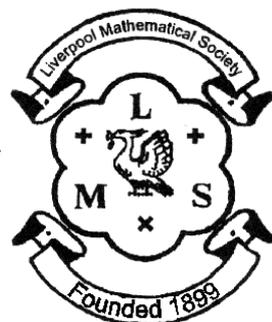# MATHEMATICAL EDUCATION ON MERSEYSIDE

Sponsored by

Challenge '17
For Year 8 or below

Illustrations by Will Ashworth and Theo Chaddock

Rules
1) Challenge '17 should be attempted at home during February half term.
2) Your entry must be your own work, though of course you may ask for help on how to get started or for the meanings of unfamiliar words.
3) Entries without any working out at all or written on this sheet **will not be marked**.
4) It is possible to win a prize even if you have not completed all of the questions, so hand in your entry even if it is not quite finished.
5) You must write **your name and school in neat writing on every page.**

Either you or your maths teacher needs to return your entry by 10th March to this address:
Challenge '17 Entries,
Chris Marchant,
Department of Mathematical Sciences,
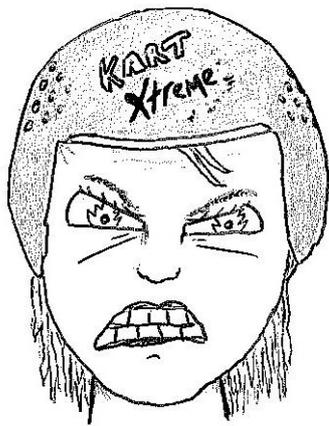University of Liverpool,
Peach Street,
Liverpool,
L69 7ZL

A Prize-Giving Evening will be held at the University of Liverpool on 10th May.
We hope that you enjoy the questions.

1. A Chain of Events

Three friends, Davina, Jolene and Katie, set out to the Thorpe Towers theme park, travelling on their three bikes. They lock up the bikes and go to enjoy their day. When they return, they find two of the bikes have disappeared. Assuming only one person can ride the remaining bike at a time, and that it is 12 miles back home, how should they proceed, to be fair to each other? The bike has a speedometer with a mileage counter.

What if only one bike had been stolen?

2. Lap It Up

Alyssa challenges Martin to a race around the go-kart track at the fairground. A race consists of 7 laps.

It turns out that Alyssa is a more gung-ho driver than Martin and she completes each lap in 45 seconds, compared with Martin's minute and a half.

If they start off alongside each other, how many times are they alongside each other in total during the race?
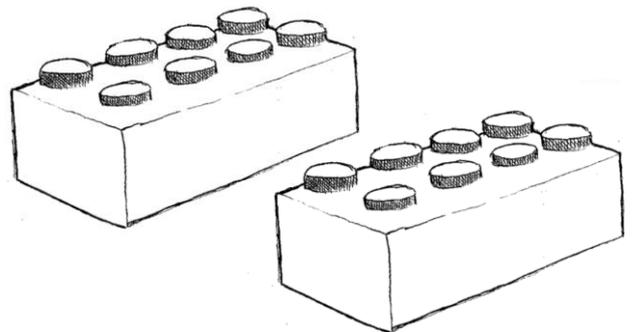
3. Connect Twenty-Four

Ken has two standard white Lego bricks, as shown. There are 24 unique ways in which Ken can connect his two Lego bricks. Show these 24 arrangements of his bricks. (Arrangements are regarded as the same if one can be rotated to give the other.)

4. St Sebastian's Shuttlecocks

Traditionally, the annual end-of-season badminton tournament at St Sebastian's High School features 32 pupils. This year, the tournament has attracted 54 entrants. Members of the school team are always automatically admitted to the tournament.

It is decided to play one qualifying round during the week before the tournament for all of the other entrants.

How many matches take place in the qualifying round? How many members does the school team have?

How many matches in total (qualifying plus tournament) will have taken place by the time a champion is crowned?
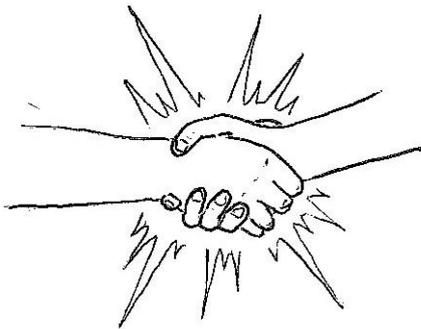
5. Shake It Up

The headteacher insists that, at the start of the St Sebastian's High School badminton tournament, each player must shake hands with every other player. 32 pupils are competing, so how many handshakes will there be?

6. Basket balls

In a sideshow game at the fair, in order to win a cuddly prize, players have to accurately throw 30 balls into five empty baskets, laid out within a 3 × 3 grid, so that the number of balls in each row, column and each of the two diagonals is the same.

Joel decides to try. The four corner baskets contain balls already, as shown opposite:

Help Joel win by working out how many balls he should throw into each of the five empty baskets.
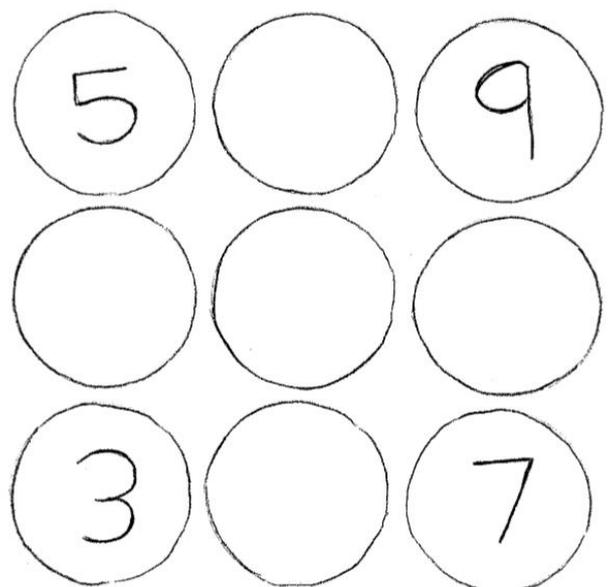
7. Game of Throws

In the game of darts, you can hit each of the numbers 1 – 20. Your score is doubled by landing in the outer ring and trebled by landing in the inner ring. You score 25 by hitting the outer bull's eye and 50 by hitting the inner bull's eye

Jo is practising ahead of a big match. She is a good player, so all of her throws successfully land on the board!

List all of the scores, between 1 and 180, which Jo cannot achieve with three darts, showing how you worked this out. (Disregard the rule about finishing with a double.)

8. Four Go to the Fair

Four university friends – Chris, Lonnie, Philippa and Robert – go for a summer's day out at the fair.

In some order, they originally hail from Chester, Liscard, Prescot and Rhyl.

They go on four different attractions: the carousel, log flume, pirate ship and rollercoaster.

However, for each attraction, one student doesn't ride it and instead takes a turn waiting with their bags.

No initial letters of name, hometown or missed ride match.

Robert doesn't want to wet his trendy hairstyle.

Chris is too tall for the rollercoaster.

Lonnie isn't Welsh.

Match each student with their missed ride and where they come from.