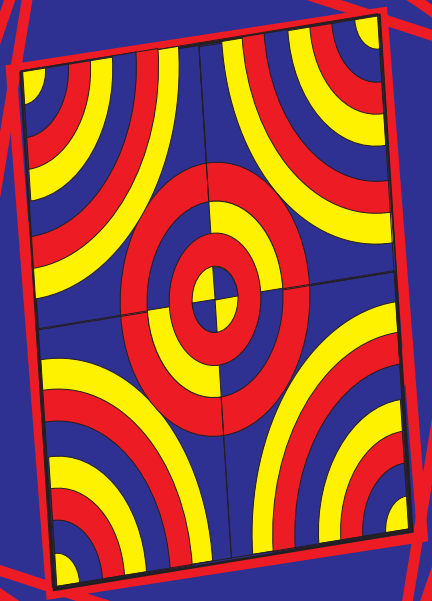
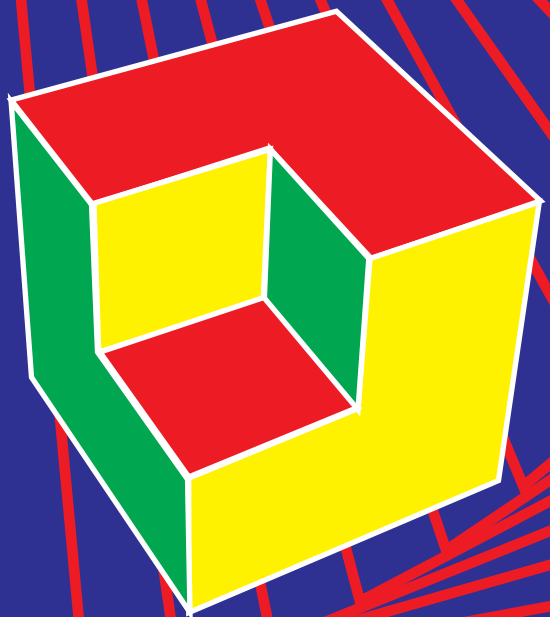
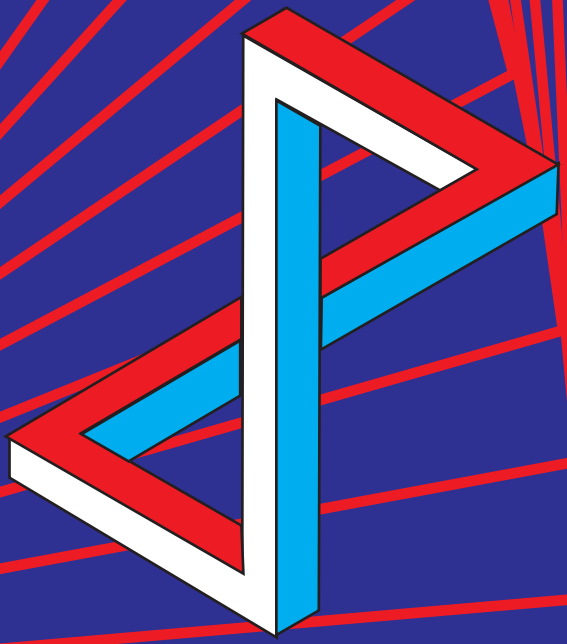
Grand Designs and Structures



Kim Freeman





GRAND DESIGNS AND STRUCTURES
Kim Freeman

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From the Author

Those teachers that remember teaching secondary school mathematics in the 1980s will remember classroom walls full of students' work. There were usually strings from one end of the room to the other with mathematical models and posters hanging off them. By contrast today's maths rooms are bare and lessons are dominated by PowerPoint slides, videos and computers (when we can book them!).

Despite all these new innovations there are still students who can not use a ruler, measure or draw a straight line. There are some who do not know what to do with a compass. Because they can not manipulate and deal with solid figures they can not visualise what they look like if viewed at different angles. The same number of students are failing and passing but what is evident is that mathematics is not as fun as it was before. It has become a mechanical process of passing tests and accumulating grades for a final report at the end of each year.

