#1 Pre-Calculus – Hustle
MAΘ National Convention 2007

Let z be a complex variable, there is a solution of $z^6 = 1$ for which z is in the third quadrant (not on either axis) of the complex plane. What is this solution, expressed as $a + bi$? (where a, b are real and $i = \sqrt{-1}$)

Answer : _____

Round 1 2 3 4 5

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Round 1 2 3 4 5

#2 Pre-Calculus – Hustle
MAΘ National Convention 2007

Divide, $\frac{3+2i}{1-3i}$. Express your answer as $a+bi$, (where a, b are real and $i=\sqrt{-1}$).

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

#3 Pre-Calculus – Hustle
MAΘ National Convention 2007

Evaluate $\left(e^3\right)^{\ln 2} \cdot \ln\left(\frac{\sqrt{e}}{e^2}\right)$

Answer : _____

Round 1 2 3 4 5

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MAΘ National Convention 2007

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#4 Pre-Calculus – Hustle
MAΘ National Convention 2007

What is the product of the solutions to $\sin(2x) - \sin(x) = 0$ on the interval $x \in (0, 2\pi]$?

Answer : _____

Round 1 2 3 4 5

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#5 Pre-Calculus – Hustle
MAΘ National Convention 2007

In the expansion of $(3w - x + 2y + z)^7$ what is the coefficient of the wxy^2z^3 term?

Answer : _____

Round 1 2 3 4 5

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MAΘ National Convention 2007

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#6 Pre-Calculus – Hustle
MAΘ National Convention 2007

Let θ be the acute angle the lines $3x + 4y = 0$ and $12x + 5y = 0$ form. What is $\cos\theta$?

Answer : _____

Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#7 Pre-Calculus – Hustle
MAΘ National Convention 2007

Let $a = \log_5 3$, what is $3^{\left(\frac{1}{a}\right)}$?

Answer : _____

Round 1 2 3 4 5

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Round 1 2 3 4 5

#8 Pre-Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $\cos^2\left(\frac{\pi}{12}\right)+\cos^2\left(\frac{5\pi}{12}\right)$

Answer : _____

Round 1 2 3 4 5

#8 Pre-Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $\cos^2\left(\frac{\pi}{12}\right)+\cos^2\left(\frac{5\pi}{12}\right)$

Answer : _____

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Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#9 Pre-Calculus – Hustle
MAΘ National Convention 2007

Let r_1, r_2, r_3, r_4 be the roots of the equation $f(x) = 4x^4 - 2x^3 + 7x^2 + x - 19$.
What is the sum of the roots taken two at a time?
(i.e. $r_1r_2 + r_1r_3 + r_1r_4 + r_2r_3 + r_2r_4 + r_3r_4$)

Answer : _____

Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#10 Pre-Calculus – Hustle
MAΘ National Convention 2007

What is the largest solution to $4^x - 5 \cdot 2^x + 6 = 0$? Simplify your answer. ($c \log_b a$ is simplified when $a, b > 0$, b is as small as possible and a is not a power of an integer).

Answer : _____

Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#11 Pre-Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $\sum_{k=1}^{23}\left(\frac{1}{k}-\frac{1}{k+1}\right)$

Answer : _____

Round 1 2 3 4 5

#11 Pre-Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $\sum_{k=1}^{23}\left(\frac{1}{k}-\frac{1}{k+1}\right)$

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Evaluate: $\sum_{k=1}^{23}\left(\frac{1}{k}-\frac{1}{k+1}\right)$

Answer : _____

Round 1 2 3 4 5

#12 Pre-Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $(1-i)^7$ and express your answer in the form $a+bi$, (where a, b are real and $i=\sqrt{-1}$).

Answer : ______________

Round 1 2 3 4 5

#12 Pre-Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $(1-i)^7$ and express your answer in the form $a+bi$, (where a, b are real and $i=\sqrt{-1}$).

Answer : ______________

Round 1 2 3 4 5

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Answer : ______________

Round 1 2 3 4 5

#12 Pre-Calculus – Hustle
MAΘ National Convention 2007

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Answer : ______________

Round 1 2 3 4 5

#13 Pre-Calculus – Hustle
MAΘ National Convention 2007

How many distinct permutations are there of all the letters in TEATREE?

Answer : _____

Round 1 2 3 4 5

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MAΘ National Convention 2007

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#14 Pre-Calculus – Hustle
MAΘ National Convention 2007

Let the roots of $f(x) = x^3 - 6x^2 + 11x - 6$ be a, b, c where $a \le b \le c$, what is $100a + 10b + c$?

