

# The Scottish Mathematical Council

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## MATHEMATICAL CHALLENGE 2010–2011

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, Professor L E Fraenkel,*

*The London Mathematical Society and The Scottish International Education Trust.*

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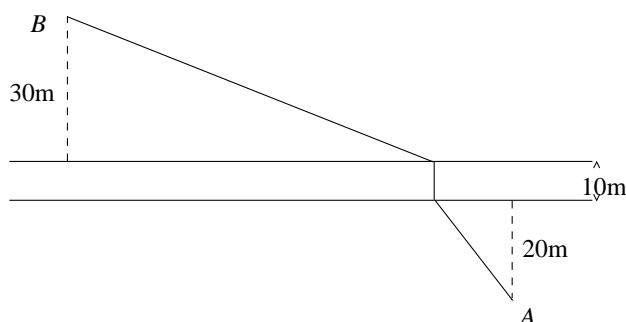
Particular thanks are due to the Universities of Aberdeen, Edinburgh, Glasgow, St Andrews, Strathclyde, and to Preston Lodge High School, Bearsden Academy, Beaconsfield School, St Aloysius College and Turriff Academy.

### Senior Division: Problems 2

- S1.** The shape of a fifty-pence piece is based on a regular heptagon which is a 7-sided polygon. The distance between each vertex and each of its two 'nearly opposite' vertices is 1 unit. The perimeter of the coin is formed by circular arcs of radius 1 unit which are centred on each vertex, and join the two nearly opposite vertices. Find the length of the perimeter of the coin.



- S2.** A rabbit's burrow is at  $A$  and he knows that there are carrots in a garden at  $B$ , across a road, which is 10m wide. The burrow is 20m from the nearer edge of the road and the carrots are 30m beyond the other edge as shown in the diagram. The straight line distance from  $A$  to  $B$  is 80m.



The rabbit is wary of crossing the road and knows from past experience that he must cross directly across the road, not askew. What is the length of the shortest possible route for the rabbit from the burrow to the carrots?

- S3.** One disc of 20 cm diameter and one of 10 cm diameter are cut from a disc of plywood of diameter 30 cm. What is the diameter of the largest disc that can be cut from the wood that remains? (Ignore the thickness of the saw cut.)
- S4.** Calculate

$$67^2$$

$$667^2$$

$$6667^2$$

$$66667^2$$

Find the value of the square of the number consisting of one million sixes, followed by one seven. Justify your answer.

**S5.** In a wood there are more than 100 trees and all the trees have leaves on them. The number of trees in the wood is more than double the number of leaves on any one tree in the wood. Identify which of the following statements must be true:

- at least two trees have the same number of leaves on them;
- at least three trees have the same number of leaves on them;
- at least four trees have the same number of leaves on them.

**Explain your answer in each case.**

**END OF PROBLEM SET 2**