

# The Scottish Mathematical Council

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## MATHEMATICAL CHALLENGE 2008–2009

Entries must be the unaided efforts of individual pupils. Solutions must include explanations.

**Answers without explanation will be given no credit.**

*CURRENT AND RECENT SPONSORS OF MATHEMATICAL CHALLENGE ARE*

*The Edinburgh Mathematical Society, Professor L E Fraenkel,*

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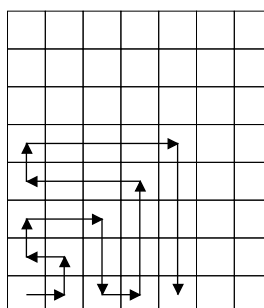
The Scottish Mathematical Council is indebted to the above for their generous support and gratefully acknowledges financial and other assistance from schools, universities and education authorities.

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### Middle Division: Problems 2

- M1.** Shaun starts to write down the natural numbers in the square cells of a very large piece of graph paper. He starts at the bottom left corner and writes down the numbers using the following arrangement.

We will identify each of the cells using co-ordinates  $(x, y)$  where  $x$  is the number of positions to the right and  $y$  is the number of position up from the bottom. For example, the cell containing the number 8 has the co-ordinates  $(3, 2)$ .



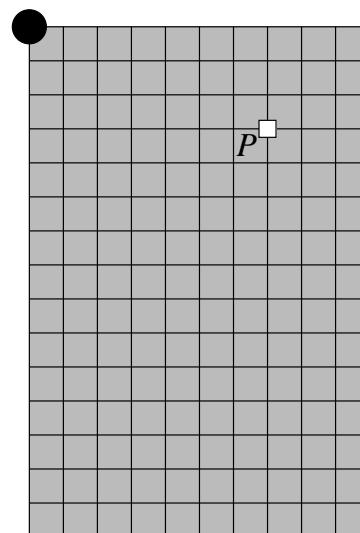
5	6	7			
4	3	8			
1	2	9			

If  $N$  is an even number, what number appears in the cell with co-ordinates  $(1, N)$ ? In what cell does the number 2009 appear? Explain your answers.

- M2.** The street system in New York is built up as a series of blocks. The section in which Gordon works is 10 blocks wide and 15 blocks long and Grand Central Station is located in the top north-west corner of the section. When asked where exactly he worked, he would not specify the location, but said that from Grand Central station, starting on January 1st 2009, he could take a different route to work every day except Christmas Day (which he took off anyway!) but that on the January 1st 2010, he would need to repeat a route already used. If Gordon only walks either south or east, find out where he works.

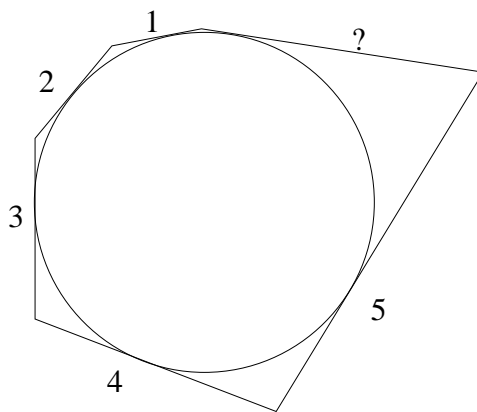
Give your answer as grid location from the station, for example,  $P$  is 3 blocks south, 7 blocks east.

Grand Central Station



- M3.** At a horse show, a driver is demonstrating his ability to drive his pony and two-wheeled trap in a tight circle. The wheels of the trap are 5 ft apart and for the tightest circle, the outer wheel makes one and a quarter turns for every turn of the inner wheel. What is the circumference of the circle made by the outer wheels?
- M4.** A desert island has a total of twenty shipwrecked people living on it. The leader suggests that the food provisions should be shared between them. There is a total of twenty portions of provisions and she proclaims that each man will be given three portions, each woman will be given two portions and each child half a portion.
- How many men, women and children are shipwrecked on the island?

- M5.** In the hexagon shown, all edges are tangent to the circle. If their lengths are 1, 2, 3, 4 and 5 as illustrated, what is the length of the remaining edge?



**END OF PROBLEM SET 2**