This book is a result of me dusting off my old teaching notes. By the end of the year your classroom can be a "visual symphony". You can have posters of mathematical images on the walls, giant platonic solids hanging from the ceiling. Students should be able to spell words like icosahedron and decahedron. They should have researched about them and done a presentation to the class. They should know why they are important to mathematicians.

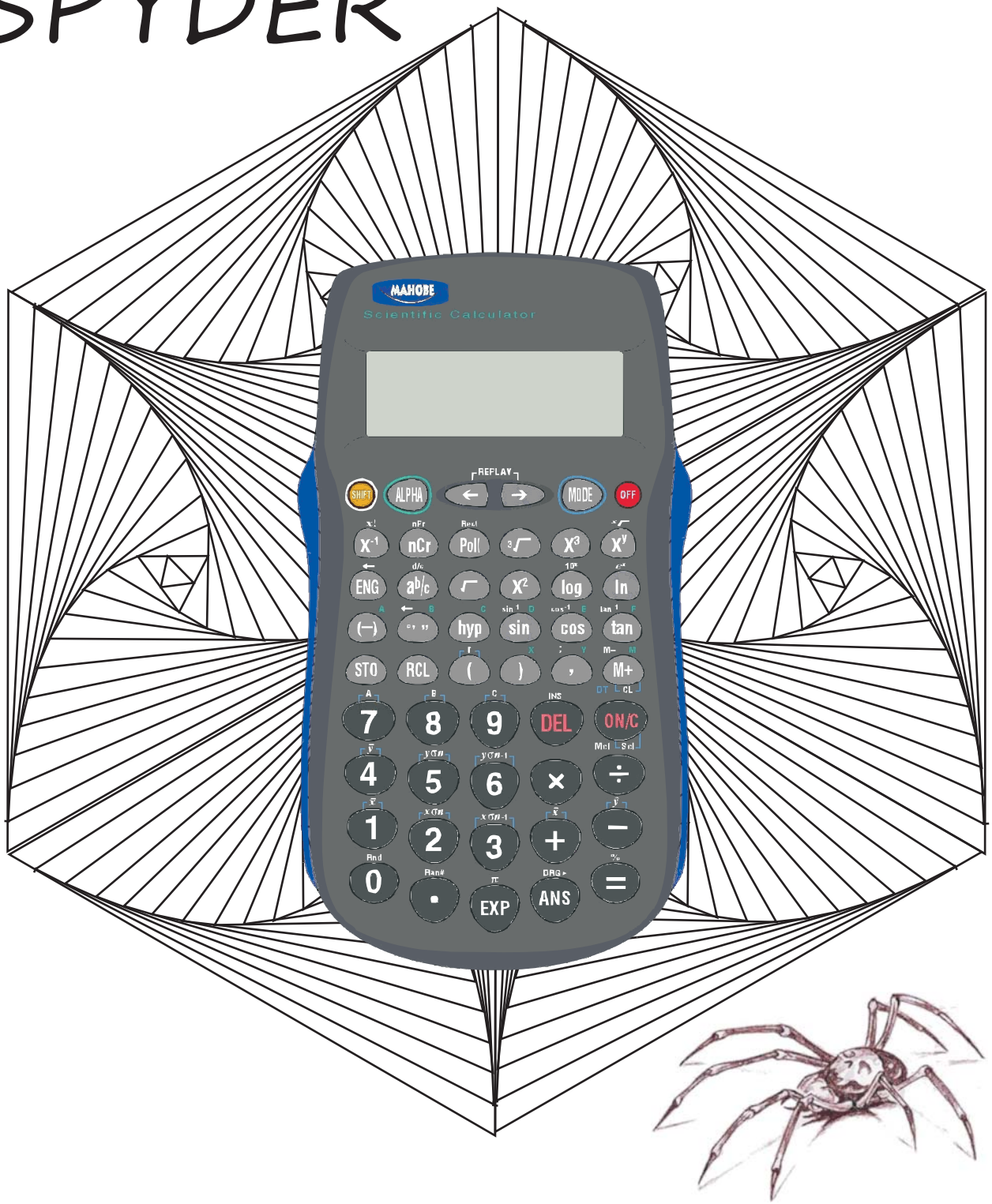
The following pages provide a rich selection of activities for your students. Don't just copy the sheets and hand them all the same activity. If doing a session on line designs make sure that you give out 3 or 4 different designs. Combine them all on the wall to make a mural. Now its time to challenge your other classes to make their mural more interesting and visual. There are many nets to try from simple cubes to more time consuming structures. Copy them onto larger pieces of card. Each one has a possible story and background to research.

