WISCONSIN MATHEMATICS, SCIENCE & ENGINEERING TALENT SEARCH

PROBLEM SET I (2014-2015) October 2014

1. Are there functions $f(x)$ and $g(y)$ defined on all the real numbers so that $f(x)g(y) = x+y+1$ for every choice of x and y?

2. Prove that every triangle can be divided into 4 isosceles triangles.

3. We have a 5 by 5 grid of squares where the four corner squares are colored white and the rest of the squares are colored black. We can change the colors of any two adjacent squares (i.e. two squares that share a side) by flipping the colors of each of the two squares from black to white or from white to black. We can do this as many times as we wish. Is it possible to make all the squares in the grid white?

4. You have 2014 marbles each of which you can paint red, green, blue or yellow. Find the largest integer m so that no matter how you paint the marbles and no matter how you put them into 25 bags, at least one bag has at least m marbles of the same color.

5. Show that the minimal value of $\left|\frac{a}{b} - \frac{123}{2014}\right|$ is $\frac{1}{1883\cdot 2014}$ if a, b are positive integers with $b < 2014$.

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.

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