

**#1 Precalculus - Hustle**  
**MA@ National Convention 2015**

---

Solve for x:  $|x|^2 - |x| - 2 = 4$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#1 Precalculus - Hustle**  
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Round 1 2 3 4 5

**#2 Precalculus - Hustle**  
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---

In how many ways can Jack plant three oak trees and six willow trees in a row if no two oak trees can be next to each other? Assume trees of the same type are indistinguishable.

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#2 Precalculus - Hustle**  
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---

In how many ways can Jack plant three oak trees and six willow trees in a row if no two oak trees can be next to each other? Assume trees of the same type are indistinguishable.

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Round 1 2 3 4 5

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**#2 Precalculus - Hustle**  
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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#3 Precalculus - Hustle**  
**MA@ National Convention 2015**

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Evaluate:  $\sum_{n=1}^{\infty} \frac{1}{n^2 + 4n + 3}$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#3 Precalculus - Hustle**  
**MA@ National Convention 2015**

---

Evaluate:  $\sum_{n=1}^{\infty} \frac{1}{n^2 + 4n + 3}$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#3 Precalculus - Hustle**  
**MA@ National Convention 2015**

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Evaluate:  $\sum_{n=1}^{\infty} \frac{1}{n^2 + 4n + 3}$

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Round 1 2 3 4 5

**#3 Precalculus - Hustle**  
**MA@ National Convention 2015**

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Evaluate:  $\sum_{n=1}^{\infty} \frac{1}{n^2 + 4n + 3}$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#4 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

---

Find the sum of all  $x \in [0, 2\pi)$  such that  
 $\cos(2x) = \sin(x)$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#4 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

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**MA $\odot$  National Convention 2015**

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**#4 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#5 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

---

$$\begin{bmatrix} 1 & 2 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} a & b \\ c & d \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

Find  $a+b-(c+d)$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#5 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

---

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Round 1 2 3 4 5

**#6 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

---

Find the positive difference between the maximum and minimum y values among all points on the graph of  $r^2 = 4r(\cos \theta) - 3$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#6 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

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Round 1 2 3 4 5

**#7 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

---

$$\mathbf{u} = \mathbf{i} - \mathbf{k}$$

$$\mathbf{v} = 2\mathbf{i} + \mathbf{j} + 3\mathbf{k}$$

Find  $2(\mathbf{u} \cdot \mathbf{v})^2 + |\mathbf{u} \times \mathbf{v}|^2$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#7 Precalculus - Hustle**  
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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#8 Precalculus - Hustle**  
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---

Robert, Ryan, Jay, Case, and Theo are playing a dice game where the players roll one standard fair die. Robert starts, and they take turns in the aforementioned order. If the first person to roll a 5 or higher wins, what is the probability Jay wins?

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#8 Precalculus - Hustle**  
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Round 1 2 3 4 5



**#9 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

---

Let  $\alpha$  equal the smaller angle of intersection between  $y = 2x$  and  $x - 2y = 20$ . Find  $\csc \alpha$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#9 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

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Round 1 2 3 4 5

**#10 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

---

Given  $\cos x = \frac{3}{5}$  and that the terminal side of  $x$   
lies within the first quadrant, evaluate:  
 $3\sin^2 x + 8\tan^2 x + \csc^2 x + 25\sin^2 x + 3\cos^2 x$   
 $-8\sec^2 x - \cot^2 x$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#10 Precalculus - Hustle**  
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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#11 Precalculus - Hustle**  
**MA $\Theta$  National Convention 2015**

---

Let  $\theta$  be the smallest positive angle of counterclockwise rotation so that the major and minor axes of  $4x^2 + 4xy + 4y^2 + 2x + 7y + 1 = 0$  coincide with the  $x$  and  $y$  axes. Find  $\sin \theta$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#11 Precalculus - Hustle**  
**MA $\Theta$  National Convention 2015**

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Round 1 2 3 4 5

**#12 Precalculus - Hustle**  
**MA@ National Convention 2015**

---

Given  $2f(x) + f\left(\frac{1}{x}\right) = x$ , find  $f(x)$  as a single fraction.

