Problem 1. Let $i$ denote a square root of $-1$, and consider the sequence of numbers defined by $y_0 = 1$, $y_1 = 5$, and $y_n = iy_{n-1} + y_{n-2}$ for $n \geq 2$. Evaluate $\frac{y_{2015}}{y_{2009}}$.

Problem 2. In a polygon, the exterior angles are the angles supplementary to the interior angles, as in the figure below.

In a given regular $n$-gon, each interior angle measures exactly 7 times that of each exterior angle. Find $n$.

Problem 3. Let $r(x)$ be the remainder after dividing $x^{2015}$ by $x^2 - x$. Find $r(2)$.

Problem 4. An arithmetic sequence of positive integers contains the numbers 6 and 122, though 122 is not the term directly after 6. There are no perfect squares in the sequence between the terms 6 and 122. What is the next number in the sequence after 122?
**Problem 5.** Find the smallest positive real solution \( x \) (in radians) to the equality
\[
\sqrt{3} \cos(x) - \sin(x) = \sqrt{2}.
\]

**Problem 6.** Find the largest integer \( m < 45 \) such that \( m^m \) divides evenly into \( 45^{15} \).

**Problem 7.** Find the radius of a circle inscribed in a triangle with two sides of length 17 and one side of length 16.

**Problem 8.** A rotation of the plane around a point \( P \) takes the triangle with vertices \((2,0), (4,0), \) and \((3,1)\) to the triangle with vertices \((0,4), (0,6), \) and \((-1,5)\). Find the coordinates of \( P \).

Note: Not drawn to scale/accuracy.