United Kingdom Mathematics Trust

Maths Challenges News

Issue 41 February 2013

In this issue

UKMT Teacher Meetings

Teachers told us their views about last year's UKMT Teacher Meetings:
'***Fantastic resources and excellent class ideas***!' (Cambridge)
'***Better than excellent!'*** (Bristol)
'***Creative support for classroom practices'*** (Manchester)

Don't miss out on this year's events being held at:
York: Friday 21st June
Cardiff: Tuesday 25th June
Greenwich: Wednesday 26th June
Warwick: Tuesday 2nd July
Cambridge: Wednesday 3rd July
Dates at Glasgow, Southampton and Liverpool will be confirmed shortly.

The meetings aim to contribute to the continuing professional development of mathematics teachers and provide materials to use in the classroom.

Each meeting will include a speaker from NRICH on using materials from their website, a teacher showing how UKMT materials can be used and developed across the age and ability range, and an inspirational mathematical speaker.

Further information will be sent to schools later this term, and look out for updates on our website at www.ukmt.org.uk. We look forward to seeing you at these events!

Primary Team Maths Resources

Did you know the UKMT provide free resources to enable secondary schools to organise and host local team maths events for their feeder schools? Schools may also choose to use the materials in other ways, such as for an end of term activity for their Year 7 pupils.

The Primary Team Maths Resources (PTMR) includes more materials than would be needed for any one competition allowing schools to choose the most appropriate activities for them. Some of the rounds will be familiar to those participating in the UKMT team events (for instance the Group Round, Crossnumber and Relay) but there are also additional rounds (Logic, Speed Test, Make a Number and Investigations).

The 2013 PTMR has just been launched. To obtain a set of these materials, contact us by email only to enquiry@ukmt.org.uk. Sample materials can also be found at www.tmc.ukmt.org.uk.

PTMR Group Round 2012
In a training session, Sally takes three strides to cover 10m while Harry takes four strides to cover 12m. How far apart are Sally and Harry after they have both taken 300 strides?

PTMR Speed Test 2012
I leave Peterborough at 10:37, 8 minutes late, and arrive at King's Cross 3 minutes early at 11:43. What would the journey time have been if the train had left and arrived on time?

UKMT Contact Details

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Diary Dates for 2013

Maths Challenges and Follow-on Rounds 2013

Challenge	*Date*	*Follow-on Round*	*Date*
Intermediate	**Thursday 7 February 2013**	**IMOK Olympiad** **IMOK Kangaroo**	**Thursday 14 March 2013** **Thursday 21 March 2013**
Junior	**Thursday 25 April 2013**	**JMO**	**Tuesday 11 June 2013**
Senior	**Thursday 7 November 2013**	**BMO1 and Senior Kangaroo** **BMO2**	**TBC** **TBC**

The Mathematics of Waiting

A martingale is a fair game of chance, where knowledge of past events does not help you to predict the future. The fact that no punter can expect to beat (or lose to) the house at a fair game can be used to effect calculations of expected waiting times.

Consider a fair coin being tossed repeatedly. Suppose we choose to wait until the toss results form a particular consecutive sequence, say HTHTHT. How long do we expect to wait? At first sight, you might think that because each sequence of six tosses is equally likely to occur when you toss a coin six times, then the expected waiting times should be the same for all such sequences. However, this is wrong. In fact the expected waiting time until you see HTHTHT is 84 tosses. On the other hand, the expected waiting to see HHHHHH or TTTTTT is 126, and these are the strings which one must wait the longest to see. On the other hand, a string of length six for which the expected waiting time is minimal is HHHHHT, and one expects to wait 64 tosses to see that.

You can make these calculations by means of martingales. Every minute, on the minute, a new punter walks into the UKMT casino. Customers can opt to place a bet on the result of a coin toss. If they are correct, they get their stake back, and the value of their stake again. If they are wrong, they lose their stake. At any time, after a bet, UKMT can pay out winnings, close the casino for the day, turf everyone out, and go to the beach. This is all clearly a fair game, and a martingale.

To work out the expected time until getting two consecutive heads, punters adopt the strategy of always betting on heads, betting an initial stake of £1, and doubling up if they win, and going to the beach as soon as they lose. UKMT, on the other hand, elects to close the casino when there are two consecutive heads.

