest value of x for which the tangent line is horizontal?

Answer : _____

Round 1 2 3 4 5

#14 Calculus – Hustle
MAΘ National Convention 2007

For $f(x) = e^{2x} - 10e^{x} + 12x$, what is the greatest value of x for which the tangent line is horizontal?

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Round 1 2 3 4 5

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Round 1 2 3 4 5

#15 Calculus – Hustle
MAΘ National Convention 2007

On what interval(s) is
$f(x) = \frac{x^3}{3} + x^2 - 3x + 1$ both concave up and decreasing? Please, express your answer in interval notation i.e. $x \in (a,b) \cup (c,d)$

Answer : _____

Round 1 2 3 4 5

#15 Calculus – Hustle
MAΘ National Convention 2007

On what interval(s) is
$f(x) = \frac{x^3}{3} + x^2 - 3x + 1$ both concave up and decreasing? Please, express your answer in interval notation i.e. $x \in (a,b) \cup (c,d)$

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Round 1 2 3 4 5

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MAΘ National Convention 2007

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Answer : _____

Round 1 2 3 4 5

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MAΘ National Convention 2007

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Answer : _____

Round 1 2 3 4 5

#16 Calculus – Hustle
MAΘ National Convention 2007

What is the area between the curve $y = \sin(x)$ and the x-axis, from $x = -\pi$ to $x = \pi$?

Answer : _____

Round 1 2 3 4 5

#16 Calculus – Hustle
MAΘ National Convention 2007

What is the area between the curve $y = \sin(x)$ and the x-axis, from $x = -\pi$ to $x = \pi$?

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Answer : _____

Round 1 2 3 4 5

#17 Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $\int \frac{\sec^2 x}{1+\tan^2 x}\,dx$

Answer : _____

Round 1 2 3 4 5

#17 Calculus – Hustle
MAΘ National Convention 2007

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Round 1 2 3 4 5

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Evaluate: $\int \frac{\sec^2 x}{1+\tan^2 x}\,dx$

Answer : _____

Round 1 2 3 4 5

#18 Calculus – Hustle
MAΘ National Convention 2007

What is the arc length of the curve defined by $x(t) = 3t^2$, $y(t) = 4t^2$ from $t = 0$ to $t = 2$?

Answer : _____

Round 1 2 3 4 5

#18 Calculus – Hustle
MAΘ National Convention 2007

What is the arc length of the curve defined by $x(t) = 3t^2$, $y(t) = 4t^2$ from $t = 0$ to $t = 2$?

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Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#19 Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $\int_0^\infty xe^{-x^2}\,dx$

Answer : _____

Round 1 2 3 4 5

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MAΘ National Convention 2007

Evaluate: $\int_0^\infty xe^{-x^2}\,dx$

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Round 1 2 3 4 5

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MAΘ National Convention 2007

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Round 1 2 3 4 5

#19 Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $\int_0^\infty xe^{-x^2}\,dx$

Answer : _____

Round 1 2 3 4 5

#20 Calculus – Hustle
MAΘ National Convention 2007

What is the maximum value of the function $f(x) = -x^3 + 3x + 1$ for $x \in [-3, 3]$?

Answer : _____

Round 1 2 3 4 5

#20 Calculus – Hustle
MAΘ National Convention 2007

What is the maximum value of the function $f(x) = -x^3 + 3x + 1$ for $x \in [-3, 3]$?

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MAΘ National Convention 2007

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Answer : _____

Round 1 2 3 4 5

#21 Calculus – Hustle
MAΘ National Convention 2007

What is the first derivative of $\sin^2\left(x^2\right)$ with respect to x?

Answer : _____

Round 1 2 3 4 5

#21 Calculus – Hustle
MAΘ National Convention 2007

What is the first derivative of $\sin^2\left(x^2\right)$ with respect to x?

Answer : _____

Round 1 2 3 4 5

#21 Calculus – Hustle
MAQ National Convention 2007

What is the first derivative of $\sin^2\left(x^2\right)$ with respect to x?

Answer : _____

Round 1 2 3 4 5

#21 Calculus – Hustle
MAQ National Convention 2007

What is the first derivative of $\sin^2\left(x^2\right)$ with respect to x?

Answer : _____

Round 1 2 3 4 5

#22 Calculus – Hustle
MAΘ National Convention 2007

Let $f(x)$ be a differentiable, invertible function, such that $f(2)=3$. Let $g(x)=f^{-1}(x)$. What is $f'(2)$ given that $g'(2)=7$ and $g'(3)=11$?

Answer : _____

Round 1 2 3 4 5

#22 Calculus – Hustle
MAΘ National Convention 2007

Let $f(x)$ be a differentiable, invertible function, such that $f(2)=3$. Let $g(x)=f^{-1}(x)$. What is $f'(2)$ given that $g'(2)=7$ and $g'(3)=11$?

Answer : _____

Round 1 2 3 4 5

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MAΘ National Convention 2007

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Answer : _____

Round 1 2 3 4 5

#23 Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $\lim_{h\to 0}\frac{(4+h)^2-(4-h)^2}{2h}$

Answer : _____

Round 1 2 3 4 5

#23 Calculus – Hustle
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Evaluate: $\lim_{h\to 0}\frac{(4+h)^2-(4-h)^2}{2h}$

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#23 Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $\lim_{h\to 0}\frac{(4+h)^2-(4-h)^2}{2h}$

Answer : _____

Round 1 2 3 4 5

#24 Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $\lim_{x\to 0}\dfrac{\sin(x)-\cos(x)+1}{x^3-3x^2+3x}$

Answer : _____

Round 1 2 3 4 5

#24 Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $\lim_{x\to 0}\dfrac{\sin(x)-\cos(x)+1}{x^3-3x^2+3x}$

Answer : _____

Round 1 2 3 4 5

#24 Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $\lim_{x\to 0}\dfrac{\sin(x)-\cos(x)+1}{x^3-3x^2+3x}$

Answer : _____

Round 1 2 3 4 5

#24 Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $\lim_{x\to 0}\dfrac{\sin(x)-\cos(x)+1}{x^3-3x^2+3x}$

Answer : _____

Round 1 2 3 4 5

#25 Calculus – Hustle
MAΘ National Convention 2007

What is $f'(1)$ if
$f(x) = (-x-1)^3 (x+1)^2 (2x-3)$?

Answer : _____

Round 1 2 3 4 5

#25 Calculus – Hustle
MAΘ National Convention 2007

What is $f'(1)$ if
$f(x) = (-x-1)^3 (x+1)^2 (2x-3)$?

Answer : _____

Round 1 2 3 4 5

#25 Calculus – Hustle
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What is $f'(1)$ if
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Answer : _____

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Answer : _____

Round 1 2 3 4 5