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#12 Precalculus - Hustle**  
**MA@ National Convention 2015**

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Given  $2f(x) + f\left(\frac{1}{x}\right) = x$ , find  $f(x)$  as a single fraction.

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**MA@ National Convention 2015**

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Round 1 2 3 4 5

**#12 Precalculus - Hustle**  
**MA@ National Convention 2015**

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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#13 Precalculus - Hustle**  
**MA@ National Convention 2015**

---

Given  $(\log_a b)^{16} + (\log_b a)^{16} = 47$ , where  $a$  and  $b$  are real numbers with all logarithms defined, find  $(\log_a b)^6 + (\log_b a)^6$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#13 Precalculus - Hustle**  
**MA@ National Convention 2015**

---

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Answer : \_\_\_\_\_

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**MA@ National Convention 2015**

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**MA@ National Convention 2015**

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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#14 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

---

What is the area enclosed by a regular 24-gon inscribed in a circle with radius 1?

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#14 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

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What is the area enclosed by a regular 24-gon inscribed in a circle with radius 1?

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**MA $\odot$  National Convention 2015**

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Round 1 2 3 4 5

**#15 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

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Evaluate: 
$$\frac{\sin\left(\frac{\pi}{12}\right) + \cos\left(\frac{\pi}{12}\right)}{\sin^3\left(\frac{\pi}{12}\right) + \cos^3\left(\frac{\pi}{12}\right)}$$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#15 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

---

Evaluate: 
$$\frac{\sin\left(\frac{\pi}{12}\right) + \cos\left(\frac{\pi}{12}\right)}{\sin^3\left(\frac{\pi}{12}\right) + \cos^3\left(\frac{\pi}{12}\right)}$$

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Round 1 2 3 4 5

**#15 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#15 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

---

Evaluate: 
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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#16 Precalculus - Hustle**  
**MA@ National Convention 2015**

---

Zach is struggling to figure out what  $|3+4i|$  equals and asks Will for help. If Will is always correct, what answer does he get?

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#16 Precalculus - Hustle**  
**MA@ National Convention 2015**

---

Zach is struggling to figure out what  $|3+4i|$  equals and asks Will for help. If Will is always correct, what answer does he get?

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**#16 Precalculus - Hustle**  
**MA@ National Convention 2015**

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Round 1 2 3 4 5

**#16 Precalculus - Hustle**  
**MA@ National Convention 2015**

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Answer : \_\_\_\_\_

Round 1 2 3 4 5



#17 Precalculus - Hustle  
MA@ National Convention 2015

---

Find  $A$  such that

$$\sum_{n=1}^{\infty} \frac{1}{\sum_{i=0}^n \binom{n}{i}} = \ln(A)$$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

#17 Precalculus - Hustle  
MA@ National Convention 2015

---

Find  $A$  such that

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Round 1 2 3 4 5

#17 Precalculus - Hustle  
MA@ National Convention 2015

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#17 Precalculus - Hustle  
MA@ National Convention 2015

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Round 1 2 3 4 5

**#18 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

---

Gabe makes a regular, convex polygon by connecting the roots of  $x^6 = 64$  when plotted on the complex plane. Find the area enclosed by this polygon.

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#18 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

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**MA $\odot$  National Convention 2015**

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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#19 Precalculus - Hustle**  
**MA@ National Convention 2015**

---

What is the distance between the polar  
coordinates  $\left(3, -\frac{\pi}{12}\right)$  and  $\left(4, \frac{\pi}{4}\right)$ ?

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#19 Precalculus - Hustle**  
**MA@ National Convention 2015**

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What is the distance between the polar  
coordinates  $\left(3, -\frac{\pi}{12}\right)$  and  $\left(4, \frac{\pi}{4}\right)$ ?

