SMS-Royal Institution Masterclasses
2009 December Programme

	Group A	Group B
Day 1 (December 1)		
0900-1200	***Chases & escapes*** Professor Alan Davies	***Mathematical problem solving*** Assoc Prof Tay Eng Guan
1200-1300	Lunch time (lunch not provided)	
1300-1600	***The Mathematics of Sudoku*** Assoc Prof Helmer Aslaksen	***What happens when we tile the whole numbers with arithmetic progressions*** Assoc Prof Sinai Robins
Day 2 (December 2)		
0900-1200	***Mathematical problem solving*** Assoc Prof Tay Eng Guan	***Chases & escapes*** Professor Alan Davies
1200-1300	Lunch time (lunch not provided)	
1300-1600	***What happens when we tile the whole numbers with arithmetic progressions*** Assoc Prof Sinai Robins	***The Mathematics of Sudoku*** Assoc Prof Helmer Aslaksen

About Masterclasses

The Secondary Mathematics Masterclasses was launched in January 1981 by the Royal Institution of Great Britain. It forms a network of around 60 series of classes aimed at students from 12 to 14 year olds. They are organized regionally, mainly by local groups of volunteers, based at universities or schools. A series consists of between five to ten classes, with a class running for about two and a half hours. The presenters are chosen for their ability to communicate their enthusiasm and excitement for the subject. Most groups invite students on the basis of teacher recommendation and are looking for not just an aptitude in mathematics, but also a keenness and determination to explore.

Masterclasses are designed to encourage, inspire and engage young people in the art and practice of mathematics by introducing them to aspects, including applications, which may not usually be covered in the school curriculum. Topics range from art to cryptography, from dinosaurs to mazes. Within each class, students are given the opportunity to explore the subject for themselves, either individually or in small groups, with help being on hand if needed.

Since the Royal Institution (Ri) was established over 200 years ago, the Ri has observed 14 of its resident scientists receive the Nobel Prize, and witnessed the discovery of 10 of the chemical elements. Some of the most influential and seminal scientific discoveries such as sodium, the electric generator and the atomic structure of crystals were discovered here. Our heritage is unique; famous scientists such as Humphry Davy, Michael Faraday, James Dewar and William and Lawrence Bragg all based their innovative and groundbreaking work at the Ri.

During these 200 years, the Ri has continued to communicate scientific issues to the general public through its high calibre events that break down the barriers between science and society. It acts as a unique forum for informing people about how science affects their daily lives, and prides itself on its reputation for engaging the public in scientific debate. Lectures for young people have been an important activity at the Ri since Michael Faraday initiated them in the 1820s.

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Abstracts

Chases and Escapes

We have all played games of chase and escape, they are part of growing up. However, chases and escapes occur in many other places, e.g. in nature (predator and prey), in sport (track cycling), in the movies (Indiana Jones), computer games etc.
When something chases something else the trajectory is called a pursuit curve and the mathematics of such curves was first described by the French mathematician Pierre Bouger in the early eighteenth century. The mathematical description of pursuit curves usually requires a knowledge of calculus. However, there is an alternative approach; we shall develop a graphical approach to generating pursuit curves which uses only graph paper, pencil and ruler. Our mathematical background will require a knowledge of elementary geometry and the ideas of distance, time and speed.

Speaker
Professor Alan Davies is our overseas speaker from the Royal Institution. He is currently Professor of Mathematics in the School of Physics, Astronomy and Mathematics at the University of Hertfordshire.

Mathematical Problem Solving

What is the sum of all the digits of the numbers in the sequence 1, 2, 3, …, $10^n - 1$? That's easy – it's the sum of an Arithmetic Progression. Wait a second, it can't be so simple! But do I care? It looks interesting though, maybe I shall try to solve it.

Mathematical problem solving is about emotions and intellect. It is art and science, aesthetics and utility. Never thought about mathematics this way? This talk will introduce the art and science of mathematical problem solving using Polya's model and the analysis of the process within Schoenfeld's framework.

Speaker
Associcate Professor Tay Eng Guan is an associate professor at the National Institute of Education, Nanyang Technological University.

What happens when we tile the whole numbers with arithmetic progressions?

An arithmetic progression is a sequence of whole numbers of the form An+B, n=0,1,2,...
whose common difference is called A, where A and B are constants. For example, the even integers are an arithmetic progression of the form 2n + 0, and the odd numbers are an arithmetic progression of the form 2n+1. There is a strange phenomenon that occurs when we TILE all of the integers with as many arithmetic progressions as we like, but a finite number of them. We'll construct some tilings by hand, to experiment with this phenomenon and discover it as we play with examples of it.

Speaker
Associate Professor Sinai Robins is an associate professor at the School of Physical & Mathematical Sciences, College of Science, Nanyang Technological University.

The Mathematics of Sudoku

Sudoku is a logic puzzle where you are given a 9×9 grid made up of nine 3×3 blocks. The goal is to place the numbers 1 through 9 into the cells in such a way that each row, column and box contains each number exactly once. Some of the cells are given, and this is done in such a way that there is a unique way to fill in the remaining cells. The puzzles can be of varying levels of difficulty. They can be easy enough to appeal to anybody, while a mathematician will immediately be fascinated by the more fiendish puzzles and start thinking about algorithms. I will describe some of the techniques for solving this puzzle and we will solve some puzzles together.

Speaker
Associate Professor Helmer Aslaksen is an associate professor at the Departtment of Mathematics, National University of Singapore.