Problem 1: Let $T$ be an isosceles right triangle whose shorter sides have length 1 and suppose we are given 17 points inside $T$. Prove that two of these points are at distance $< 0.36$ apart.

Problem 2: We select $n + 1$ different integers from the set $\{1, 2, \ldots, 2n\}$. Prove that two of these selected integers will have greatest common divisor equal to 1.

Problem 3: We select a set $S$ of $n + 1$ integers from the set $\{1, 2, \ldots, 2n\}$. (a) Is it always true that there exist $i, j \in S$ with $j = 2i$? (b) Is it always true that there exist $i, j \in S$ with $j = di$ for some integer $d \geq 2$?

Problem 4: Prove that there exists a positive integer $n$ such that $34^n - 1$ is divisible by 49.

Problem 5: For a positive integer $n$, a permutation of size $n$ is a rearrangement $p_1p_2\ldots p_n$ of the numbers $1, 2, \ldots, n$. For example, the permutations of size 3 are 123, 213, 132, 231, 312, and 321. If $n$ is an odd positive integer and $p_1p_2\ldots p_n$ is a permutation of size $n$, prove that the product

$$(1 - p_1)(2 - p_2)\cdots(n - p_n)$$

is an even integer.

Problem 6: Let $k \leq n$ be positive integers. How may ways are there to place $k$ rooks in an $n \times n$ chessboard in such a way that no two rooks attack each other?

Problem 7: Let $n$ be an even positive integer. How many permutations $p_1p_2\ldots p_n$ of $n$ are there in which the sum of any two consecutive entries is odd?

Problem 8: We want to select three subsets $A, B,$ and $C$ of $[n]$ in such a way that $A \subseteq C, B \subseteq C,$ and $A \cap B \neq \emptyset$. In how many ways can we do this?

Problem 9: A certain high school class contains $n$ sophomores, $n$ juniors, and $n$ seniors. In how many ways can the students in this class form $n$ groups of three people if every group has to contain a sophomore, a junior, and a senior?