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Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#20 Precalculus - Hustle**  
**MA@ National Convention 2015**

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Evaluate:  $\lim_{x \rightarrow \infty} (\sqrt{x^2 + 3x} - \sqrt{x^2 - x})$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#20 Precalculus - Hustle**  
**MA@ National Convention 2015**

---

Evaluate:  $\lim_{x \rightarrow \infty} (\sqrt{x^2 + 3x} - \sqrt{x^2 - x})$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#20 Precalculus - Hustle**  
**MA@ National Convention 2015**

---

Evaluate:  $\lim_{x \rightarrow \infty} (\sqrt{x^2 + 3x} - \sqrt{x^2 - x})$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#20 Precalculus - Hustle**  
**MA@ National Convention 2015**

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Evaluate:  $\lim_{x \rightarrow \infty} (\sqrt{x^2 + 3x} - \sqrt{x^2 - x})$

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#21 Precalculus - Hustle**  
**MA@ National Convention 2015**

---

If Ankit invests \$5 in a bank account with 5% interest compounded continuously, how long (in years) will it take for his money to grow to \$2015?

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#21 Precalculus - Hustle**  
**MA@ National Convention 2015**

---

If Ankit invests \$5 in a bank account with 5% interest compounded continuously, how long (in years) will it take for his money to grow to \$2015?

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#21 Precalculus - Hustle**  
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If Ankit invests \$5 in a bank account with 5% interest compounded continuously, how long (in years) will it take for his money to grow to \$2015?

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#22 Precalculus - Hustle**  
**MA@ National Convention 2015**

---

Find the length of the longest altitude in a triangle with side lengths 7, 8, and 9.

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#22 Precalculus - Hustle**  
**MA@ National Convention 2015**

---

Find the length of the longest altitude in a triangle with side lengths 7, 8, and 9.

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#22 Precalculus - Hustle**  
**MA@ National Convention 2015**

---

Find the length of the longest altitude in a triangle with side lengths 7, 8, and 9.

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#22 Precalculus - Hustle**  
**MA@ National Convention 2015**

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Find the length of the longest altitude in a triangle with side lengths 7, 8, and 9.

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#23 Precalculus - Hustle**  
**MA@ National Convention 2015**

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What point is the result of the point  $(2,4)$  being rotated 60 degrees about the origin?

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#23 Precalculus - Hustle**  
**MA@ National Convention 2015**

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What point is the result of the point  $(2,4)$  being rotated 60 degrees about the origin?

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#23 Precalculus - Hustle**  
**MA@ National Convention 2015**

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What point is the result of the point  $(2,4)$  being rotated 60 degrees about the origin?

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#23 Precalculus - Hustle**  
**MA@ National Convention 2015**

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What point is the result of the point  $(2,4)$  being rotated 60 degrees about the origin?

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#24 Precalculus - Hustle**  
**MA@ National Convention 2015**

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Find the shortest distance between the graphs of  
 $y = x + 1$  and  $y = x - 1$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#24 Precalculus - Hustle**  
**MA@ National Convention 2015**

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Find the shortest distance between the graphs of  
 $y = x + 1$  and  $y = x - 1$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#24 Precalculus - Hustle**  
**MA@ National Convention 2015**

---

Find the shortest distance between the graphs of  
 $y = x + 1$  and  $y = x - 1$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#24 Precalculus - Hustle**  
**MA@ National Convention 2015**

---

Find the shortest distance between the graphs of  
 $y = x + 1$  and  $y = x - 1$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5



**#25 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

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Find the maximum area of a triangle with sides of lengths  $\cos 15^\circ$  and  $\sin 15^\circ$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#25 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

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Find the maximum area of a triangle with sides of lengths  $\cos 15^\circ$  and  $\sin 15^\circ$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#25 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

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Find the maximum area of a triangle with sides of lengths  $\cos 15^\circ$  and  $\sin 15^\circ$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

**#25 Precalculus - Hustle**  
**MA $\odot$  National Convention 2015**

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Find the maximum area of a triangle with sides of lengths  $\cos 15^\circ$  and  $\sin 15^\circ$ .

Answer : \_\_\_\_\_

Round 1 2 3 4 5

