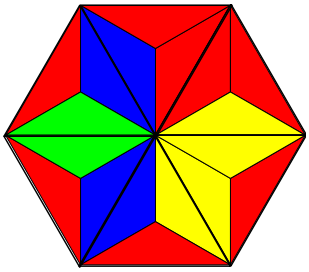
Puzzles based on the 24 Four-Colour Triangles

This month's puzzles are all based on a common theme – the 24 triangles which can be formed by different patterns of shading using four colours. You will need to print and cut out the set of 24 triangles which you will find below

All the puzzles based on these triangles use the same two basic rules:

- Triangles must be fitted together so that only sides of the same colour touch.
- All the sides around the edge of a shape must be the same colour.



For example, on the right is a small hexagon made from just six of the triangles, fitted together so that the two rules above are followed.

Shapes Puzzle

Form the 24 triangles into a hexagon with 2 triangles on each edge, following the 2 rules above.

Extension:
Form the 24 triangles into 4 small hexagons, each made from 6 triangles, following the two rules above. Explain the logic you use to solve this. (you will find it easier to solve if you apply some logic rather than just trying things at random!)

Numbers Puzzle

If 5 colours were used to shade the triangles instead of 4, how many possible triangles would there be?

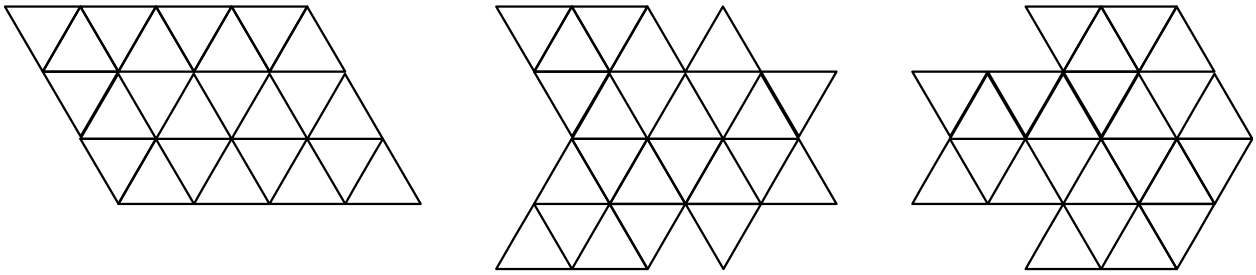
[Note that when 3 colours are used in a triangle (eg Red, Green and Blue), there are two possible triangles because going round clockwise the colours could be arranged RGB or RBG. But with two colours (eg Red and Green) there is only one triangle because RRG and RGR are the same if you rotate the triangle.]

