

WISCONSIN MATHEMATICS, SCIENCE & ENGINEERING TALENT SEARCH

PROBLEM SET I (2016-2017)

October 2016

1. There is a bag with marbles in it. Here are some statements about the bag.
 - (a) There is a blue marble in the bag.
 - (b) There is a red marble and a blue marble in the bag.
 - (c) There is a red marble and a blue marble and a green marble in the bag.
 - (d) There is a red marble in the bag.
 Is it possible that exactly two of these statements are true?
2. In the triangle ABC we have $AC = BC$. There is a point F on the side BC for which we have $AB = AF = FC$. Find the angles of the triangle ABC .
3. How many ways can we choose 3 positive integers $a < b < c$ so that $a \cdot b \cdot c = 30,030$?
4. We have a list of 2016 numbers. We notice that if we erase any of the numbers, then the absolute value of the sum of the remaining 2015 numbers is the same as the absolute value of the number we erased. Show that the sum of the 2016 numbers in the list is equal to zero.
5. A table with 5 rows and 5 columns is filled with nonnegative integers. With an *add move* we can select one of the 5 rows or one of the 5 columns and add 1 to each number in that row or column. With a *subtract move* we can select one of the 5 rows or one of the 5 columns and subtract 1 from each number in that row or column. Suppose that we can find a sequence of add moves and subtract moves that will reduce our table of nonnegative integers to a table filled with zeros only. Prove that in that case the original table of nonnegative integers can also be reduced to all zeros using *only* subtract moves.

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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