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Loughborough University

Department of Mathematical Sciences

MATHEMATICAL CHALLENGE

CHRISTMAS - 2012

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Problem 1. The number 2012^{2012} is written out as a decimal, and the sum of the digits is denoted by S_1. The sum of the digits of S_1 is denoted by S_2. What is the sum of the digits of S_2? Justify your answer.

Problem 2. There are 2013 straight lines on a plane, such that no two of them are parallel and no three of them have a common point. Prove that among the pieces they cut the plane into there are always at least 1342 triangles.

Problem 3. Sherlock Holmes and Professor Moriarty play a deadly game with a block of chocolate in which Moriarty has poisoned one of the pieces as indicated below:
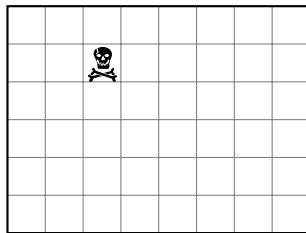
Each of them in turn breaks the block along any horizontal or vertical line, and eats the broken-off part. Whoever is left with the last, poisoned piece will have to eat it. Sherlock Holmes makes the first move. Assuming that he knows which piece is poisoned, how should he play to avoid eating the poisoned piece? Is there survival strategy for any position of the poisoned piece? The same question for 7×9 block. Justify your answers.

Remarks.

1. There will be a first prize of £50 to the person handing in what will be considered to be the best effort to these problems. There may also be special prizes for the most original solutions.
2. Any student registered on one of the undergraduate programmes in the Department of Mathematical Sciences may submit solutions to any or all of these problems.
3. Solutions should be handed in on or before Friday 25 January 2013 to either Prof. A.P. Veselov (W233ma) or Dr. B. Winn (W278), who will be the judges for the Challenge.