

**#0 Theta Ciphering**

**MA@ National Convention 2017**

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A regular  $n$ -gon has at least 2017 diagonals.

What is the minimum positive integral value of  $n$ ?

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**#1 Theta Ciphering**  
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How many negative integers DO NOT satisfy the

inequality  $\frac{x^2 - 2x - 15}{x^2 + 4x + 3} \leq 7$ ?

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**#2 Theta Ciphering**

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Find the real number  $C$  such that the maximum value of the function  $f(x) = -6x^2 + 24x + C$  is 100.

**#2 Theta Ciphering**

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**#3 Theta Ciphering**  
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A square has sides of length 4 inches. A convex hexagon is created whose vertices are the midpoints of the four sides of the square and two non-consecutive vertices of the square. Find the area enclosed by the hexagon, in square inches.

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**#4 Theta Ciphering**  
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Let  $f(x) = x^3 + 12x^2 + 48x + C$ , where  $C$  is a real number. If  $f$  has only one real root, for how many integer values of  $C$  in the interval  $[1, 1000]$  is this root an integer?

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**#5 Theta Ciphering**  
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Four vertical posts are planted in four collinear spots on level ground, 3 feet between each post in a pair of consecutive posts. In order, the lengths, in feet, of the parts of the posts above ground are 10, 6, 5, and 9. One wire attaches the tops of the 10- and 5-foot posts while another wire attaches the tops of the 6- and 9- foot posts. How high, in feet, above the ground is the point where the two wires cross each other? Write your answer as an improper fraction.

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Find the value of the determinant of  $A$ , where

$$A = \begin{bmatrix} 2 & 1 \\ -2 & 0 \\ 3 & -4 \end{bmatrix} \cdot \begin{bmatrix} 3 & 2 & -5 \\ -1 & 1 & -2 \end{bmatrix}.$$

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For a regular  $n$ -gon, the number of degrees in one of its exterior angles is multiplied by its total number of diagonals, and that product is divided by the total number of degrees in the sum of its interior angles, resulting in a value of 0.999. What is the value of  $n$ ?

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Nine cards are each numbered with a different digit from 1 to 9, inclusive, and five additional cards are each numbered with the digits 2, 5, 5, 7, and 8. These fourteen cards are placed in a hat, and 5 cards are chosen at random. What is the probability that the cards chosen can be sequenced in a strictly increasing order?

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The two asymptotes of a hyperbola have equations  $y = 1.5x + 6$  and  $y = -1.5x$ , and the two  $y$ -intercepts of the hyperbola are on the same branch of the hyperbola. If the distance between the two  $y$ -intercepts of the hyperbola is  $\sqrt{35}$ , find the distance between the vertices of the hyperbola.

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The polynomial  $f(x) = x^3 - 17x^2 + 14x + 6$  has three distinct real roots. Find the harmonic mean of those roots.

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How many lines of symmetry does a regular 2017-gon have?

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Find the sum of the infinite geometric series

whose second term is  $\frac{6}{5}$  and whose fifth term is

$$-\frac{1}{180}.$$

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