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Recreational Mathematics The Fields Medals for beginners

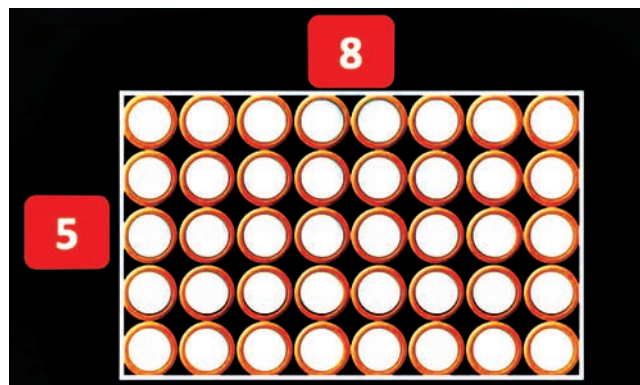
Problems inspired by maths' biggest prize

At the beginning of July, the Fields Medals were announced. The award, which every four years goes to up to four mathematicians under 40, is a recognition both of outstanding work and future promise. The announcement of the prize inspired Alex Bellos to find puzzles for each area of the winners of the Fields Medal 2022. The first three were published in his weekly puzzle section in *The Guardian* 'Can you solve it?' and are reprinted here with permission. The fourth one has been added by the editors of this journal.

Maryna Viazovska, aged 37, from Ukraine, won a medal for her groundbreaking work on how to pack spheres in 24 dimensions. In her honour, the first puzzle is about how to pack beers in three dimensions.

Puzzle 1: A crate problem

Is it possible to put more than 40 cans of beer of diameter 1 unit and height 2.6 units in a crate that has dimensions $5 \times 8 \times 2.6$? Here's 40 in the crate. But can you fit any more in?



Devised by Trần Phương, a legendary maths educator from Vietnam

James Maynard, aged 35, from the UK, won a medal for his many prime results about prime numbers. As a tribute to his success, here is a puzzle about the number 13, a prime number.

Puzzle 2: Chairs, mate

Place 13 chairs along the walls of a rectangular room such that each wall has the same number of chairs as the wall it faces.

From the journal 'Pythagoras'

June Huh, aged 39, from the US, won a medal for results linking graph theory, combinatorics, algebra and many other abstract concepts. A graph in this context means a network of discrete points connected to each other, which is one way you might think of a chessboard, which is discrete squares connected to each other.

Puzzle 3: Chess neighbours

Imagine a 9×9 chessboard (like a Sudoku grid, but with alternating black and white cells). Each square has a different person standing on it. Is it possible for all 81 people to step onto a neighbouring square, so that each square again has a different person on it?

From the journal 'Pythagoras'

Hugo Duminil-Copin, aged 36, from France, won a medal for his work on percolation theory, the analysis of fluids flowing through a porous medium, like water coursing through coffee grounds. It involves the formation of connected clusters in random networks, but can also represent the spread of a disease, the advance of a forest fire or the march of an ant colony.

Puzzle 4: Ant Alice

Twenty-five ants are placed randomly on a meter-long rod; the thirteenth ant from the west end of the rod is our friend, Ant Alice. Each ant is facing east or west with equal probability. They proceed to march forward (that is, in whatever direction they are facing) at 1 cm/sec; whenever two ants collide, they reverse directions. What is the probability that Alice is the last ant to fall off the rod?

From 'Mathematical Mind Benders' by Peter Winkler

<https://www.theguardian.com/science/series/alex-bellos-monday-puzzle>

Solutions: Puzzle 1: yes you can. Puzzle 2: put a chair in the corner. Puzzle 3: you can't. Puzzle 4: chance of 12 heads with 24 tosses of a fair coin.

