#0 Theta Ciphering
MAΘ National Convention 2016

Find the fifth term of the expansion of $(2x-1)^7$, where the terms are written in descending order of the exponent of *x*.

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Solve for x:

$$\left(\frac{4}{9}\right)^{2x+7} = \left(\frac{27}{8}\right)^{x+3}$$

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Given $x^2 - y^2 = 7$ and $x + y = -1$, find the value of $5x + 6y - 3xy$.

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#3 Theta Ciphering
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Solve for real *x*, where all expressions are real:

$$\sqrt{3x}+\sqrt{2x-1}=\frac{5}{\sqrt{2x-1}}$$

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Evaluate: $3(\log 4)(\log 25)^2 + (\log 25)^3 + (\log 4)^3$
$+3(\log 4)^2(\log 25)$

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#5 Theta Ciphering
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Find the distance between the vertex of $y=\frac{1}{2}x^2-6x+15$ and the center of $x^2-4x+y^2-6y=5$.

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#6 Theta Ciphering
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Two numbers x and y have a geometric mean of 12 and an arithmetic mean of 12.5. Find the sum of the squares of x and y.

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Write 2016_{10} as a base 4 numeral.

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#8 Theta Ciphering
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Todd and Calvin start cycling from the same point but in perpendicular directions. Todd and Calvin are traveling at 30 miles/hour and 24 miles/hour, respectively, and they travel for 48 minutes and 25 minutes, respectively. They then both begin at the same time traveling toward each other, both at 12 miles/hour. How many minutes will it take them to meet?

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Two vertical poles are 32 feet apart at their bases. The height of the two poles are 40 feet and 24 feet. From the top of each pole, a wire is stretched to the base of the opposite pole. At what height above the ground, in feet, do the two wires cross one another?

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#10 Theta Ciphering
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Find the *x*-intercept of the line that is perpendicular to $5x-2y=6$ and passes through the midpoint of the line segment whose endpoints are $(-5,-3)$ and $(-1,7)$.

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#11 Theta Ciphering
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A regular hexagon is circumscribed about a circle whose radius has length 9 units. Find the area of the region inside the hexagon and outside the circle.

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#12 Theta Ciphering
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A triangle has a circumscribed circle whose radius is 8 more than twice the length of the radius of the triangle's inscribed circle. If the distance between the centers of these two circles is 12, find the length of the radius of the circumscribed circle.

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#13 Theta Ciphering
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Solve for x: $\begin{vmatrix} 1 & x & 2 \\ 2 & 3 & 0 \\ 0 & -1 & 2 \end{vmatrix} = \begin{vmatrix} 0 & 3 & 1 \\ -2 & 1 & -2 \\ x & 1 & 0 \end{vmatrix}$

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How many distinct permutations of the letters in the word BOOKKEEPER are there?

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