



1. Consider the polynomial $f(x) = 2024x^{2024} - 2023x + 1 = 0$. Let the roots of the $f(x)$ be $r_1, r_2, \dots, r_{2024}$. Compute $(2023r_1 - 1)(2023r_2 - 1)\cdots(2023r_{2024} - 1)$.

2. Compute

$$\arcsin\left(\frac{2}{\sum_{k=0}^{\infty} \sin^{2k}\left(\frac{1}{2024}\right)} - 1\right).$$

3. A polynomial f with real coefficients satisfies the functional equation

$$f(f(x) + y^2) = f(x + y)f(x - y) + 4f(xy)$$

for all real x, y . What is the sum of all possible values of $|f(1)|$?