



Maths Challenges News

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Logic Problems

In April this year, it was refreshing to see mathematics make the news. A logic problem from Singapore's equivalent of the Intermediate Maths Challenge went viral, causing huge debate on social media. The UKMT's Challenges often contain questions of this nature, and in the 27 years since Mathematical Challenges were introduced, many of them have contained logic problems.

In the very first Challenge, the 1988 Schools' Mathematical Challenge (the forerunner of today's JMC and IMC) had the following as Q15:

Arash runs faster than Betty, and Dovey will always beat Chandra in a race. Betty is never beaten by Edwina. One day all five race against each other. Just one of the following results is possible. Which is it? (ABCDE indicates 'Arash first, ...').

A ABCDE B BEDAC C ABCED D ADBCE E ADCEB

The most recent Challenge paper, April's JMC, also contained a logic problem (Q17). This is the latest in a number of Challenge problems in which fictional characters may or may not be making true statements. Another such example is Q11 in the 2010 IMC. Probably the most difficult logic problem in a Challenge is Q24 of the 2001 SMC. The true/false statement type of question is not the only sort of logic problem to appear on Challenge papers, however, as seen in the 1998 JMC.

JMC 2015, Q17

Knave of Hearts: "I stole the tarts."
 Knave of Clubs: "The Knave of Hearts is lying."
 Knave of Diamonds: "The Knave of Clubs is lying."
 Knave of Spades: "The Knave of Diamonds is lying."

How many of the four Knaves were telling the truth?
 A 1 B 2 C 3 D 4 E more information needed

IMC 2010, Q11

"You eat more than I do," said Tweedledee to Tweedledum.
 "That is not true," said Tweedledum to Tweedledee.
 "You are both wrong," said Alice, to them both.
 "You are right," said the White Rabbit to Alice.

How many of the four statements were true?
 A 0 B 1 C 2 D 3 E 4

SMC 2001, Q24

Someone ate the Queen of Hearts' tarts. Precisely one of the following statements about the tarts and the three Knaves of Clubs, Diamonds and Spades is true. Which one?

- A None of the three Knaves ate any tarts
- B The Knave of Clubs ate some tarts
- C Only one of the three Knaves ate any tarts.
- D At least one of the Knave of Diamonds and the Knave of Spades ate no tarts.
- E More than one of the three Knaves ate some tarts.

JMC 1998, Q17

Four crosses are to be placed in this 4 by 4 grid so that no two crosses go in the same row or column, or in any of the ten 'diagonals'. The position of the first cross is given.

		D	
		C	
X		B	
		A	

Where must the cross go in the third column?
 A B C D E can't be sure

One of the features of logic problems is that attempting them is often very appealing – no mathematical knowledge is needed – and this probably explains the phenomenon of the Singapore problem. Hopefully, you have been attempting these problems as you have been reading the article (the correct answers can be found on page 3). Keep your eye out for logic problems in future Challenges!

Howard Groves, Chair of the JMC and IMC Problems Group,

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Diary Dates for 2015-16

<i>Challenge</i>	<i>Date</i>	<i>Follow-on Round</i>	<i>Date</i>
Senior	Thursday 5 November 2015	BMO1 and Senior Kangaroo BMO2	Friday 27 November 2015 Thursday 28 January 2016
Intermediate	Thursday 4 February 2016	IMOK Olympiad IMOK Kangaroo	Thursday 10 March 2016 Thursday 17 March 2016
Junior	Thursday 28 April 2016	JMOK (Olympiad and Kangaroo)	Tuesday 14 June 2016

Entry Details for Mathematical Olympiad for Girls

Entries are now being accepted for the UK Mathematical Olympiad for Girls (MOG), which is taking place on Tuesday 29th September. The UK MOG continues to go from strength to strength, from small beginnings in 2011 which saw only 155 entries, to over 2,000 entries from throughout the UK last year.

We hope through MOG to encourage and inspire as many girls as possible to get involved in advanced mathematical problem solving. However some students can be discouraged from taking part in subsequent activities if they have a negative experience through sitting an Olympiad paper when they are not ready for it.

