#0 Alpha Ciphering
MAΘ National Convention 2015

Evaluate:

$$\cos 1^\circ \cdot \cos 2^\circ \cdot \cos 3^\circ \cdot \ldots \cdot \cos 179^\circ$$

#0 Alpha Ciphering
MAΘ National Convention 2015

Evaluate:

$$\cos 1^\circ \cdot \cos 2^\circ \cdot \cos 3^\circ \cdot \ldots \cdot \cos 179^\circ$$

#0 Alpha Ciphering
MAΘ National Convention 2015

Evaluate:

$$\cos 1^\circ \cdot \cos 2^\circ \cdot \cos 3^\circ \cdot \ldots \cdot \cos 179^\circ$$

#0 Alpha Ciphering
MAΘ National Convention 2015

Evaluate:

$$\cos 1^\circ \cdot \cos 2^\circ \cdot \cos 3^\circ \cdot \ldots \cdot \cos 179^\circ$$

#1 Alpha Ciphering
MAΘ National Convention 2015

Solve for x:

$$\big||x-2|-5\big| \leq 2$$

Express your answer in interval notation.

#1 Alpha Ciphering
MAΘ National Convention 2015

Solve for x:

$$\big||x-2|-5\big| \leq 2$$

Express your answer in interval notation.

#1 Alpha Ciphering
MAΘ National Convention 2015

Solve for x:

$$\big||x-2|-5\big| \leq 2$$

Express your answer in interval notation.

#1 Alpha Ciphering
MAΘ National Convention 2015

Solve for x:

$$\big||x-2|-5\big| \leq 2$$

Express your answer in interval notation.

#2 Alpha Ciphering
MAΘ National Convention 2015

Solve for the 2×2 matrix M:

$$M \begin{bmatrix} 5 & 11 \\ 3 & 3 \end{bmatrix} + 2M = \begin{bmatrix} 1 & 1 \\ 2 & 4 \end{bmatrix}$$

#2 Alpha Ciphering
MAΘ National Convention 2015

Solve for the 2×2 matrix M:

$$M \begin{bmatrix} 5 & 11 \\ 3 & 3 \end{bmatrix} + 2M = \begin{bmatrix} 1 & 1 \\ 2 & 4 \end{bmatrix}$$

#2 Alpha Ciphering
MAΘ National Convention 2015

Solve for the 2×2 matrix M:

$$M \begin{bmatrix} 5 & 11 \\ 3 & 3 \end{bmatrix} + 2M = \begin{bmatrix} 1 & 1 \\ 2 & 4 \end{bmatrix}$$

#2 Alpha Ciphering
MAΘ National Convention 2015

Solve for the 2×2 matrix M:

$$M \begin{bmatrix} 5 & 11 \\ 3 & 3 \end{bmatrix} + 2M = \begin{bmatrix} 1 & 1 \\ 2 & 4 \end{bmatrix}$$

#3 Alpha Ciphering
MAΘ National Convention 2015

Two of the six 6th roots of $-352+936i$ lie in the first quadrant on the complex plane. One of them is $3+i$, the other can be expressed as $a+bi$. Find $a+b$.

#3 Alpha Ciphering
MAΘ National Convention 2015

Two of the six 6th roots of $-352+936i$ lie in the first quadrant on the complex plane. One of them is $3+i$, the other can be expressed as $a+bi$. Find $a+b$.

#3 Alpha Ciphering
MAΘ National Convention 2015

Two of the six 6th roots of $-352+936i$ lie in the first quadrant on the complex plane. One of them is $3+i$, the other can be expressed as $a+bi$. Find $a+b$.

#3 Alpha Ciphering
MAΘ National Convention 2015

Two of the six 6th roots of $-352+936i$ lie in the first quadrant on the complex plane. One of them is $3+i$, the other can be expressed as $a+bi$. Find $a+b$.

#4 Alpha Ciphering
MAΘ National Convention 2015

$12\cos 2x - 5\sin 2x$ can be rewritten as $A\cos\left(Bx + \arcsin\left(\frac{C}{D}\right)\right)$ for integers A, B, C, D, where $A, B > 0$ and C, D relatively prime. Find the value of $A + B + CD$.

#4 Alpha Ciphering
MAΘ National Convention 2015

$12\cos 2x - 5\sin 2x$ can be rewritten as $A\cos\left(Bx + \arcsin\left(\frac{C}{D}\right)\right)$ for integers A, B, C, D, where $A, B > 0$ and C, D relatively prime. Find the value of $A + B + CD$.

