# *One Hundred Factorial*

**The Maths Learning Centre's Puzzle and Games Gathering**
www.adelaide.edu.au/mathslearning/play
#100factorial

## Lousy Labelling

Three boxes filled with lots of balls are on the table. One box is full of red balls, one is full of blue balls, and one is filled with both red and blue.

Three labels are made for the boxes, but they are stuck to the wrong ones so that no box ends up with the right label.

You can't see what colour the balls in each box are unless you pull some balls out to look.

**How many balls do you need to pull out of the boxes to know which box is which?**

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## Seven Sticks

I have seven sticks, all different lengths, all a whole number of centimetres long. I can tell the longest one is less than 30 cm long, because it's shorter than a piece of paper, but other than that I have no way of measuring them.

Whenever I pick three sticks from the pile, I find that I can't ever make a triangle with them.

**How long is the shortest stick?**

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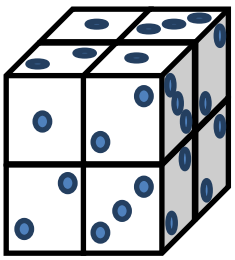
## Combo Cube

Eight cubes are marked with one dot on two opposite faces, two dots on two opposite faces and three dots on two opposite faces.

The eight cubes are glued together to form a bigger cube.



The dots on each face of the large cube are counted, to get six totals.

**Can the cubes be arranged so that the six totals are consecutive numbers?**

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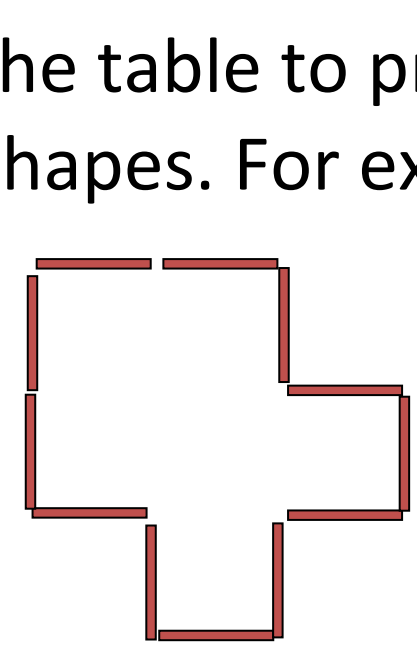
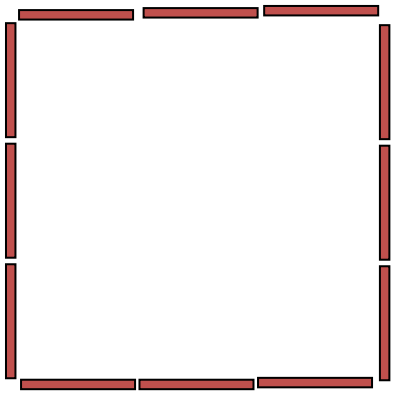
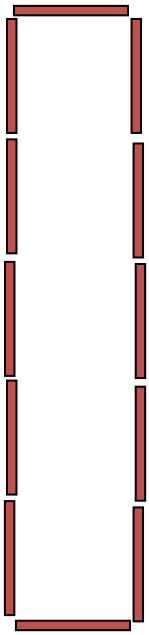
## Twelve matchsticks

Twelve matchsticks can be laid on the table to produce a variety of shapes. For example:







Some shapes have the same area and some have a different area. For example, the shapes above have areas of 6, 9 and 5.

**Arrange 12 matchsticks to make a shape with area 4.**

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## Numbers of Letters

The numbers seven, eleven, fifteen, nineteen make a sequence where the numbers go up by 4 each time. But if you count the number of letters in each word, you get a sequence of numbers that goes up by 1 each time – 5, 6, 7 8.

The list above has 4 numbers in it.
**Find a list with 6 numbers in it.**
**That is, you need 6 numbers that go up by the same amount each time, but the number of letters is an arithmetic sequence too.**

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## One Hundred Factorial

The number 100! (pronounced aloud as "one hundred factorial") is the number produced when all the numbers from 1 to 100 are multiplied together.

That is, $100! = 1 \times 2 \times 3 \times \ldots \times 99 \times 100$.

**When this number is calculated and written out in full, how many zeroes are on the end?**

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## Red and Black

An ordinary pack of 52 cards is arranged so that the black and red cards alternate. You cut the deck and do a single riffle shuffle (as shown to the right).

Before you began shuffling you noticed that the cards on the bottom of the two piles were different colours. When you've finished the shuffle, you begin laying out pairs of cards from the top of the pile.

**What's the probability that every pair of cards that you lay out has both a red and a black card?**

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## Only ones

Using any or all of the operations of addition, subtraction, multiplication, division and exponentiation (and brackets), and as many of the number 1 as you need, produce each of the numbers from 2 to 20. For example, here is one way to make the number 17:

$$(1+1+1)^{(1+1)} \times (1+1) - 1 = 17$$

**What is the smallest number of 1's needed to make each number from 2 to 20?**

(Note you can't concatenate the 1's to make numbers like 11 – each 1 must stand alone as its own number.)