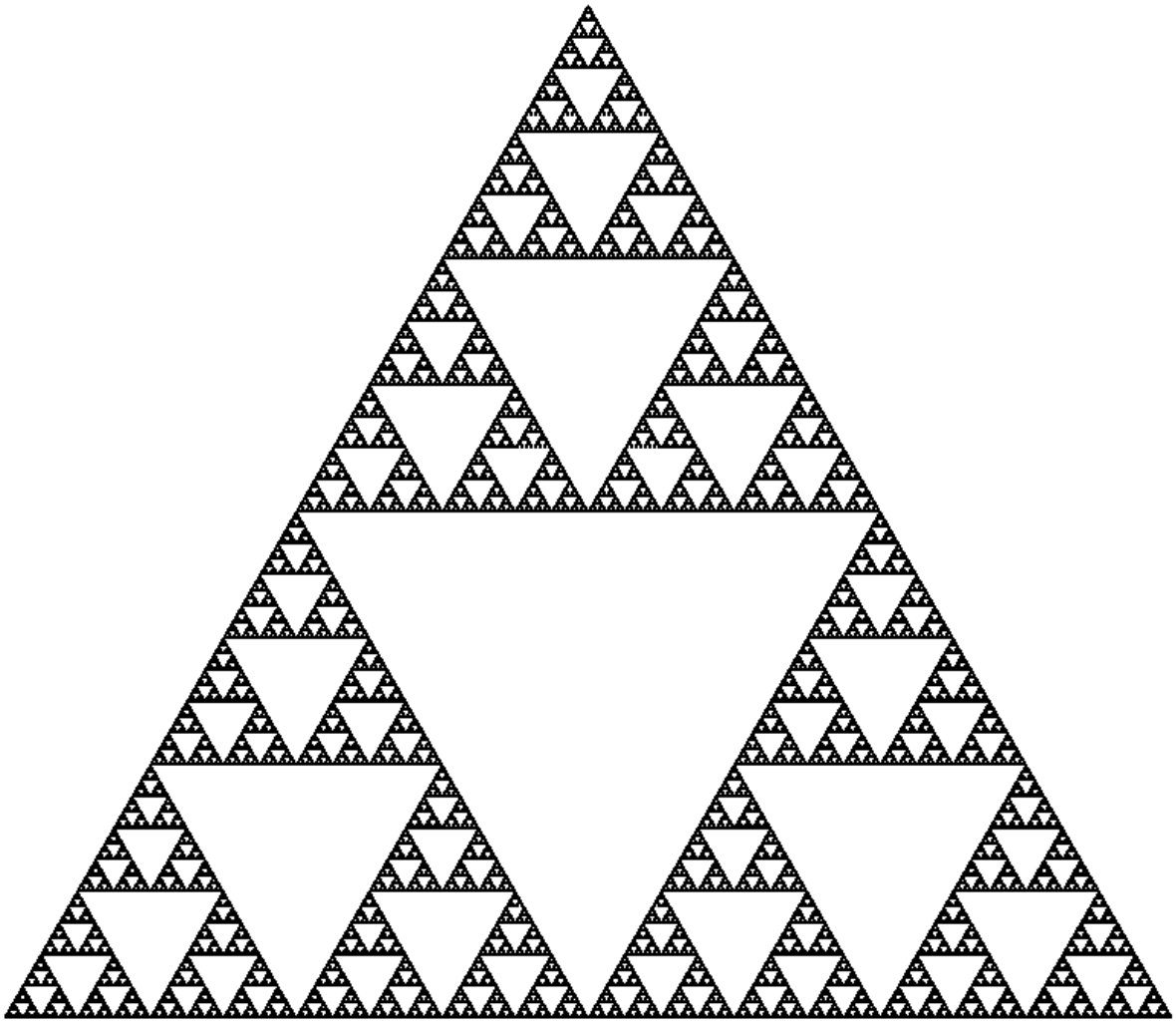
Hills Road
Sixth Form College
Cambridge

A Level Further Maths Summer Work



As a Further Mathematician, we would like you to attempt some additional problems as well as the mathematics summer work to ensure your mathematical muscles get a suitably challenging workout before the course starts! All the knowledge you need, you knew at GCSE. The key, particularly for the geometry questions, is whether you can select the relevant knowledge to solve each problem - this is a skill that is crucial for studying Further Maths! Write your answers, together with lots of lovely working, on separate paper.