Thus all punters bring a pound to the table, and on any day, the only winners will be the punters in the casino when it closes. If n people play, then the punters have spent £n on playing. When the casino closes, the penultimate competitor has just won two games, gaining £4 (ignoring the participation fee) and the final player has gained £2 (ignoring the participation fee). The game is fair, so the expected number of punters through the door on any day is $4 + 2 = 6$, so this is the expected waiting time for HH.

To work out the expected wait for HT, everything is the same except that each punter starts with a first bet on H, and then doubles up, always betting on T in the future. UKMT decides to close the casino when there is a H followed by a T. The penultimate punter is £4 up, but the final punter entering the casino bet H when a T came up, so is cleaned out. Therefore the expected waiting time to see HT is 4. These results may seem implausible, but you can always get some school pupils to perform some experiments for you!

Now look at the expected waiting times to reach any given sequence of 3 results: HHH, $8 + 4 + 2 = 14$ (similarly TTT); HHT, $8 + 0 + 0 = 8$ (similarly TTH); THH, $8+0+0 = 8$ (similarly THH); and HTH, $8+0+2 = 10$ (similarly THT).

Why does all this happen? Suppose that you have ten buses an hour passing your house, but you do not know the timetable. If the buses are well spread out in time, you will not expect to wait long for one. On the other hand, if they travel in convoy, you expect to wait. Strings which self-overlap are like convoys.

How long do you expect to wait until a monkey types this article?

Geoff Smith, University of Bath. *I wish to thank David Williams FRS for introducing me to martingales.*

Social Media

Receive regular updates from UKMT by following us on Twitter @UKMathsTrust, or liking us on Facebook at http://www.facebook.com/UKMathsTrust.

European Kangaroo

Every year on the third Thursday in March a huge number of students (this year over six million) from all over the world take part in an international mathematical competition called the Mathematical Kangaroo. Students of all ages (from 7 to 18) take part, in six different age categories, solving around 30 multiple-choice questions. The Kangaroo aims to attract as many students as possible, with the purpose of showing them that mathematics can be interesting, useful and fun.

Why is it named the "Kangaroo"?

Towards the end of the last century, many countries considered the idea of using mathematical competitions to popularise mathematics among a wide circle of students. In 1991, Andre Deledicq and Jean Pierre Boudine were inspired by the Australian mathematical competition to start a similar contest in France, which they named the Mathematical Kangaroo. The contest, consisting of mostly easy and attractive multiple-choice problems, was a great success. As a result, in 1993 a meeting was organised in Paris, at which it was proposed to several European countries that they should jointly organise a European Kangaroo contest. The idea was well received and in June 1994, at the European Council in Strasbourg, representatives from 10 European countries established the Association Kangourou Sans Frontieres (AKSF). This association, which is responsible for organising the Kangaroo contest, was officially established and registered on 17 January 1995 in Paris, with Andre Deledicq as its first president.

Photo from AKSF2012 meeting in Cyprus

Present and future

Every year since 1993, in October or November, representatives from all member countries gather at an annual meeting, at which the problems for the next year are chosen. After the meeting, representatives from each country translate the problems into their own language, adapt the questions (for example, changing the name John to Johann) and then use the selected problems in their own countries. The results of the students from different countries are not compared to each other; this would be against the spirit of the Kangaroo, which is intended to be an individual contest, not the basis for international comparisons. So the problems and rules of the contest are international but the contest in each country is organised independently and each country has its own winners.

In the UK, the UKMT uses the Kangaroo papers as follow-on competitions. The Grey and Pink Kangaroo papers form part of the suite of follow-on rounds for the Intermediate Mathematical Challenge. The Senior Kangaroo is a new follow-on round for the Senior Mathematical Challenge which incorporates Kangaroo questions.

At the moment the AKSF has 57 member countries and this year at the annual meeting in Cyprus six new members joined (Chile, Ghana, Ireland, Malaysia, Panama and Peru).

Even though the contest is organised in such a decentralised way, there are many new challenges ahead for the AKSF, especially with more and more new countries wanting to join. One issue is the security of the problems, an issue which is made more difficult because participating countries come from many different continents with many different time zones but one which is growing in urgency as students become more proficient with modern communications technology.

AKSF Meeting 2013

The UKMT is hosting the 2013 AKSF meeting in late October in Edinburgh where we will welcome more than 150 representatives from over 50 countries worldwide to come together and set the problems for the 2014 Kangaroo papers.

