

The Scottish Mathematical Council

www.scot-maths.co.uk

MATHEMATICAL CHALLENGE 2017–2018

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.*

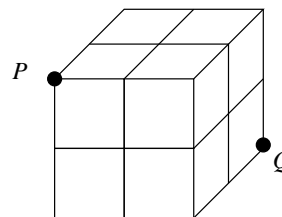
The Scottish Mathematical Council is indebted to the above for their generous support and gratefully acknowledges financial and other assistance from schools, universities and education authorities.

Particular thanks are due to the Universities of Aberdeen, Edinburgh, Glasgow, Heriot Watt, St Andrews, Stirling, Strathclyde and to Bearsden Academy, Kelvinside Academy and Northfield Academy.

Senior Division: Problems 1

S1. In a trapezium $PQRS$, PQ is parallel to SR and $\angle SPQ = \angle RQP = 135^\circ$. The trapezium contains an inscribed circle and the length of PQ is 1 cm. What is the **exact** length of QR ?

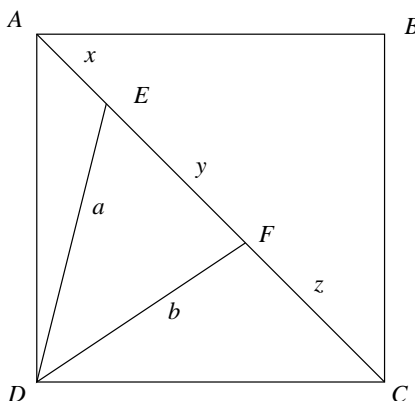
S2. Each of the six faces of a solid cube is divided into four squares as indicated in the diagram. Starting from vertex P paths can be travelled to vertex Q along connected line segments. Each movement along a path must take one closer to Q . How many possible paths are there from P to Q ?



S3. In a magic square, the sum of the numbers in each diagonal, row and column is the same. What is the value of $y + z$ in this 3×3 magic square?

v	24	w
18	x	y
25	z	21

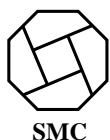
S4.



In the diagram, $ABCD$ is a square. Points E and F are chosen on AC so that angle EDF is 45° . If $AE = x$, $EF = y$ and $FC = z$, prove that

$$y^2 = x^2 + z^2$$

SEE OVER FOR QUESTION S5.



Mathematical Challenge Problems 1

SENIOR DIVISION 2017-2018

PLEASE USE CAPITALS TO COMPLETE

SURNAME	<input type="text"/>	FOR OFFICIAL USE Marker <input type="text"/> Marks <table border="1"><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td></td><td></td><td></td><td></td><td></td></tr></table> Total <input type="text"/>	1	2	3	4	5					
1	2		3	4	5							
OTHER NAME(S) (underline the one you prefer)	<input type="text"/>											
SCHOOL	<input type="text"/>											
AGE	<input type="text"/>	YEAR OF STUDY	S	<input type="text"/>								

— — — — - **CUT ALONG HERE** — — — —

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 organisers.

For further information on the competition, please see the Information Circular, which has been distributed to all secondary schools. Please contact the local organiser, whose name and address are given above, if you require a further copy.

S5. (a) A class of 15 is to be divided into groups of three for practical work. There is one pair of twins in the class. Show that if the groups are selected at random the probability that the twins are in the same group of three is $\frac{1}{7}$.

(b) If there were two pairs of twins in the class determine the probability that there would be at least one group containing a pair of twins.

END OF PROBLEM SET 1

CLOSING DATE FOR RECEIPT OF SOLUTIONS :

Look out for Problems 2 in early December!

Look on the SMC web site:

www.scot-maths.co.uk

for information about Mathematical Challenge