

The Scottish Mathematical Council

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MATHEMATICAL CHALLENGE 2014–2015

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.

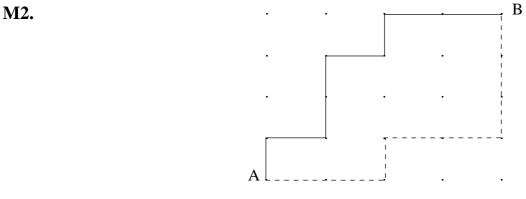
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Middle Division: Problems 2

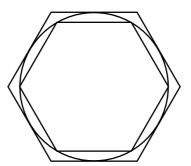
M1. The scales of a large fish are made up of arcs of circles with radius r cm. Each row of scales overlaps the row below. The scales within a row just touch, with their centres on a straight line. The next row of scales, which overlaps the previous row, is r cm above the previous row, with the centres of the scales above the points where the scales in the previous row touch.

What is the visible area of a single scale?



Paths from A to B can **only** proceed upwards or to the right: two example paths from A to B are shown. How many such paths are there from A to B that do not go through the centre dot?

- **M3.** Three sides of a regular polygon with 8 sides are chosen at random. Find the probability that, when these sides are extended, they form a triangle containing the polygon.
- **M4.** A fruit drink manufacturer has a mixture of 100 litres containing w% of pure orange juice. By adding *x* litres of a mixture containing *y*% of pure orange juice he wishes to produce a mixture containing *z*% of pure orange juice. Find the value of *x* in terms of *w*, *y* and *z*.
- M5.



A regular hexagon circumscribes a circle which circumscribes another regular hexagon. The inner hexagon has an area of 3 square units. What is the area of the outer hexagon?

END OF PROBLEM SET 2