

R1-1. Compute the value of

$$\frac{\frac{\frac{\frac{\frac{\frac{1}{1+1}}{1+2+1}}{1+2+2+1}}{1+2+3+2+1}}{1+2+2+1}}{1+2+1}}{1+1}}{1}.$$

R1-2. Let $T = TNYWR$ and let $K = 1/T$. Suppose $\{a_n\}$ is a sequence of real numbers satisfying $a_n a_{n+2} + a_{n+1} = 1$ for all $n \geq 1$. Given that $a_1 = 2$ and $a_2 = 3$, compute $a_1 + a_2 + \dots + a_K$.

R1-3. Let $T = TNYWR$. Rectangle $ABCD$ with perimeter T satisfies $AB = 2BC$. Suppose that the circle centered at A passing through D intersects the circle centered at C passing through D at a point $P \neq D$. Compute the length of BP .

R2-1. Jack is standing at 0 on the number line. After every second, if he is at position n , he moves to either $n + 3$, $n + 1$, $n - 1$, or $n - 3$ each with an equal probability. The probability that Jack is back at 0 after 4 seconds is $\frac{m}{n}$, where m and n are relatively prime positive integers. Compute m .

R2-2. Let $T = TNYWR$. Let f be the function defined by $f(x) = x^4 - x^3 + x^2 - x + 1$, and let $g(x) = f(x + T)$. Compute the product of roots of $g(x)$.

R2-3. Let $T = TNYWR$ and let S be the sum of the digits of T . Suppose f is a function satisfying $f(2^n) = n^2$ and $f(3n) = f(2n) + 1$ for every integer $n \geq 1$. Compute $f(3^S)$.