Combinatorics Problems, Part 1

1. Show that $\binom{r}{r} + \binom{r+1}{r} + \cdots + \binom{n}{r} = \binom{n+1}{r+1}$.

2. Find a nice formulation for the sum $\binom{n}{0}^2 + \binom{n}{1}^2 + \cdots + \binom{n}{n}^2$.

3. Let $S_n = \binom{n}{0} + \binom{n-1}{1} + \cdots + \binom{n-\lfloor \frac{n}{2} \rfloor}{\lfloor \frac{n}{2} \rfloor}$. Show that $S_n = F_n$.

4. Given $S = \{1, 2, \cdots, n\}$, How many unordered pairs $\{A, B\}$ are there where A and B are nonempty subsets of S with $A \cap B = \emptyset$.

5. Do there exist 10,000 10-digit numbers which are all divisible by 7 and are all rearrangements of the same digits.

6. A person has a coat of area 1 composed of five possibly overlapping patches. The area of each patch is at least $\frac{1}{3}$. Prove that there are two patches whose overlap has area of at least $\frac{1}{5}$.

7. A permutation of n elements is a one-to-one function $\pi: \{1, 2, \cdots, k\} \to \{1, 2, \cdots, k\}$. A permutation π of $\{1, 2, 3, \cdots, 2n\}$ has property P if $|\pi(i) - \pi(i+1)| = n$ for at least one i. Show that for any $n \in \mathbb{Z}$, there are more permutations with property P that without it.

8. Let M be a set of $n \geq 4$ points in the plane, no three of which are collinear. Initially these points are connected with n segments so that each point in M is the endpoint of exactly two segments. Then, we perform moves where we choose two segments AB and CD that intersect and replace them by the segments AC and BD if none of them is present.

   Prove that it is impossible to perform $\frac{n^3}{4}$ moves.

Combinatorics Problems And Solutions

Huangqi Zhang

Combinatorics Problems And Solutions:

Unveiling the Magic of Words: A Report on "**Combinatorics Problems And Solutions**"

In some sort of defined by information and interconnectivity, the enchanting power of words has acquired unparalleled significance. Their power to kindle emotions, provoke contemplation, and ignite transformative change is truly awe-inspiring. Enter the realm of "**Combinatorics Problems And Solutions**," a mesmerizing literary masterpiece penned by a distinguished author, guiding readers on a profound journey to unravel the secrets and potential hidden within every word. In this critique, we shall delve into the book is central themes, examine its distinctive writing style, and assess its profound impact on the souls of its readers.

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