Answer : _____

Round 1 2 3 4 5

#14 Pre-Calculus – Hustle
MAΘ National Convention 2007

Let the roots of $f(x) = x^3 - 6x^2 + 11x - 6$ be a, b, c where $a \le b \le c$, what is $100a + 10b + c$?

Answer : _____

Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#15 Pre-Calculus – Hustle
MAΘ National Convention 2007

Let $A = \begin{pmatrix} 2 & 3 \\ 0 & -1 \end{pmatrix}$ and $B = A^4$, what is the determinant of B?

Answer : _____

Round 1 2 3 4 5

#15 Pre-Calculus – Hustle
MAΘ National Convention 2007

Let $A = \begin{pmatrix} 2 & 3 \\ 0 & -1 \end{pmatrix}$ and $B = A^4$, what is the determinant of B?

Answer : _____

Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#16 Pre-Calculus – Hustle
MAΘ National Convention 2007

What is the y-intercept of the asymptote with a positive slope of the hyperbola $\frac{(x-2)^2}{4} - \frac{(y-1)^2}{9} = 1$?

Answer : _____

Round 1 2 3 4 5

#16 Pre-Calculus – Hustle
MAΘ National Convention 2007

What is the y-intercept of the asymptote with a positive slope of the hyperbola $\frac{(x-2)^2}{4} - \frac{(y-1)^2}{9} = 1$?

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Answer : _____

Round 1 2 3 4 5

#17 Pre-Calculus – Hustle
MAΘ National Convention 2007

What is the area of the region enclosed by $3x^2 + y^2 + 12x + 6y = 15$?

Answer : ______________

Round 1 2 3 4 5

#17 Pre-Calculus – Hustle
MAΘ National Convention 2007

What is the area of the region enclosed by $3x^2 + y^2 + 12x + 6y = 15$?

Answer : ______________

Round 1 2 3 4 5

#17 Pre-Calculus – Hustle
MAΘ National Convention 2007

What is the area of the region enclosed by $3x^2 + y^2 + 12x + 6y = 15$?

Answer : ______________

Round 1 2 3 4 5

#17 Pre-Calculus – Hustle
MAΘ National Convention 2007

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Answer : ______________

Round 1 2 3 4 5

#18 Pre-Calculus – Hustle
MAΘ National Convention 2007

Evaluate: $\sum_{n=1}^{\infty} n \cdot 2^{-n}$

Answer : _____

Round 1 2 3 4 5

#18 Pre-Calculus – Hustle
MAΘ National Convention 2007

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Answer : _____

Round 1 2 3 4 5

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#18 Pre-Calculus – Hustle
MAΘ National Convention 2007

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Answer : _____

Round 1 2 3 4 5

#19 Pre-Calculus – Hustle
MAΘ National Convention 2007

In triangle ABC, $AB = 4$, $BC = 5$, $\cos(B) = 1/8$. What is the length of $\overline{AC}$?

Answer : _____

Round 1 2 3 4 5

#19 Pre-Calculus – Hustle
MAΘ National Convention 2007

In triangle ABC, $AB = 4$, $BC = 5$, $\cos(B) = 1/8$. What is the length of $\overline{AC}$?

Answer : _____

Round 1 2 3 4 5

#19 Pre-Calculus – Hustle
MAΘ National Convention 2007

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Answer : _____

Round 1 2 3 4 5

#19 Pre-Calculus – Hustle
MAΘ National Convention 2007

In triangle ABC, $AB = 4$, $BC = 5$, $\cos(B) = 1/8$. What is the length of $\overline{AC}$?

Answer : _____

Round 1 2 3 4 5

#20 Pre-Calculus – Hustle
MAΘ National Convention 2007

What is the determinant of

$$\begin{pmatrix} 1 & 2 & 3 & 4 \\ 0 & 2 & 3 & 4 \\ 0 & 0 & 3 & 4 \\ 0 & 0 & 0 & 4 \end{pmatrix}?$$

Answer : _____

Round 1 2 3 4 5

#20 Pre-Calculus – Hustle
MAΘ National Convention 2007

What is the determinant of

$$\begin{pmatrix} 1 & 2 & 3 & 4 \\ 0 & 2 & 3 & 4 \\ 0 & 0 & 3 & 4 \\ 0 & 0 & 0 & 4 \end{pmatrix}?$$

