6. THE CHOCOLATE PILE

At a special birthday party the Oompa-Loompa parents hide a large number of chocolates for their three children to find. They are ably assisted by their pet squirrel, Red, who helps in the search. At the end of the day they have collected a huge pile which they agree to share equally in the morning.

During the night the eldest child awakes and decides to take his share first. He divides the pile into three but there is one left over which he gives to Red. He hides his share and goes back to bed. The second child then wakes up and decides that she will take her share of the chocolates. She divides the remaining chocolates into three, and she also has one chocolate left over which she gives to Red. She hides her share and goes back to bed. Later the youngest child wakes up and decides to take his share. He divides the remaining chocolates into three and again one is left over which he gives to Red. He hides his share and goes back to bed.

In the morning, the three children share out the remaining chocolates, and find one left over, which they give to Red.

What is the minimum number of chocolates they could have collected for this to be possible and how many would each child have?

BONUS

What names and confectionery used in these questions can be found in the book "Charlie and the Chocolate Factory" and/or the films?

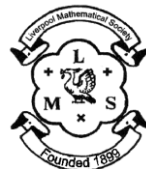The competition is promoted by Liverpool Mathematical Society (LMS)
www.maths.liv.ac.uk/lms.html
The Liverpool Mathematical Society incorporates the Liverpool Branch of the Mathematical Association.
The MA is a Registered Charity (No. 313281).

LIVERPOOL MATHEMATICAL SOCIETY

Open Challenge '13

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, 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 2 March to this address:
Open Challenge '13 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 24 April. Solutions will be posted on www.maths.liv.ac.uk/lms.html shortly afterwards. We hope that you enjoy the questions.

1. WHO'S WHO

Eight Oompa-Loompa children at a party ate 32 Cavity-Filling Caramels between them. Ann ate one, Betty two, Claire three and Doris four.
Frank Smith ate as many as his sister, Mark Brown ate twice as many as his sister, Glyn Jones three times as many as his sister and Harry Robinson four times as many as his sister.
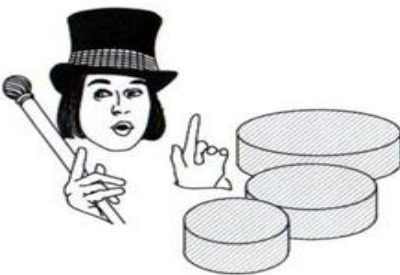Who's whose sister?

2. TAKE YOUR PICK

A box of Wonka chocolates contains milk, white and plain varieties. The number of plain chocolates is at least half the number of white and at most one third the number of milk. Given that the total number of plain and white chocolates exceeds 55, find the minimum number of milk chocolates in the box.

3. A PIECE OF CAKE

Willy Wonka prepared a test for Charlie's four rivals. He had three cylindrical chocolate cakes made for Veruca, Mike, Violet and Augustus. Each cake was 100mm in height and their diameters were 250mm, 200mm and 150mm. He told them that they had to be shared equally so that Veruca, Mike and Violet each had just one piece and Augustus was to have two pieces.
How could they do this?

4. SPECIAL CANDY-COATED PENCILS

A special one off pack of Candy-Coated Pencils consisted of a large cylinder, radius A, which contained three identical smaller cylinders, radius a, which just fitted into the larger cylinder. What is the radius of the smaller cylinders compared to the larger one? The central section trapped between the three smaller cylinders is to be made of solid chocolate. If all the cylinders are of height h what is the volume of the solid chocolate?
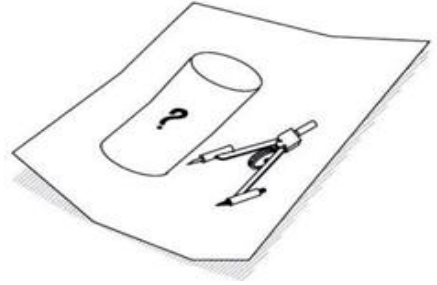
5. THE WONKA BAR
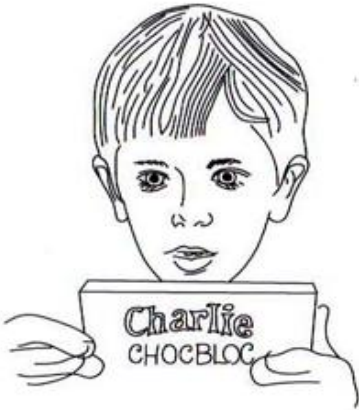
One day, during hot weather, Charlie thought his family would like a treat and decided to share the special Wonka bar they had been saving. This bar was twice as wide as it was high and twice as long as it was wide.

As Charlie fetched the bar from the cupboard the clock struck an hour, and his mother remarked that it had done this when she put it in the cupboard.

However, whilst the slab had been in the cupboard, it had melted in the hot weather into a new shape. It was still cuboid and the new length was similarly twice the new width, but its height was not good.

Charlie's father remarked that a slab had been left in the cupboard in similar weather for five whole days, and the height had dwindled away to nothing. The volume had remained the same throughout, though, he said cheerily.

The family decided to divide the whole slab into an exact number of chunks, by making a number of equally spaced slices along the length and width. Each chunk would be the height of the melted slab, and have a square cross-section with its side being four times the height. How many chunks were there, and how long had the slab been in the cupboard?