Before you know it your class will be drawing chalk diagrams in the middle of the playground and all the other teachers and students will look on in envy. Your students will talk about maths in their other classes and they will remember your classes for years to come.

I hope you and your students enjoy using these pages and that they stimulate a wealth of ideas for future lessons.

Kim Freeman, 2012

SPYDER



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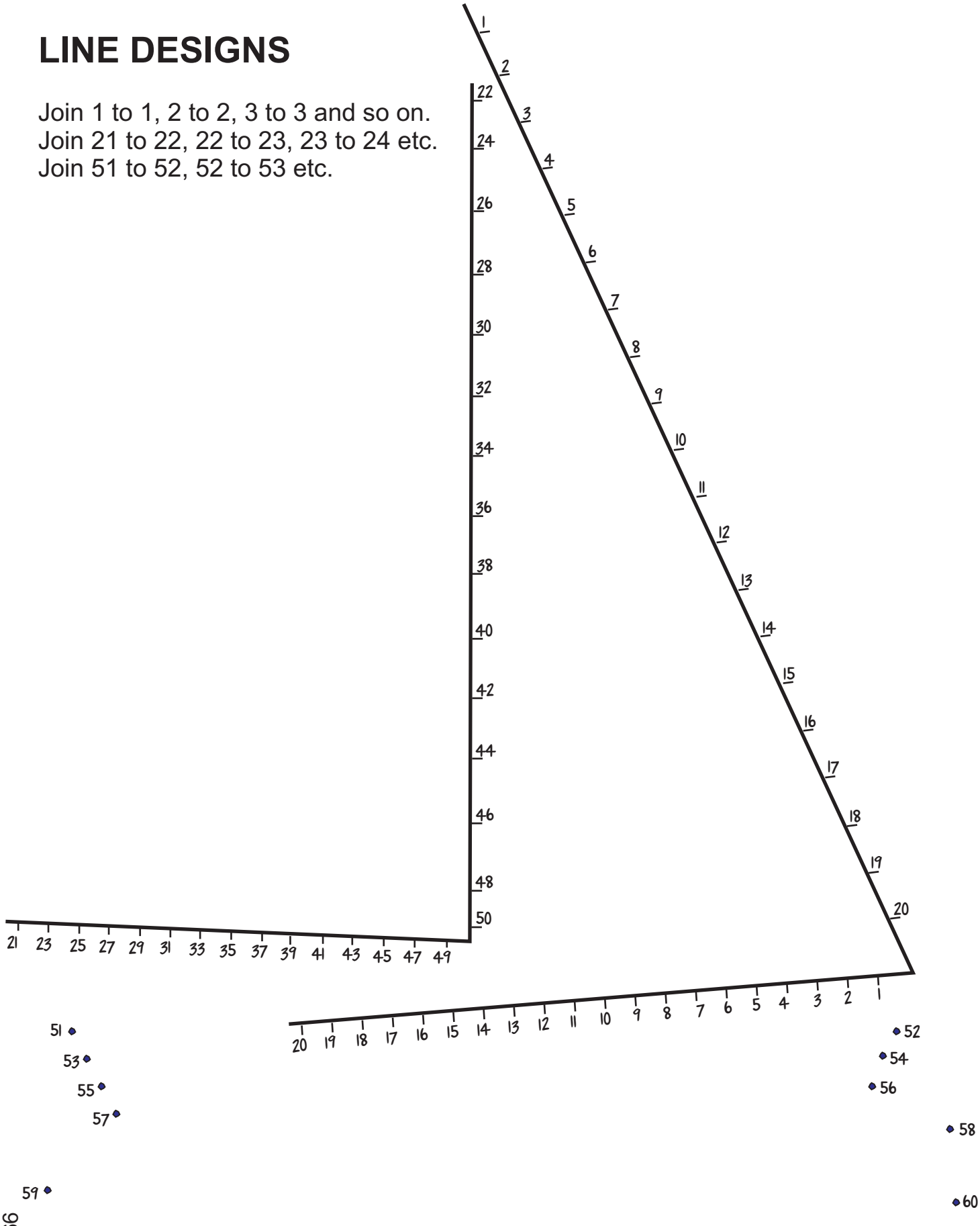
LINE DESIGNS