Algebra

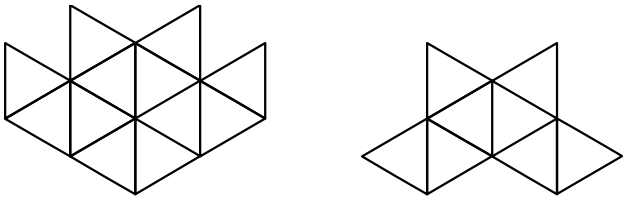
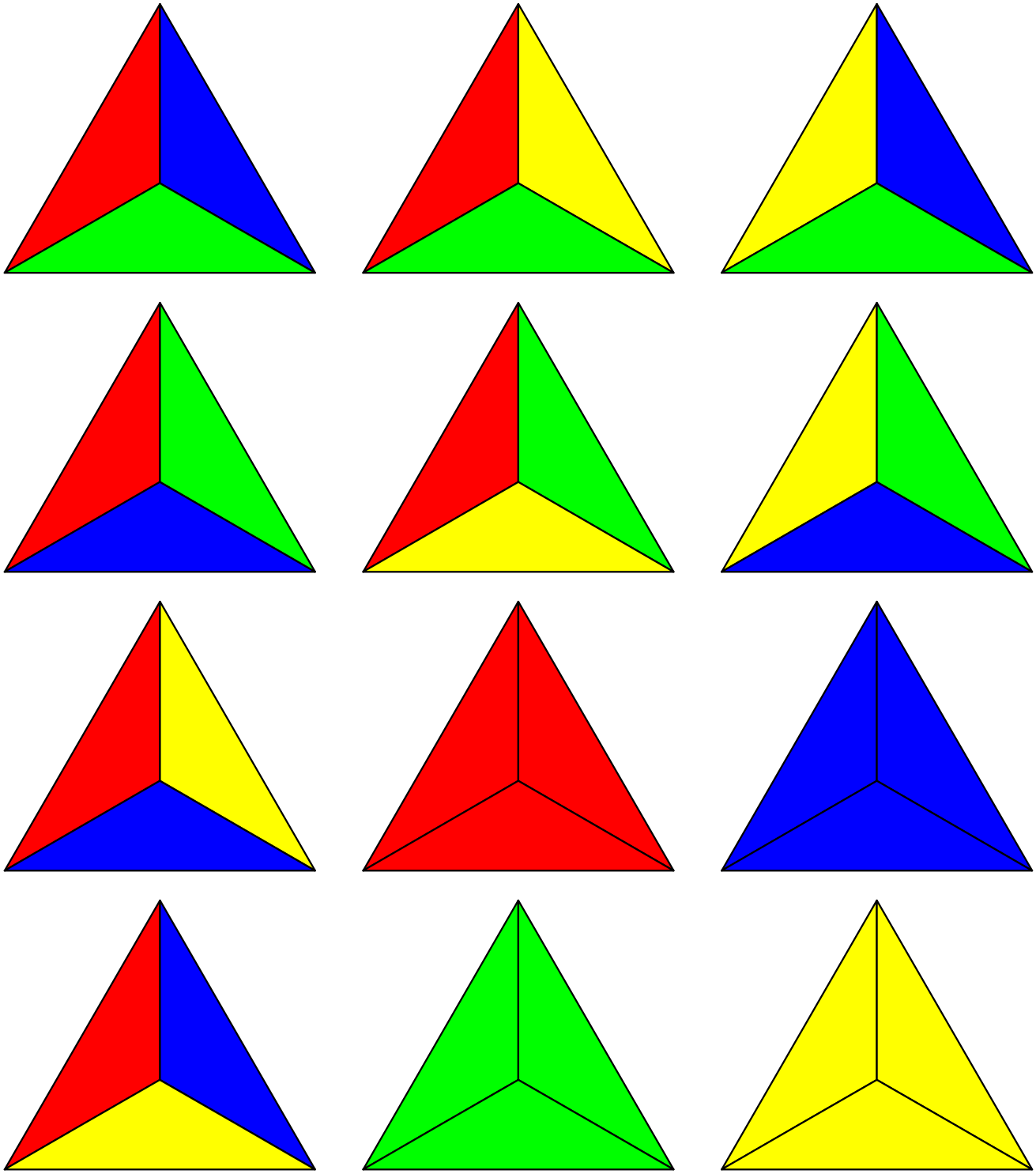
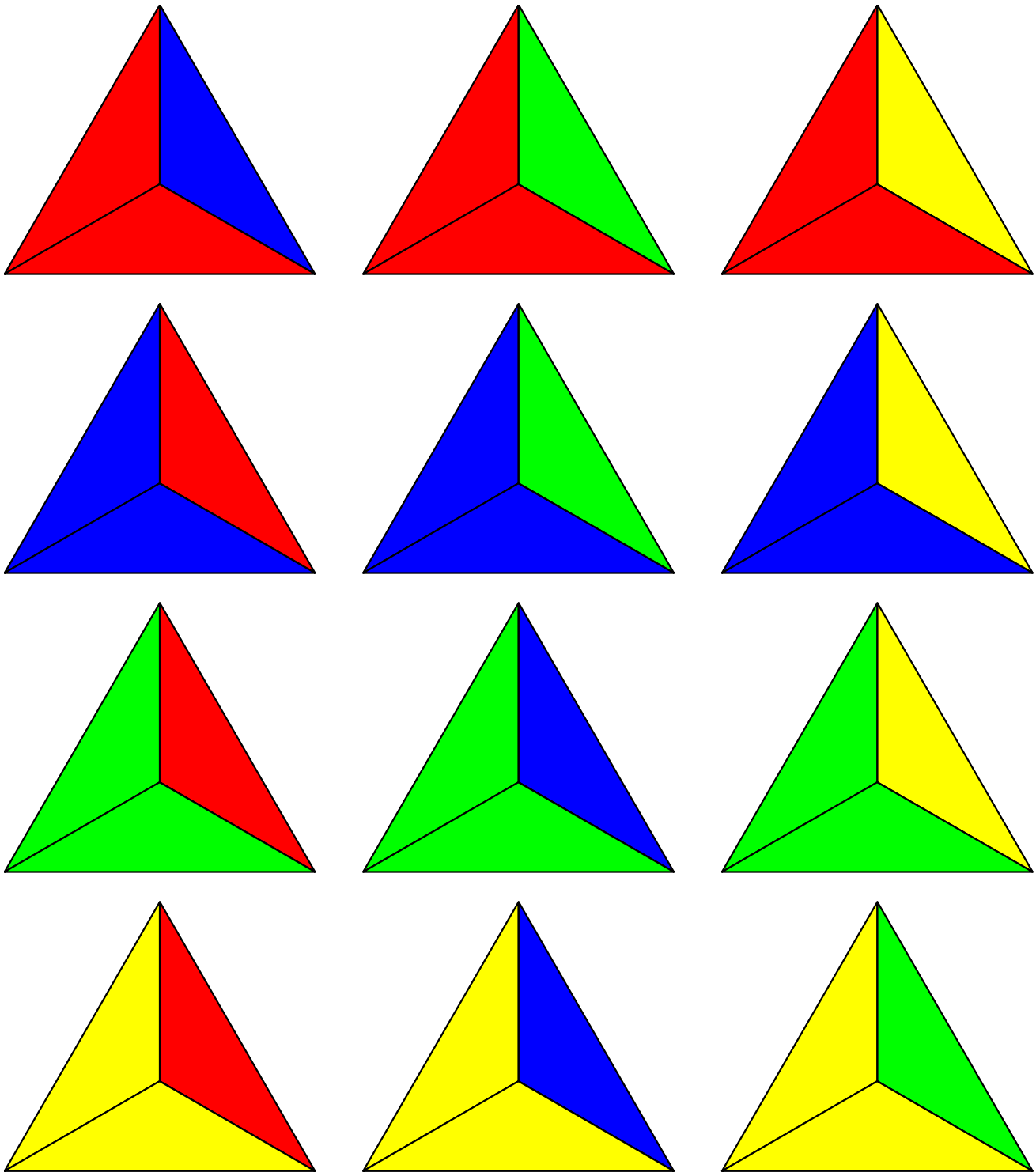
If n colours were used to shade the triangles instead of 4, how many possible triangles would there be (this will be a formula which should work for any value of n).
[It will help to do the "Number" puzzle first!]

Miscellaneous

One of the three shapes below is impossible to make with the 24 triangles, using the two standard rules above. Can you say which one is not possible, and explain why?



Extension: Below is a "duplication puzzle" (a shape made of twelve triangles; the puzzle is to make two copies of the shape using the 24 triangles and the usual rules), and a "triplication puzzle" (a shape made of 8 triangles; the puzzle is to make 3 copies of it). One can be solved, the other cannot; which is which, and why?



Duplication Puzzle Triplication Puzzle