We recommend that students who are entered for MOG will probably already have achieved some success at UKMT follow-on rounds or in the mentoring schemes, and are confident mathematicians. Whilst we do allow entries from younger girls, MOG is aimed at girls in Year 11 (and equivalent) and above.

To give some indication of the type of questions involved, MOG past papers can be found at www.bmoc.maths.org/home/egmo and we encourage all interested students to attempt some of these before entering the competition, as Olympiad questions may be different in style to anything they have previously attempted. The paper contains five questions to be answered in two-and-a-half hours.

How to enter your students for MOG 2015

In 2015 MOG will be held on **Tuesday 29th September**. To enter your student for MOG2015, please complete the form at https://www.surveymonkey.com/r/MOG_ENTRY. Your registration will be acknowledged and the paper will be sent *by email* to our registered UKMT Senior or Intermediate Challenge school contact on Monday 28th September for the paper to be taken on Tuesday 29th September. Entry to the competition is free of charge.

MOG also forms part of the process to identify potential squad members for the annual European Girls' Mathematical Olympiad and other international competitions. Therefore, students should be eligible to be part of the UK team (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).

Try Question 3 from MOG 2014:

A large whiteboard has 2014 + signs and 2015 - signs written on it. You are allowed to delete two of the symbols and replace them according to the following two rules.

- (i) If the two deleted symbols are the same, then replace them by +.
- (ii) If the two deleted symbols are different, then replace them by -.

You repeat this until there is only one symbol left. Which symbol is it?



The UK team and leaders at EGMO 2015

Try Problem 2 from the 2015 European Girls' Mathematical Olympiad:

A *domino* is a 2×1 or 1×2 tile. Determine in how many ways exactly n^2 dominoes can be placed without overlapping on a $2n \times 2n$ chessboard so that every 2×2 square contains at least two uncovered unit squares which lie in the same row or column.

Senior Team Maths Challenge



Photo from the 2014-15 STMC event in Carlisle

Entry forms for the 2015-16 Senior Team Maths Challenge (STMC) 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).

This year, over 1150 schools and colleges from around the UK competed in 59 regional heats of the Senior Team Maths Challenge, organised jointly by UKMT and the FMSP. The winning teams from each regional event, and some high-scoring runners-up, progressed to the National Final at the Royal Horticultural Halls in London in February. The final was

extremely close with our first ever three-way tie. Our congratulations go to the champions from Hampton School, Harrow School, and King Edward's School Birmingham. Congratulations too to the winners of the poster competition, Dunblane High School.

We look forward to welcoming you to a regional STMC event in November!

Try Q6 from the 2014-15 STMC Group Round.

Each of the ten different letters in *MATHS CHALLENGE* represents a different digit.

$$\begin{array}{r} S T M C \\ + S T M C \\ \hline M A T H S \end{array}$$

$L^2 = E$ and $E > G$.

What is the value of $C + H + A + L + L + E + N + G + E$?

Planet	Distance from Sun (AU)	Mass (Earth masses)	Year
Mercury	0.4	0.055	88
Venus	0.7	0.815	225
Earth	1.0	1.000	365
Mars	1.5	0.339	687
Jupiter	5.2	318	11.9
Saturn	9.5	95	29.5
Uranus	19.2	46	84
Neptune	30.1	17	165
Dwarf planet: Pluto	39	0.046	248

Design based on the winning poster by Dunblane High School

Logic Problems Answers

The answers to the logic problems featured on the first page are:

- SMC 1988, Q15 : ADBCCE (D)
- JMC 2015, Q17: 2 (B)
- IMC 2010, Q11: 1 (B)
- SMC 2001, Q24: More than one of the three Knaves ate some tarts (E)
- JMC 1998, Q17: A (A)

Note that in both the 2015 and 2010 problems it is not possible to deduce which statements are true, but it is possible to deduce the *number* of true statements.

