Evaluate: \( \sum_{i=1}^{9999} \log \left( \frac{i}{i+1} \right) \)
The function \( f(x) = x^3 + 15x^2 + 39x - 55 \) has roots \( r, s, \) and \( t \), and \( r > s > t \).
Find the value of \( 3r + s - 5t \).
Question #2
Theta Ciphering
MAΘ National Convention 2007

Given that $5 \log(5 \log(5 \log(...))) = 100$, solve for $x$. 
Given that \( i = \sqrt{-1}, \frac{31 - 5i}{2 - 5i} = a + bi, \)
and that \( a \) and \( b \) are elements of the set of real numbers, what is the value of \( \frac{a!}{b!} \)?
What is the area of an equiangular octagon with side lengths that alternate between 4 and 6 as shown in the diagram?
How many distinct positive integers are factors of 1512?
Given that $p$ is a prime number, $p > 3$, and that $\frac{1}{p} = .ABABABABAB\ldots$, where $A$ and $B$ are distinct digits. What is $p$?
Given that \( f(x) = \frac{ax^2 + b}{x^4 + c} \) and that 
\[(1,2), \left(2, \frac{5}{16}\right), \text{ and } \left(3, \frac{10}{81}\right)\] all lie on \( f(x) \). Find \( f(5) - f(-5) \).
Question #8
Theta Ciphering
MAΘ National Convention 2007

What is the determinant of the matrix \( A^2 \) given that
\[
A = \begin{bmatrix}
1 & 3 & 6 \\
3 & 5 & -1 \\
1 & 4 & 2 \\
\end{bmatrix}
\]
Question #9
Theta Ciphering
MAΘ National Convention 2007

What is $|z|$, given that $z = a + bi, i = \sqrt{-1}$,
and $\frac{3x + 7}{x^2 - 3x - 4} = \frac{a}{x + 4} + \frac{b}{x - 1}$?
A cup is in the shape of inverted (point-down) right circular cone whose height is 10 cm and has a base radius equal to 5 cm. The cup is partially full of water and the water takes up 2.7% of the volume of the cup. What is the distance from the top of the water to the top of the cup (in cm)?