

Maths Challenges News

Issue 42

June 2013

In this issue

Diary dates for 2013/14

2

The Geometry of the Triangle

Welcome Gerard

Mathematical Circles

3

Mathematical Olympiad for Girls

Senior Team Maths Challenge

4

Romanian Success

Prize Sudoku

UKMT Honours!

We were thrilled to see two of our volunteers named in the 2013 New Year Honours list. Our congratulations go to Terry Heard MBE and Jenny Ramsden MBE. Their citations were as follows:

Terence James Heard. Co-Founder, UK Mathematics Trust. For services to the Teaching of Mathematics.

Miss Jenny Stephanie Ramsden. For services to Further Education and to Mathematics Education through the UK Mathematics Trust.



We were pleased to hear that the Queen commented to Jenny about the importance of mathematics. Neither Jenny nor Terry mentioned to the Queen that she has appeared in one of our questions (IMC 1998, Q7):

Each person's birthday product is obtained by multiplying the day of the month in which they were born by the number of the month in which they were born, and then multiplying the answer by the year in which they were born. Here are five English queens and their birthdays. Which of them has the same birthday product as someone born on 5 February 1998?

- A Mary I, 18 February 1518 B Elizabeth I, 7 September 1533 C Anne, 6 February 1665
D Victoria, 24 May 1819 E Elizabeth II, 21 April 1926



Senior Maths Challenge

We received over 98,000 entries to the 2012 Senior Maths Challenge (SMC). Help us break the 100,000 entry mark and make 2013 our biggest ever SMC!

The top 60% of students nationwide receive certificates, and each school also receives certificates to award to their top scorer in each year group and the school. High scoring students are invited to participate in the British Mathematical Olympiad or Senior Kangaroo. Results are emailed to schools shortly after the Challenge and detailed analysis of how your students performed compared to the nation are subsequently posted.

The SMC involves answering 25 multiple-choice questions in 90 minutes and takes place on Thursday 7 November. It is aimed at all 16-19 year olds studying mathematics and is also suitable for students who may no longer be studying mathematics but have completed their GCSE (or equivalent).

The 2013 SMC entry form can be downloaded from www.ukmt.org.uk.

According to one astronomer, there are one hundred thousand million galaxies in the universe, each containing one hundred thousand million stars. How many stars is that altogether?

- A 10^{13} B 10^{22} C 10^{100} D 10^{120} E 10^{121}

UKMT Contact Details

UK Mathematics Trust - a registered charity in England & Wales.
UKMT, School of Mathematics, University of Leeds, LS2 9JT
Tel: 0113 343 2339 Fax: 0113 343 5500 Twitter: @UKMathsTrust
Email: enquiry@ukmt.org.uk Website: www.ukmt.org.uk

Diary Dates for 2013-14

Maths Challenges and Follow-on Rounds 2013-14

Challenge	Date	Follow-on Round	Date
Senior	Thursday 7 November 2013	BMO1 and Senior Kangaroo BMO2	Friday 29 November 2013 Thursday 30 January 2014
Intermediate	Thursday 6 February 2014	IMOK (Olympiad and Kangaroo)	Thursday 20 March 2014
Junior	Thursday 1 May 2014	JMO	Thursday 12 June 2014

The Geometry of the Triangle

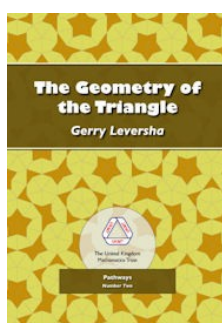
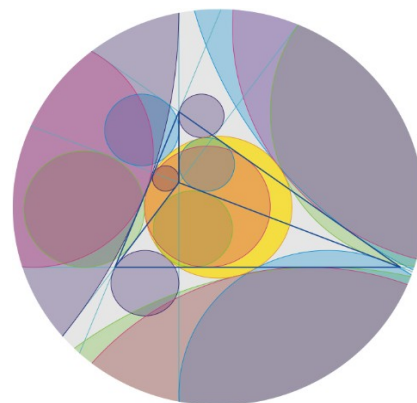
The triangle is the simplest of all figures, but it gives rise to an extraordinary wealth of interesting geometry. Some of this is probably already familiar. For instance, the perpendicular bisectors of the sides of a triangle intersect at the circumcentre, the centre of the circle passing through the three vertices. The angle bisectors intersect at the incentre, the centre of the circle which is tangent to the three sides. The medians meet at the centroid, which is the triangle's centre of gravity, and the altitudes meet at a point called the orthocentre. Moreover, the circumcentre, centroid and orthocentre are collinear on the Euler line. Also on this line is the centre of a circle which, as its name suggests, passes through nine significant points of the triangle.