Answer : _____

Round 1 2 3 4 5

#20 Pre-Calculus – Hustle
MAΘ National Convention 2007

What is the determinant of

$$\begin{pmatrix} 1 & 2 & 3 & 4 \\ 0 & 2 & 3 & 4 \\ 0 & 0 & 3 & 4 \\ 0 & 0 & 0 & 4 \end{pmatrix}?$$

Answer : _____

Round 1 2 3 4 5

#20 Pre-Calculus – Hustle
MAΘ National Convention 2007

What is the determinant of

$$\begin{pmatrix} 1 & 2 & 3 & 4 \\ 0 & 2 & 3 & 4 \\ 0 & 0 & 3 & 4 \\ 0 & 0 & 0 & 4 \end{pmatrix}?$$

Answer : _____

Round 1 2 3 4 5

#21 Pre-Calculus – Hustle
MAΘ National Convention 2007

What are all values of x for which the inequality, $\left|x^2-1\right| \le \left|x^2+2x+1\right|$, holds?

Please express your answer in set form i.e. $\{x : a < x < b \quad \vee \quad x > c\}$.

Answer : _____

Round 1 2 3 4 5

#21 Pre-Calculus – Hustle
MAΘ National Convention 2007

What are all values of x for which the inequality, $\left|x^2-1\right| \le \left|x^2+2x+1\right|$, holds?

Please express your answer in set form i.e. $\{x : a < x < b \quad \vee \quad x > c\}$.

Answer : _____

Round 1 2 3 4 5

#21 Pre-Calculus – Hustle
MAQ National Convention 2007

What are all values of x for which the inequality, $\left|x^2-1\right| \le \left|x^2+2x+1\right|$, holds?

Please express your answer in set form i.e. $\{x : a < x < b \quad \vee \quad x > c\}$.

Answer : _____

Round 1 2 3 4 5

#21 Pre-Calculus – Hustle
MAQ National Convention 2007

What are all values of x for which the inequality, $\left|x^2-1\right| \le \left|x^2+2x+1\right|$, holds?

Please express your answer in set form i.e. $\{x : a < x < b \quad \vee \quad x > c\}$.

Answer : _____

Round 1 2 3 4 5

#22 Pre-Calculus – Hustle
MAΘ National Convention 2007

Given a key ring and 5 symmetric, different colored 'keys', in how many distinct ways can the keys be arranged on the key ring?

Answer : _____

Round 1 2 3 4 5

#22 Pre-Calculus – Hustle
MAΘ National Convention 2007

Given a key ring and 5 symmetric, different colored 'keys', in how many distinct ways can the keys be arranged on the key ring?

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

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MAΘ National Convention 2007

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Answer : _____

Round 1 2 3 4 5

#23 Pre-Calculus – Hustle
MAΘ National Convention 2007

What is the distance between the plane $x + 2y + 3z + 4 = 0$ and the point $(1, 1, 1)$?

Answer : _____

Round 1 2 3 4 5

#23 Pre-Calculus – Hustle
MAΘ National Convention 2007

What is the distance between the plane $x + 2y + 3z + 4 = 0$ and the point $(1, 1, 1)$?

Answer : _____

Round 1 2 3 4 5

#23 Pre-Calculus – Hustle
MAΘ National Convention 2007

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Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#24 Pre-Calculus – Hustle
MAΘ National Convention 2007

What is the probability of rolling an odd number as the sum of two standard dice?

Answer : _____

Round 1 2 3 4 5

#24 Pre-Calculus – Hustle
MAΘ National Convention 2007

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Answer : _____

Round 1 2 3 4 5

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Answer : _____

Round 1 2 3 4 5

#24 Pre-Calculus – Hustle
MAΘ National Convention 2007

What is the probability of rolling an odd number as the sum of two standard dice?

Answer : _____

Round 1 2 3 4 5

#25 Pre-Calculus – Hustle
MAΘ National Convention 2007

Let $u = \langle -2, 3, 1 \rangle$ and $v = \langle 4, -3, -2 \rangle$,
what is $(u \times v) \cdot u$?

Answer : _____

Round 1 2 3 4 5

#25 Pre-Calculus – Hustle
MAΘ National Convention 2007

Let $u = \langle -2, 3, 1 \rangle$ and $v = \langle 4, -3, -2 \rangle$,
what is $(u \times v) \cdot u$?

Answer : _____

Round 1 2 3 4 5

#25 Pre-Calculus – Hustle
MAΘ National Convention 2007

Let $u = \langle -2, 3, 1 \rangle$ and $v = \langle 4, -3, -2 \rangle$,
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Answer : _____

Round 1 2 3 4 5

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Round 1 2 3 4 5