

The Scottish Mathematical Council

www.scot-maths.co.uk

MATHEMATICAL CHALLENGE 2015-2016

Entries must be the unaided efforts of individual pupils.

Solutions must include explanations and answers without explanation will be given no credit.

Do not feel that you must hand in answers to all the questions.

CURRENT AND RECENT SPONSORS OF MATHEMATICAL CHALLENGE ARE

*The Edinburgh Mathematical Society, The Maxwell Foundation, Professor L E Fraenkel,
The London Mathematical Society and The Scottish International Education Trust.*

The Scottish Mathematical Council is indebted to the above for their generous support and gratefully acknowledges financial and other assistance from schools, universities and education authorities.

Particular thanks are due to the Universities of Aberdeen, Edinburgh, Glasgow, St Andrews, Stirling, Strathclyde and to Bearsden Academy, Kelvinside Academy and Northfield Academy.

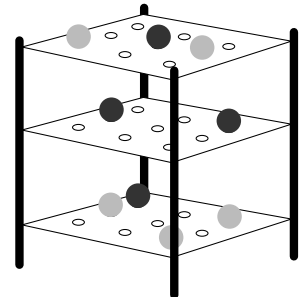
Middle Division: Problems 2

- M1.** A pairs jousting tournament in which each knight would fight every other knight in the competition (unless he had to withdraw due to serious injury) was just about to start. Some unknown knights rode up and asked to be allowed to take part in the tournament. It was decided to include the unknown knights and 26 more pairs competitions had to be scheduled.

How many knights were taking part originally and how many unknown knights arrived?

- M2.** Imagine a three-dimensional version of noughts and crosses: two players take it in turn to place different coloured marbles in a $3 \times 3 \times 3$ cube arrangement as shown in the diagram. cube in a box made from 27 transparent cubes. The object of the game is to create as many lines of three marbles of your own colour as possible.

How many different possible lines are there?



- M3.** A circle of radius 15 cm intersects another circle of radius 20 cm at right angles. Work out an exact expression for the difference between the areas of the non-overlapping portions. What is the sum of the areas of the non-overlapping portions? Give your answer to four significant figures.
- M4.** A radio ham places an aerial mast where it gives the best reception on the roof of his rectangular garage. He then fixes wire supports from the top of the mast to each corner of the roof. The lengths of two opposite supports are seven metres and four metres and the length of one of the others is 1 metre. Find the length of the remaining support.
- M5.** A large board has $1000 +$ signs and $999 -$ signs written on it. Any two symbols can be deleted provided they are replaced as follows:

- if the deleted symbols are the same, they are replaced by a $+$
- if the deleted symbols are different they are replaced by a $-$.

Repeat this process until there is only one symbol left. Which symbol is it and why?

END OF PROBLEM SET 2