What is not so well known is that the incircle and the nine-point circle are always tangential to each other. In fact, you can find sixteen related circles, all of which are tangent to the nine-point circle.

This book explores the fascinating web of interconnection between points, lines and circles which results from a simple triangle. But, unlike some other accounts which just mention these 'interesting facts', everything in this book is proved using Euclidean methods and presented in a logical sequence. New techniques, such as cross-ratio, spiral similarities and inversion, are introduced when needed. Excellent diagrams accompany the text in order to guide the reader through the mathematical detail and there are hundreds of challenging exercises as well as complete solutions.

As well as the well-known triangle centres already mentioned, this book introduces readers to many others. These include the symmedian point, the unique point which is the centroid of its pedal triangle, the isogonic centres, one of which minimises the

sum of the distances from an interior triangle point to the vertices, and the outer Soddy point which solves an isoperimetric problem. In the course of this wide-ranging journey through unfamiliar territory, the reader will encounter configurations such as the Morley triangle, which is formed from angle trisectors, the Lester circle, which was discovered only in 1996, and the Brocard triangles, all of which are in perspective with the original triangle. And the list goes on: the isodynamic points, Poncelet's porism, the Mittenpunkt and Clawson points, the Feuerbach triangle, and much more. This comprehensive and accessible account provides an invaluable guide to the further reaches of that fascinating continent which is triangle geometry.

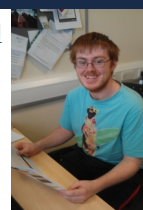


Gerry Leversha, author of *The Geometry of the Triangle*

The Geometry of the Triangle is available to purchase now from www.publications.org.uk.

Welcome to Gerard

If you phone the UKMT Maths Challenges Office, don't be surprised to hear a new voice! Gerard started full time with UKMT early in the New Year, and his main responsibilities are dealing with customer enquiries and assisting our packing team. Outside the office, Gerard participates in Aikido (a Japanese martial art focused on circular movements) and Tai Chi (an ancient Chinese fighting system used by many people now for gentle exercise and relaxation).



UKMT Mathematical Circles

The Mathematical Circles are a new UKMT enrichment event. We trialled two events in 2012 and a further four events earlier this year. Students from a local area came together for two days and were introduced to some mathematically demanding topics. They had the opportunity to discuss mathematics and make new friends from other schools around their region. Topics included geometry, proof and modular arithmetic.

Thanks to a grant from the DfE, we are expanding these and running 12 Mathematical Circles in the coming year and 15 the year after. Local schools will be able to select which two students from Year 10 they wish to send to the event, but as the work is mathematically demanding, we suggest passing the invitations on to those students who have performed particularly well in the UKMT Intermediate Maths Challenge.



Events are being planned in the summer term in Teesside, Yorkshire and Hertfordshire, and in Manchester, Hull, and Kent amongst others in the autumn term. Keep your eye out for further news about the locations of these Mathematical Circles.

If you would like to find out more about how you can become involved in the Mathematical Circles, either through your school hosting an event or by supporting us in running a session, please do contact us at enquiry@ukmt.org.uk.



Department
for Education

Mathematical Olympiad for Girls

After a very successful first year in Cambridge, Luxembourg took on the baton for holding the 2013 European Girls' Mathematical Olympiad (EGMO). This European Olympiad was founded by UKMT to increase the participation of girls in international maths competitions, and has grown since the inaugural event last year. Twenty-two countries participated and further countries had also hoped to join, so it looks like EGMO 2014 in Turkey will be even bigger.

The selection for the EGMO team was made from performances in the Mathematical Olympiad for Girls, and BMO1 and BMO2, the two rounds of the British Mathematical Olympiad.

Our congratulations go to the UK team, Maria Holdcroft, Elizabeth Lee, Katya Richards and Kasia Warburton (pictured), on their great performance, coming home with a silver medal, bronze medal and two honourable mentions, and thanks to Hannah Roberts (Pembroke College, Oxford) for leading the team and to deputy leader Jo Harbour (Mayfield Primary School, Cambridge). A full report about EGMO2013 can be found at <http://www.bmoc.maths.org/home/egmo.shtml>.



