5. DIVE IN

Unfortunately while the judges were adding up the marks for the Women's Diving Contest final the computer broke down. The five women had to wait for 20 minutes before the results were announced. While they were waiting, each woman made two statements about how they thought the contest had gone:

Aroha said: Bianca was first; Diane was last
Bianca said: I was second; Aroha was third
Cong said: I was third; Diane was fourth
Diane said: Bianca was third; Aroha was fourth
Ekaterina said: I was first; Cong was last

The results were finally announced, and two facts were discovered. First, there were no ties, and second, to everyone's surprise it turned out that each woman had made one **true** statement and one **false** statement (not necessarily in that order).
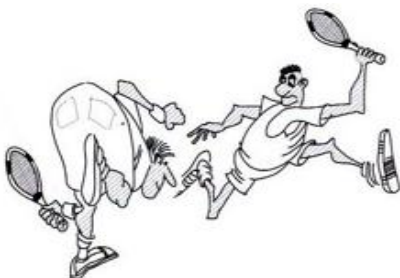(a) One woman made statements that prove that Bianca was not third. Who was she?
(b) Who was fourth?
(c) Who was last?
(d) Write down, in order from first to last, the placing of the five women.
Give brief reasons for your answers to parts (a), (b) and (c).

6. AND FINALLY

At the end of the gruelling five-set tennis final between Sinha and Menem (in which tie-breaks were to be used to decide the first four sets if the score reached six all), both players had won 33 games. In the first set, which Sinha had won, half as many games were played as in the second set. There were also half as many games played in the fourth set as the fifth. Who won the match, and what were the scores in each set?

LIVERPOOL MATHEMATICAL SOCIETY

Open Challenge '12

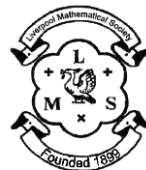## For Year 13 or below

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 you should attempt any four questions. For team entries (two or more students) you should attempt all six 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(s), date(s) of birth and school in neat 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 2 March to this address:

Open Challenge '12 Entries,
Chris Marchant,
Department of Mathematical Sciences,
University of Liverpool,
Peach Street,
Liverpool.
L69 7ZL.

All of the prizes and certificates will be awarded at an evening of mathematical recreation at the University of Liverpool on 25 April. Solutions will be posted on www.maths.liv.ac.uk/lms.html shortly afterwards. We hope that you enjoy the questions.

1. WAVE THE FLAG

During 2010, a National newspaper held a competition to design a new flag for the opening of the London Olympics.
Beth entered the competition.
Her flag featured a gold cross with a blue background. She also placed a circle into her design. The top and bottom of the circle just touch the vertices of the top and bottom triangles, as shown.

(a) Beth designed her flag to be 240 cm long and 150 cm high.
If the edges of the cross are 40 cm and 30 cm away from each of the corners, as shown in the figure, what is the radius of the centre circle?
(b) Beth decided to remove the circle from her design. With the circle removed, what is the total area of the cross?
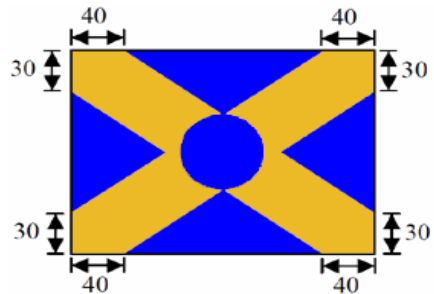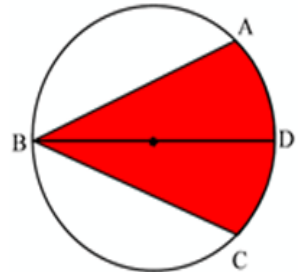
2. HAMMER IT OUT

When the hammer throwing area is being prepared, the groundsman is told to use two different varieties of grass seed to cover the circular area shown.
He is given this diagram in which A and C are two points on a circle, symmetrically placed about the diameter BD.
The throwing area ABCD is 37.5% of the total area.
What is the size of the angle ABC?
To his dismay the groundsman discovered that the angle was not the official international designated size. What was the percentage error?

3. GETTING THERE

A hotel company was offering a package deal for visitors to the Olympics. They had three hotels, The Royal (R), The Sovereign (S) and The Tower (T) near the venues for the archery (A), badminton (B), cycling (C) and equestrian (E) events, all of the same quality. Guests could book with the company, who would provide accommodation and a chauffeur-driven car to the event of their choice for each booking. Each hotel only had a certain number of cars to drive people to events; the numbers available were R: 9, S: 6, T: 10. The company received 25 bookings, for the following events A: 8, B: 5, C: 7, E: 5.

The first table shows one of the many possible ways in which the hotel company could allocate the bookings to the hotels. The next table shows the distances from the hotels to the four venues. As the hotels were of equal quality, the company divided the bookings among the hotels so as to minimise the distance that their cars had to travel. How were they eventually allocated?
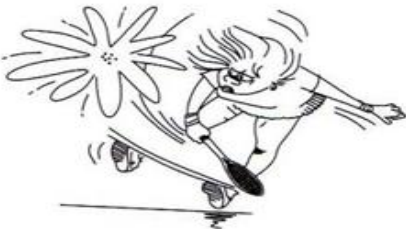
Possible hotel allocation

	A	B	C	E
R	3	1	5	
S			2	4
T	5	4		1

Distances

	A	B	C	E
R	3	2	5	1
S	2	1	3	4
T	5	6	4	8

4. ANYONE FOR TENNIS?

In the tennis quarter final match Paris was playing against Sonya, their winning probabilities for each point being 2/3 and 1/3 respectively. What are their chances of winning a game?