#4 Alpha Ciphering
MAΘ National Convention 2015

$12\cos 2x - 5\sin 2x$ can be rewritten as $A\cos\left(Bx + \arcsin\left(\frac{C}{D}\right)\right)$ for integers A, B, C, D, where $A, B > 0$ and C, D relatively prime. Find the value of $A + B + CD$.

#4 Alpha Ciphering
MAΘ National Convention 2015

$12\cos 2x - 5\sin 2x$ can be rewritten as $A\cos\left(Bx + \arcsin\left(\frac{C}{D}\right)\right)$ for integers A, B, C, D, where $A, B > 0$ and C, D relatively prime. Find the value of $A + B + CD$.

#5 Alpha Ciphering
MAΘ National Convention 2015

Find the area enclosed by the ellipse described by the polar graph

$$r = \frac{6}{2 + \cos\theta}$$

#5 Alpha Ciphering
MAΘ National Convention 2015

Find the area enclosed by the ellipse described by the polar graph

$$r = \frac{6}{2 + \cos\theta}$$

#5 Alpha Ciphering
MAΘ National Convention 2015

Find the area enclosed by the ellipse described by the polar graph

$$r = \frac{6}{2 + \cos\theta}$$

#5 Alpha Ciphering
MAΘ National Convention 2015

Find the area enclosed by the ellipse described by the polar graph

$$r = \frac{6}{2 + \cos\theta}$$

#6 Alpha Ciphering
MAΘ National Convention 2015

Point *O* is the center of a circle with radius 4. Point A lies somewhere outside the circle, with $OA = 14$. Find the geometric mean of the lengths of all line segments connecting A to a point on circle *O*.

#6 Alpha Ciphering
MAΘ National Convention 2015

Point *O* is the center of a circle with radius 4. Point A lies somewhere outside the circle, with $OA = 14$. Find the geometric mean of the lengths of all line segments connecting A to a point on circle *O*.

#6 Alpha Ciphering
MAΘ National Convention 2015

Point *O* is the center of a circle with radius 4. Point A lies somewhere outside the circle, with $OA = 14$. Find the geometric mean of the lengths of all line segments connecting A to a point on circle *O*.

#6 Alpha Ciphering
MAΘ National Convention 2015

Point *O* is the center of a circle with radius 4. Point A lies somewhere outside the circle, with $OA = 14$. Find the geometric mean of the lengths of all line segments connecting A to a point on circle *O*.

#7 Alpha Ciphering
MAΘ National Convention 2015

Find the remainder when $7^{7^{7^{7^{7^{7^{7}}}}}}$ is divided by 40.

#7 Alpha Ciphering
MAΘ National Convention 2015

Find the remainder when $7^{7^{7^{7^{7^{7^{7}}}}}}$ is divided by 40.

#7 Alpha Ciphering
MAΘ National Convention 2015

Find the remainder when $7^{7^{7^{7^{7^{7^{7}}}}}}$ is divided by 40.

#7 Alpha Ciphering
MAΘ National Convention 2015

Find the remainder when $7^{7^{7^{7^{7^{7^{7}}}}}}$ is divided by 40.

#8 Alpha Ciphering
MAΘ National Convention 2015

Let A_n be the nth term in the Fibonacci-like sequence $1, 3, 4, 7, 11, 18, \ldots$, where $A_1 = 1$, $A_2 = 3$, and $A_k = A_{k-1} + A_{k-2}$ for $k \geq 3$.

Let

$$S_n = \sum_{k=1}^{n} A_k$$

Find

$$S_{2015} - \sum_{k=1}^{2013} S_k$$

#8 Alpha Ciphering
MAΘ National Convention 2015

Let A_n be the nth term in the Fibonacci-like sequence $1, 3, 4, 7, 11, 18, \ldots$, where $A_1 = 1$, $A_2 = 3$, and $A_k = A_{k-1} + A_{k-2}$ for $k \geq 3$.

Let

$$S_n = \sum_{k=1}^{n} A_k$$

Find

$$S_{2015} - \sum_{k=1}^{2013} S_k$$

#8 Alpha Ciphering
MAΘ National Convention 2015

Let A_n be the nth term in the Fibonacci-like sequence $1, 3, 4, 7, 11, 18, \ldots$, where $A_1 = 1$, $A_2 = 3$, and $A_k = A_{k-1} + A_{k-2}$ for $k \geq 3$.

