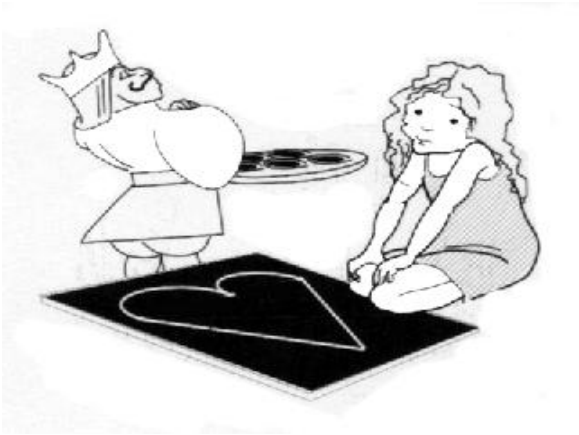


5. WHO'S BEEN AFTER THE TARTS?



The Knave of Hearts was in real trouble this time. He had been caught eating the Queen's tarts again. The Queen ordered him to make her some tarts which were to be made up of two semicircles and an equilateral triangle. However, the area of the top and the perimeter had to have the same numerical number when measured in cm^2 and cm respectively. Otherwise it would be "Off with his head!" Fortunately the Knave knew Alice was there to help him. She told him the radius of the semicircles. Can you do likewise?

BONUS

What names used can be found in Alice in Wonderland?

The competition is promoted by Liverpool Mathematical Society (LMS)

www.maths.liv.ac.uk/lms.html

The Liverpool Mathematical Society incorporates the Liverpool Branch of the Mathematical Association.
The MA is a Registered Charity (No. 313281).

(INCORPORATING THE LIVERPOOL BRANCH OF THE MA AND THE ATM)

Open Challenge '15 For Year 13 or below

Illustrations by Peter H Ackerley

Rules

- 1) It should be attempted at home during February half term.
- 2) Your entry must be your own work.
- 3) For individual entries only. You should attempt all five questions.
- 4) Entries without any working out at all or written on this sheet will not be marked.
- 5) 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.
- 6) You must write **your name, date of birth and school address in neat, legible writing on the front sheet.**
- 7) Pupils under 15 years of age should only attempt this in exceptional circumstances.

Either you or your maths teacher needs to return your entry by 6 March to this address:

Open Challenge '15 Entries,

Mrs A. Carter,
Danes Court,
Mudhouse Lane,
Burton,
Neston.
CH64 5TS.

All of the prizes and certificates will be awarded at an evening of mathematical recreation at the University of Liverpool on 29 April. Solutions will be posted on www.maths.liv.ac.uk/lms.html shortly afterwards. We hope that you enjoy the questions.

1. GAME OF QUEENS



The Red and White Queens were in one of the palace gardens laid out as a 4x4 chessboard. Where were they standing so that together they occupied or commanded all the squares on the board?

Their cousin the Blue Queen joined them and they moved to a 5x5 chessboard garden and they arranged themselves similarly. How did they do this?

Then two further cousins, the Black Queen and the Green Queen, arrived.

This time they moved to an 8x8 chessboard garden and similarly arranged themselves. How did they do this?

Finally they arranged themselves so that no queen was on a square which was under attack by any of the other queens. How did they arrange this?

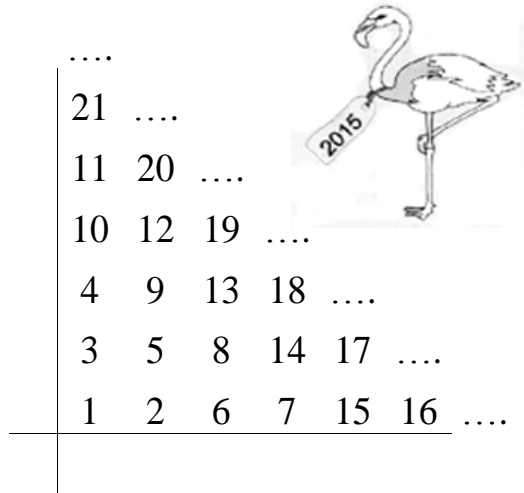
2. THE QUEEN'S CHALLENGE

The Red Queen is placing numbered flamingos into a grid.

She starts with number one and then places consecutively numbered flamingos along each diagonal as shown.

Alice notices that flamingo number 9 is in position (2,3) and number 18 is in position (4,3).

The Red Queen challenges Alice to place flamingo number 2015. Can you help her?



3. ROUND AND ROUND WE GO



The Cheshire Cat asked Alice what her favourite number was. "Twenty" she replied. He then had the cards 1 to 9 of hearts arrange themselves in a triangle so that the hearts added up to 20 on the three sides as shown.

"Now" said the Cat "can you rearrange them so that they add up to 20 again?"

"Easy" said Alice. But how could she do this and how many **different** arrangements could she have found not counting rotations or reflections. The Mad Hatter said he could find other totals for the sides. How many other totals and arrangements can you find?

4. THE QUEENS' ROSARY

In the palace grounds there are many gardens. One of them was rectangular in shape. The Red and White Queens ordered Alice to make it into a rosary (a rose garden) with half of the area to be red roses in one large rectangular bed at the centre of the garden and the other half to be a border of white roses enclosing the red roses. All Alice had to mark out the garden is a long white tape with no markings on it and some tent pegs given to her by the White Rabbit. How did Alice accomplish this?

