WISCONSIN MATHEMATICS, SCIENCE & ENGINEERING TALENT SEARCH

PROBLEM SET II (2018-2018) **November 2018**

1. There is a book club with six members. Each member brings a different book to the club meeting, and each person loans their book to another person in the club so that each person leaves with one borrowed book. At the last meeting, the book borrowed by Angelica belonged to the borrower of Ben's book. The owner of the book borrowed by Cathy borrowed the book belonging to the borrower of Derek's book. The borrower of Elena's book was not the owner of the book borrowed by Fatima. From these clues, can we determine who borrowed Angelica's book? Can we determine whose book Angelica borrowed?
2. What is the smallest possible three-digit positive integer k which has a six-digit integer multiple of the form $ABABAB$? (Here A and B are decimal digits, not necessarily distinct.)
3. Suppose we have three extremely long strips of paper, each with width 1 cm and each having parallel sides. They are placed on a large table in such a way that they make angles of $0°$, $60°$, and $120°$ with the horizontal. Consider the region that is covered by all three strips. What is the largest possible area of this region?
4. We have 2018 nonnegative numbers, all of which are at most 1. For each pair of these numbers, we find the absolute value of the difference, and then add up all the resulting differences. What is the largest possible value of the final sum?
5. We color the integers from 1 to 999 with red and blue, so that each integer is assigned one of the two colors. How many different colorings can we construct with the property that there are more red integers within the numbers $\{1, \ldots, 500\}$ than within the numbers $\{501, \ldots, 999\}$?

You are invited to submit a solution even if you get just one problem. Please do not write your solutions on this problem page. Remember that solutions require a proof or justification.

Find old and current problems and information about the talent search at: `http://www.math.wisc.edu/talent`

Find an introduction to techniques for solving problems like these at: `https://goo.gl/pqq32m`

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