Kangaroo Grey 2006

Granny told her grandchildren: "If I bake 2 pies for each of you, I'll have enough pastry left for 3 more pies. But I won't be able to bake 3 pies for each of you, as I'll have no pastry left for the last 2 pies." How many grandchildren does Granny have?

A 2 B 3 C 4 D 5 E 6

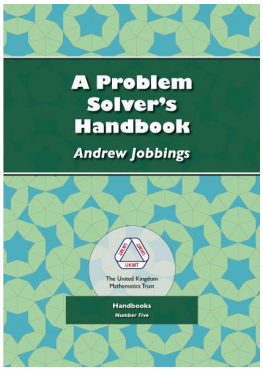
Kangaroo Pink 2008

The Seven Dwarfs were born on the same day, in seven consecutive years. The ages of the youngest three add up to 42 years. What do the ages of the oldest three add up to?

A 48 B 51 C 54 D 60 E 70

A Problem Solver's Handbook

Our newest publication, *A Problem Solver's Handbook* by Dr Andrew Jobbings, will be available to purchase from late February 2013.



Celebrating ten years of the IMOK Olympiad competitions, this book is an informal guide to Intermediate Olympiads, not only for potential candidates for the forthcoming Cayley, Hamilton and Maclaurin IMOK Olympiads (taking place on Thursday 14 March 2013), but for anyone wishing to tackle more challenging problems. The discussions of sample questions aim to show how to attack a problem which may be quite unlike anything seen before.

The author has been Chair of the IMOK Olympiad Problems Group since it began in 2003, and is Lead Author and Designer at *Arbelos* (www.arbelos.co.uk).

A Problem Solver's Handbook can be ordered from www.publications.ukmt.org.uk.

Junior Maths Challenge

Have you entered the Junior Maths Challenge (JMC)? Taking place on Thursday 25 April 2013, the JMC gives your pupils the opportunity to compete against over 280,000 other pupils in the UK and challenges your pupils by testing their problem solving skills. The JMC is straightforward to administer in school. Papers are sent back to UKMT for marking , and results are emailed and then posted along with detailed analysis of your school's performance. Certificates are awarded to the top 40% of pupils nationwide, and every school receives certificates to award to their top scoring pupil in the school and in Year 7 and Year 8 (or equivalent).

The JMC is sat in school under normal exam conditions. It is a multiple-choice paper with 25 questions to be taken in one hour and is aimed at students in Year 8 or below in England and Wales, S2 or below in Scotland, and Year 9 or below in Northern Ireland.

The questions are designed to make you think. Try Q17 from the 2012 JMC:

There are six more girls than boys in Miss Spelling's class of 24 pupils. What is the ratio of girls to boys in this class?

A 5:3 B 4:1 C 3:1 D 1:4 E 3:5

Annual Student Poster Competition

Challenge your students to design an eye-catching poster for display in schools advertising the UKMT Maths Challenges. Last year's winning poster is pictured.

The poster must include:

- the words "UKMT Maths Challenges 2013 - 14"
- the dates: Senior Challenge - Thursday 7th November 2013
  Intermediate Challenge - Thursday 6th February 2014
  Junior Challenge - Thursday 1st May 2014

You should aim for an original concept rather than an update of previous winners.

A poster will be produced based on the winning design and distributed to all schools with the September Newsletter.

Entries should be on A2 paper in portrait orientation, not landscape, and can be folded when sent. It does not need to include our logo, or that of our sponsor; but these logos will be added to the distributed poster. We regret we are unable to accept electronic entries and we cannot return posters.

Sudoku Winners - September Newsletter

Chloe Legg, Cirencester Kingshill School
G Thrussell, The Costello School, Hampshire

who each win a £10 book token.

Entrants should write their name, age and school on the back of the poster, but posters should not be identifiable from the front. The judges' decision will be final.

Traditionally posters have been based on challenge questions, although there is no requirement to do so. These questions can be found on our website at **www.ukmt.org.uk.**

As well as seeing their design in print, the winner will also receive a book with a mathematical theme for themselves, and their school will gain a free copy of *Ten Years of Maths Challenges.*

Please send entries by the closing date of Friday 19 April 2013 to:
Poster competition, UKMT, School of Maths Satellite, University of Leeds, Leeds LS2 9JT

NAME……AGE……

SCHOOL……

ADDRESS……

……POSTCODE……..