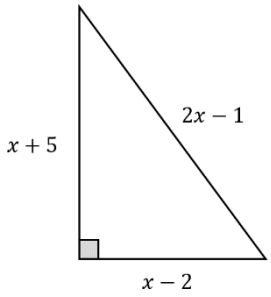
Algebra:

1) Rearrange the following to make a the subject of the equation:
   a) $\frac{1}{a}+\frac{1}{b}=\frac{1}{c}$
   b) $P=\frac{n^2+a}{n+a}$

2) Solve the equation $\frac{7}{x+2}+\frac{1}{x-1}=4$

3) Express $\frac{5}{(x+2)(x-3)}-\frac{2}{x+5}-\frac{1}{x-3}$ as a single fraction in its simplest form.

4) The diagram shows a right-angled triangle. Find the value of x and hence the area of the triangle.

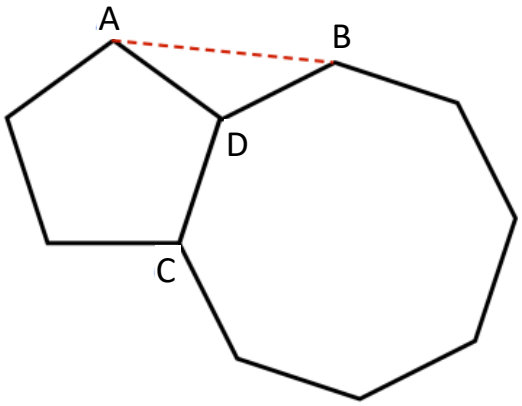


5) Given that $\mathrm{f}(x)=x^2+4$ and $\mathrm{g}(x)=x-9$ for all values of x, solve the equation $\mathrm{fg}(x)=\mathrm{gf}(x)$

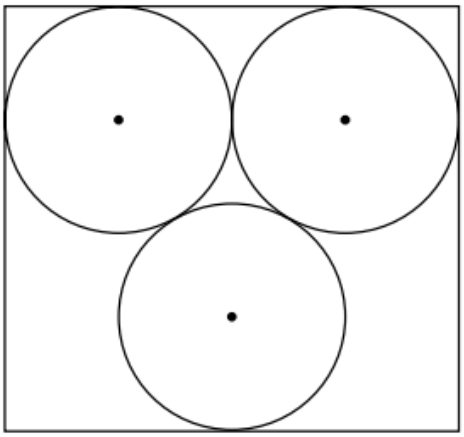
6) Let $x=\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2+\cdots}}}}$.
   a) Compute x^2-2. What do you notice?
   b) Hence find the value of x, giving your answer as a single number.

Geometry & Problem Solving:

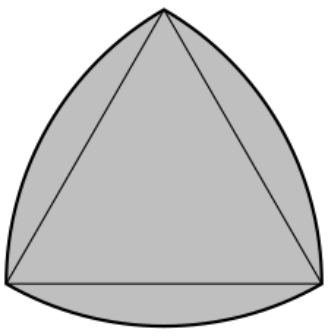
1) A is the vertex of a regular pentagon. B is the vertex of a regular octagon. C and D are vertices of both polygons. Given that the perimeter of the octagon is 120 cm, work out the length AB giving your answer to 2 decimal places.



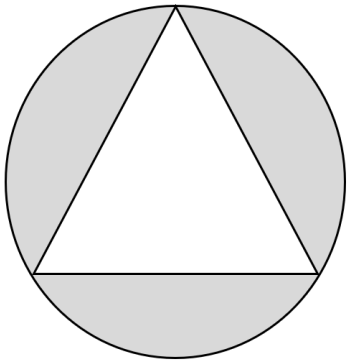
2) The diagram below shows 3 identical circles, each of radius 2 cm, inside a rectangle. Each circle touches the other two circles and the sides of the rectangle. Work out the ***exact*** area of the rectangle (leaving your answer in terms of a surd).



3) The sides of an equilateral triangle with side length r are rounded off by drawing arcs of radius r centred around the vertices of the triangle, as shown in the diagram below. Find, in terms of r, the shape's **exact**:
   a) perimeter,
   b) area.



4) The diagram shows an equilateral triangle of side length 6 cm drawn inside a circle so that each corner touches the circumference of the circle. What is the ***exact*** area of the shaded region? (Leave your answer in terms of π and surds).



One final harder question!

5) The diagram shows a square $ABCD$ of side length 1 with a circular arc centred on each of its vertices.
   a) Explain why triangle ABM is equilateral.
   b) Write down the size of angle MAN
   c) Hence find the perimeter of the shaded region $MNPQ$.