Following the success of the UK team at EGMO, we are once again organising a challenge to help identify potential squad members for the 3rd EGMO event, which takes place in Turkey in April 2014. The Mathematical Olympiad for Girls (MOG) will take place on **Thursday 26 September 2013**.

The MOG paper is aimed at strong female mathematicians who have a genuine passion for mathematics and are willing to work hard to become the best in the UK. They must also be eligible to be part of the team for the International Mathematical Olympiad (eligibility criteria is available at <http://www.bmoc.maths.org/home/eligibility.shtml>).

Age does not matter but students should be confident mathematicians and have achieved some success at UKMT follow-on rounds or mentoring schemes. If they have potential and are interested, students should attempt an old MOG paper, available at <http://www.bmoc.maths.org/home/egmo.shtml#ukmog>.

To register your student for MOG2013, please contact enquiry@ukmt.org.uk with the following information: student full name, date of birth, school year, school name, UKMT centre number, and confirmation of student eligibility (either eligible for a UK passport describing them as a British Citizen, or will have completed 3 full years of full-time secondary education in the UK by the time they leave school). Your registration will be acknowledged and the paper will be sent by email to the contact teacher on Tuesday 24 September for the paper to be sat on Thursday 26 September.

MOG 2012, Q1:

The numbers a , b , and c are real. Prove that at least one of the three numbers

$$(a + b + c)^2 - 9bc, (a + b + c)^2 - 9ca \text{ and } (a + b + c)^2 - 9ab$$

is non-negative.

Senior Team Maths Challenge

This year, a record 1100 schools and colleges from around the UK competed in 56 regional heats of the Senior Team Maths Challenge, organised jointly by UKMT and the Further Mathematics Support Programme (FMSP). The winning teams progressed to the National Final at the Camden Centre in London on February 5th. The final was extremely close with three teams tied for second place. Our congratulations go to the overall champions from Westminster School pictured with the winning trophy which was presented by Sarah Malik from Rolls-Royce.



Entry forms for the 2013-14 Senior Team Maths Challenge will be arriving in schools shortly along with a copy of the winning poster from the National Final. Alternatively, look out for further information appearing on our website, where you can also find out more and download previous STMC materials (www.stmc.ukmt.org.uk). We look forward to welcoming you to a regional heat in November!

Romanian Success!

The UK was delighted to once again be invited to send a team to the Romanian Master of Mathematics (RMM) contest, held in the Tudor Vianu National High School for Computer Science earlier this year. The contest has become a regular part of the mathematical competition calendar, and is designed to be a hard competition for countries that perform strongly at the International Mathematical Olympiad.

The UK team of Andrew Carlotti, Gabriel Gendler, Daniel Hu, Sahl Khan, Warren Li and Matei Mandache was led by Jonathan Lee, University of Cambridge. Congratulations to the team who came third overall behind USA and Russia, and were awarded two gold, one silver and one bronze medal, and two honourable mentions.

Try question 1 from paper 1 of the RMM below. All the questions and a full report by Jonathan Lee can be found at <http://www.bmoc.maths.org/home/rmm.shtml>

For a positive integer a , define a sequence of integers x_1, x_2, \dots by letting $x_1 = a$ and $x_{n+1} = 2x_n + 1$ for $n \geq 1$. Let $y_n = 2^{x_n} - 1$. Determine the largest possible k such that, for some positive integer a , the numbers y_1, \dots, y_k are all prime.

Prize Sudoku

Medium – warm up on this one!

5	8			7	9	2	
			1				
1		7	4			5	
	6			9			
4	1	9			2	6	8
			6			7	
	2			4	6	5	
				1			
3		5	9			8	7

In Sudoku, every digit from 1 to 9 must appear in each of the nine rows, each of the nine columns, and each of the nine outlined boxes.

A draw from the correct entries will take place after the closing date and the winner will receive a book with a mathematical theme.

PRIZE puzzle - a little harder! →

	5			6			7	1	
				5		7	9	3	4
7				1					
	3	5			9				
		2		4			7		
				2			4	5	
					9				8
6	1	9		8		4			
5	4				7			9	

Please send entries (photocopies accepted) by the closing date of Friday 19 July 2013 to:
Sudoku, UKMT, School of Maths Satellite, University of Leeds, Leeds LS2 9JT

NAME.....SCHOOL ADDRESS

.....

.....SCHOOL POSTCODE.....