Publications Snippets

<p>PDF PAST PAPERS to download</p> <p>Junior Mathematical Challenge</p> <p>Collection of 5 Past Papers And Solutions</p> <p>2007 - 2011</p>	<p>In response to requests from teachers, students and parents, we now sell booklets of past Challenge papers that are instantly downloadable. See http://shop.ukmt.org.uk/ for more details.</p> <p>See the rest of our publications, which include Challenge preparation materials, in-depth classroom teaching material, and books focusing on particular mathematical topics of interest, at http://www.ukmt.org.uk/publications/.</p>	<p>PDF PAST PAPERS to download</p> <p>Intermediate Mathematical Olympiad and Kangaroo (IMOK)</p> <p>MACLAURIN OLYMPIAD</p> <p>Collection of 3 Past Papers And Solutions</p> <p>2008 - 2010</p>
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Thank you to our supporters

As a registered charity, the UK Mathematics Trust relies on a balance of financial resources including fees from its mathematics competitions along with the support of individuals, trusts and companies to help achieve our aims.

To facilitate one-off and monthly donations we have a UKMT site at virginmoneygiving.com, and we are registered for gift aid. Regular donors receive a lapel pin to show their support and can opt in to receive additional news from us via email. See the UKMT's page at www.donate.ukmt.org.uk.

We are very grateful for the support from our major sponsors, OxFORD Asset Management, and the Institute and Faculty of Actuaries. Read more about their work below, and let your students have a go at this edition's competition, courtesy of OxFORD Asset Management.

Institute and Faculty of Actuaries



Institute
and Faculty
of Actuaries

The **Certified Actuarial Analyst** (CAA) is an exciting new qualification from the Institute and Faculty of Actuaries (IFoA). Launched in 2014, the CAA provides an internationally recognised professional qualification, proven technical and professional skills, and a gateway to a career in financial services. The qualification takes two to three years to complete and you can study and sit exams around the world.

On passing all the exams and qualifying as a Certified Actuarial Analyst, you will have the necessary mathematical skills and understanding to enable you to provide professional support in actuarial teams or in wider financial and analytical work where the technical application of actuarial science is required. However, the qualification will also develop wider skills in line with this technical expertise, such as communication and professionalism, and the general nature of the qualification means that the door will be open to a wide variety of career paths, such as management, technical analyst, data processing, or perhaps even moving to a different area of business such as marketing or working in an advisory role.

The Certified Actuarial Analyst qualification is suitable for a school leaver (someone who is interested in starting their career and learning on the job without having to undertake a degree) or a degree level candidate (someone who has left university and is interested in actuarial work).

The qualification provides membership of a prestigious professional body and the associated benefits of being part of the global IFoA community, including support from the IFoA throughout your career.

For more information, please contact caa@actuaries.org.uk.

Prize Question from OxFORD Asset Management

OxFORD
ASSET MANAGEMENT

OxFORD Asset Management is proud to be a sponsor of the UK Mathematics Trust. We are a research and investment firm in the heart of Oxford, employing over 80 people. Our team members have degrees in mathematics, computer science, physics, or econometrics from the world's leading universities. Our colleagues include a number of Olympiad competitors and winners. Through our research and software groups, we develop algorithms and quantitative methods and models, using computers to find and exploit relationships and anomalies in financial markets.

We invite readers to consider the prize question set out below. The most elegant (and correct) answer will be awarded a prize – a book token, together with a copy of *Mathematical Thought from Ancient to Modern Times*, by Morris Kline, signed by one of the world's leading mathematicians. Second- and third-place finishers will also receive a prize.

Prize Question:

This year, OxFORD Asset Management celebrates its 11th anniversary. In honour of our anniversary, we baked a gigantic rectangular purple cake in our new offices in central Oxford. The top of the cake has dimensions of: 2015 cm by 11 cm. The cake does not, however, fit well in our refectory, so we have decided to convert the cake to a square. How, with the smallest number of cuts, can the cake be cut into pieces which can be re-assembled into a square? Rearranging pieces of cake so that a cut dissects more than one fragment is allowed; stacking pieces on top of each other, however, is not.

Entries are open to mathematicians young and old, so please pass this problem to your students and encourage them to participate too. Please email your response by 10th July 2015 to: cake@oxam.com