



2020 July Beginner Contest

Saturday and Sunday, 11–12 July 2020

Problem 1. There are n people standing in a queue. The queue is reordered, and each person calculates the difference between their original position and their new position. Prove that the sum of these differences is an even number.

Problem 2. Let \mathbb{R} denote the set of real numbers. Find all functions $f : \mathbb{R} \rightarrow \mathbb{R}$ such that for all real numbers x and y ,

$$f(x + yf(x)) = xy + f(x).$$

Problem 3. Let Γ be the circumcircle of an acute scalene triangle ABC . Reflect A in BC to obtain A' , and let $A'C$ intersect Γ a second time at P . Denote by E the altitude from B to AC and denote by N the altitude from P to BC . Prove that the intersection of BE and PN lies on Γ .

Problem 4. Find the smallest integer n such that it is possible to place a positive integer in every cell of an infinite grid so that for each $k \geq n$, any $k \times k$ square contains the number k .

Language: English

*Time: 4 hours
Each problem is worth 7 points*