

The Scottish Mathematical Council

www.scot-maths.co.uk

MATHEMATICAL CHALLENGE 2024–2025

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,

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 Napier, Moray House, St Andrews, Stirling, Strathclyde and to George Heriot's School, Gryffe High School and Kelvinside Academy.

Senior Division: Problems 2

- **S1.** Around the circumference of a circle, mark 21 points, equally spaced, and label them 0, 1, 2, ..., 20 in cyclic order. Mark *n* of the points with an asterisk (*) so that no two pairs of * points are the same distance apart. What is the maximum value of *n*? Explain.
- **S2.** Find a set of 4 different positive integers such that the sum of any pair of them divides their product exactly.

Find a set of 6 different positive integers with the same property, or show that it is not possible to find such a set.

S3. Triangle *ABC* is right-angled at *C* and has side lengths which are integers. A second triangle, *PQR*, is located inside $\triangle ABC$ as shown, such that its sides are parallel to the sides of $\triangle ABC$ and the distance between all pairs of parallel lines is 2. Determine the side lengths of all possible triangles *ABC*, so that the area of $\triangle ABC$ is 9 times the area of $\triangle PQR$.



S4.



QRS is a straight line. Triangles PQR and RST are equilateral. M is the midpoint of PS and N is the midpoint of TQ.

Prove that triangle *MNR* is equilateral.

SEE OVER FOR QUESTION S5.



Mathematical Challenge Problems 1

SENIOR DIVISION 2024-2025

PLEASE USE CAPITALS TO COMPLETE

SURNAME		FOR OFFICIAL USE Marker
OTHER NAME(S) (underline the one you prefer)		Marks
SCHOOL		
AGE	YEAR OF STUDY S	Total

Please write your solutions on A4 paper and staple the above form to them. PLEASE WRITE YOUR NAME ON EVERY PAGE.

Send your entry through your school to the section organiser.

For further information on the competition, please see the School Materials which have been distributed to schools. A copy of these Materials can be obtained from

http://www.wpr3.co.uk/MC/materials/index.html

There are separate links for primary and secondary schools. This page also includes a list of authorities in each section and names and addresses of section organisers.

S5. Determine all real solutions of the pair of equations:

 $\sqrt{a} + b = 8$ $\log_{10} a + 2 \log_{10} b = 2$

Give your answer(s) as simplified exact numbers.

END OF PROBLEM SET 2

CLOSING DATE FOR RECEIPT OF SOLUTIONS :

21 February 2025

For information about Mathematical Challenge, look on the SMC web site: www.scot-maths.co.uk

MATHS CHALLENGES ARCHIVES

There are archives of previous questions on: **www.wpr3.co.uk/MC-archive/S/index-S.html** Here is a shortcut for your smartphone or tablet

