



Stage 3 ★★

Mixed Selection 1

1. Tangram area

The seven pieces in this $12\text{cm} \times 12\text{cm}$ square make a Tangram set.

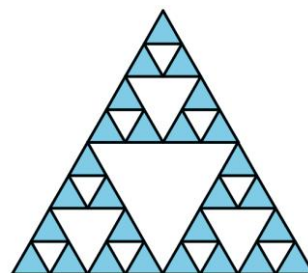
What is the area of the shaded parallelogram?



2. Triangles' triangle

The perimeter of the large triangle is 24 cm .

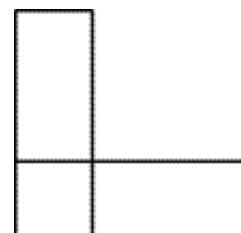
What is the total length of the black lines used to draw the figure?



3. L-emental

Two identical rectangular cards are glued together as shown, to form an 'L' shape. The perimeter of this 'L' shape is 40 cm .

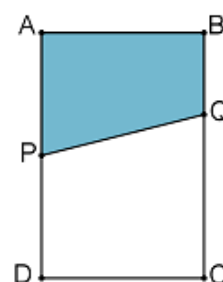
What can you say about the length and width of the original rectangles?



4. Guillotine

$ABCD$ is a rectangle. P is the midpoint of AD ; the length of BQ is one third the length of BC .

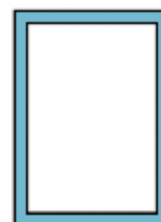
What fraction of the area of the rectangle is the area of the shaded quadrilateral $ABQP$?



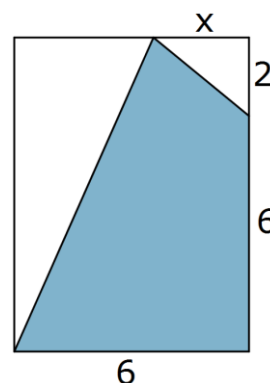
5. Margins

A $30\text{cm} \times 40\text{cm}$ page of a book includes a 2cm margin on each side, as shown.

What percentage of the page is occupied by the margins?



These problems are adapted from UKMT Mathematical Challenge problems (ukmt.org.uk)



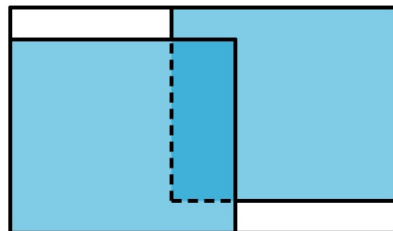


Stage 3 ★★

Mixed Selection 3

1. Double cover

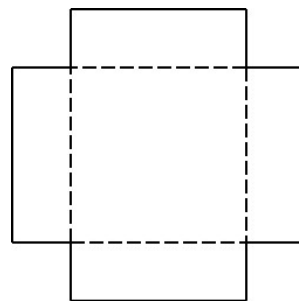
A sheet of paper is exactly the same size as a rectangular table top. The paper is cut in half and the two halves are placed on the table as shown.



What is the ratio of the area of table left uncovered to the area that is covered twice?

2. Open the box

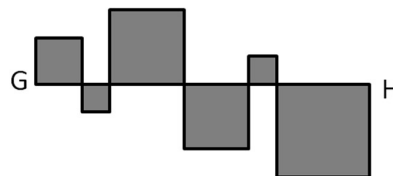
A square piece of card has a square of side 2cm cut out from each of its corners. The remaining card is then folded along the dotted lines shown to form an open box whose total internal surface area is 180cm^2 .



What is the volume of the open box?

3. Line of squares

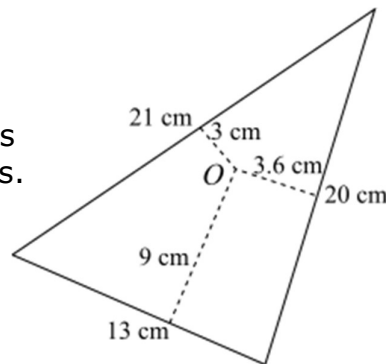
In the diagram on the right, each of the squares touches adjacent squares at the corners and the line GH along one of the edges.



If the length of GH is 24cm, what is the total perimeter of all the squares?

4. Scalene area

The diagram shows a scalene triangle with side lengths 13 cm, 20 cm and 21 cm. From a point O inside the triangle, line segments can be drawn at right angles to each of the sides. The lengths of these line segments are 9 cm, 3.6 cm and 3 cm.



What is the area of the triangle?

These problems are adapted from UKMT (ukmt.org.uk) and SEAMC (seamc.asia) problems.

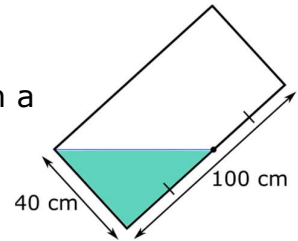


Stage 3 ★★

Mixed Selection 4

1. Tilted tank

A fish tank is a cuboid, 100 cm by 60 cm by 40 cm. It is partly filled with water, so that when it is resting on a 60 cm edge, the water level reaches the top edge and the midpoint of the base, as shown.

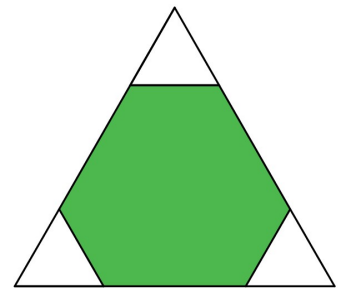


What will the height of the water be when the tank is resting on its base (a 100 cm by 60 cm face)?

2. Corner cut

Three small equilateral triangles of the same size are cut from the corners of a larger equilateral triangle with sides of length 6cm, as shown.

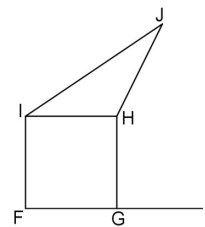
The sum of the perimeters of the small equilateral triangles is the same as the perimeter of the hexagon.



What is the side length of one of the small triangles?

3. Leaning over

The triangle HIJ has the same area as the square $FGHI$. FG has a length of 4cm.

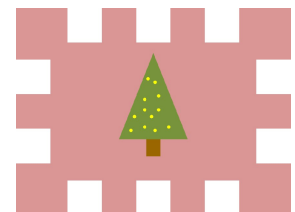


What is the perpendicular distance from J to the extension of the line FG ?

4. Christmas cut-out

Sue has a rectangle measuring 40cm by 30cm. She cuts out ten squares, each measuring 5cm by 5cm from the rectangle to make a Christmas decoration.

In each case, exactly one side of the square lies along a side of the rectangle, and none of the cut out squares touch or overlap.



What is the perimeter of the Christmas decoration?

These problems are adapted from UKMT (ukmt.org.uk) and SEAMC (seamc.asia) problems.