The Scottish Mathematical Council

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MATHEMATICAL CHALLENGE 2018−2019

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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Senior Division: Problems 2

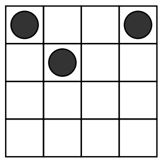
S1. Show that the product of four consecutive odd integers is always 16 less than a square number.

Deduce that the product of four consecutive odd integers can never be a square number except in one particular case.

S2. A cardboard box manufacturer makes open-topped boxes which are cubes. Because of changes in the market, there are plans to double the volume of the boxes which are made. The regular supplier of raw cardboard offers a 37.5% discount on the price that was originally being charged. A new supplier offers a deal in which the manufacturer would be paying exactly the same for the raw material for his bigger boxes as was paid for the smaller boxes.

Which is the best deal for the manufacturer?

S3. In a 4×4 grid as shown, place three coins randomly in different squares.



Determine the probability that no two coins lie in the same row or column.

S4. Distinct points A, P, Q, R and S lie on the circumference of a circle and AP, AQ, AR and AS are chords with the property that

$$\angle PAQ = \angle QAR = \angle RAS.$$

Prove that

$$AR(AP + AR) = AQ(AQ + AS).$$

S5. In a magic square, the numbers in each row, the numbers in each column, and the numbers on each diagonal have the same sum. Given the magic square shown with all of a, b, c, x, y, z positive, determine the product xyz in terms of a, b and c.

$\log a$	$\log b$	$\log x$
p	$\log y$	$\log c$
$\log z$	q	r

END OF PROBLEM SET 2