Let

$$S_n = \sum_{k=1}^{n} A_k$$

Find

$$S_{2015} - \sum_{k=1}^{2013} S_k$$

#8 Alpha Ciphering
MAΘ National Convention 2015

Let A_n be the nth term in the Fibonacci-like sequence $1, 3, 4, 7, 11, 18, \ldots$, where $A_1 = 1$, $A_2 = 3$, and $A_k = A_{k-1} + A_{k-2}$ for $k \geq 3$.

Let

$$S_n = \sum_{k=1}^{n} A_k$$

Find

$$S_{2015} - \sum_{k=1}^{2013} S_k$$

#9 Alpha Ciphering
MAΘ National Convention 2015

Find the product of the solutions of the equation:

$$4^{\ln x} - 6x^{\ln 2} + 8 = 0$$

#9 Alpha Ciphering
MAΘ National Convention 2015

Find the product of the solutions of the equation:

$$4^{\ln x} - 6x^{\ln 2} + 8 = 0$$

#9 Alpha Ciphering
MAΘ National Convention 2015

Find the product of the solutions of the equation:

$$4^{\ln x} - 6x^{\ln 2} + 8 = 0$$

#9 Alpha Ciphering
MAΘ National Convention 2015

Find the product of the solutions of the equation:

$$4^{\ln x} - 6x^{\ln 2} + 8 = 0$$

#10 Alpha Ciphering
MAΘ National Convention 2015

A bag contains 5 coins. Four of the coins are fair, and the other is a coin with tails on both sides. Stephen draws a coin out of the bag at random, and flips it 3 times, with the coin coming up tails all 3 times. If the coin is flipped a fourth time, what is the probability it comes up tails on that fourth flip?

#10 Alpha Ciphering
MAΘ National Convention 2015

A bag contains 5 coins. Four of the coins are fair, and the other is a coin with tails on both sides. Stephen draws a coin out of the bag at random, and flips it 3 times, with the coin coming up tails all 3 times. If the coin is flipped a fourth time, what is the probability it comes up tails on that fourth flip?

#10 Alpha Ciphering
MAΘ National Convention 2015

A bag contains 5 coins. Four of the coins are fair, and the other is a coin with tails on both sides. Stephen draws a coin out of the bag at random, and flips it 3 times, with the coin coming up tails all 3 times. If the coin is flipped a fourth time, what is the probability it comes up tails on that fourth flip?

#10 Alpha Ciphering
MAΘ National Convention 2015

A bag contains 5 coins. Four of the coins are fair, and the other is a coin with tails on both sides. Stephen draws a coin out of the bag at random, and flips it 3 times, with the coin coming up tails all 3 times. If the coin is flipped a fourth time, what is the probability it comes up tails on that fourth flip?

#11 Alpha Ciphering
MAΘ National Convention 2015

Let a, b, and c be the three roots of $f(x) = x^3 - 7x + 5$. Find the value of

$$\frac{1}{a+2} + \frac{1}{b+2} + \frac{1}{c+2}$$

#11 Alpha Ciphering
MAΘ National Convention 2015

Let a, b, and c be the three roots of $f(x) = x^3 - 7x + 5$. Find the value of

$$\frac{1}{a+2} + \frac{1}{b+2} + \frac{1}{c+2}$$

#11 Alpha Ciphering
MAΘ National Convention 2015

Let a, b, and c be the three roots of $f(x) = x^3 - 7x + 5$. Find the value of

$$\frac{1}{a+2} + \frac{1}{b+2} + \frac{1}{c+2}$$

#11 Alpha Ciphering
MAΘ National Convention 2015

Let a, b, and c be the three roots of $f(x) = x^3 - 7x + 5$. Find the value of

$$\frac{1}{a+2} + \frac{1}{b+2} + \frac{1}{c+2}$$

#12 Alpha Ciphering
MAΘ National Convention 2015

Find the domain of the function, written in interval notation:

$$f(x)=\sqrt{\ln\left(\left|x^2-1\right|\right)}$$

#12 Alpha Ciphering
MAΘ National Convention 2015

Find the domain of the function, written in interval notation:

$$f(x)=\sqrt{\ln\left(\left|x^2-1\right|\right)}$$

#12 Alpha Ciphering
MAΘ National Convention 2015

Find the domain of the function, written in interval notation:

$$f(x)=\sqrt{\ln\left(\left|x^2-1\right|\right)}$$

#12 Alpha Ciphering
MAΘ National Convention 2015

Find the domain of the function, written in interval notation:

$$f(x)=\sqrt{\ln\left(\left|x^2-1\right|\right)}$$