Join 1 to 1, 2 to 2, 3 to 3 and so on.
Join 21 to 22, 22 to 23, 23 to 24 etc.
Join 51 to 52, 52 to 53 etc.



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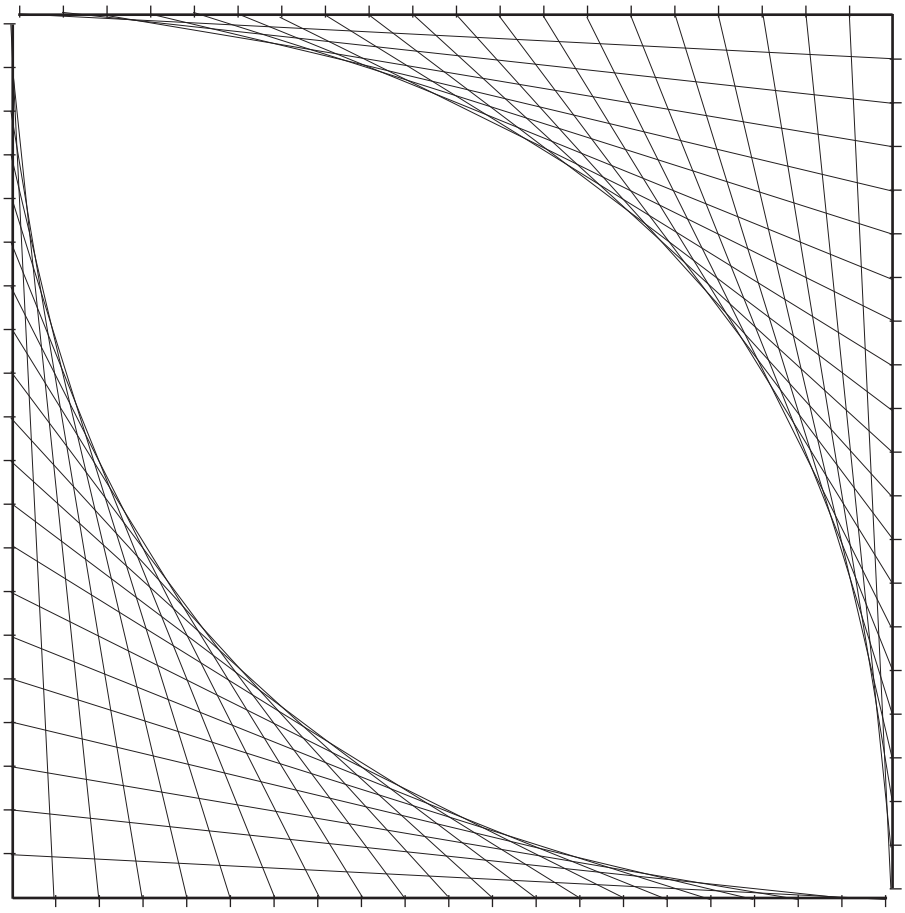
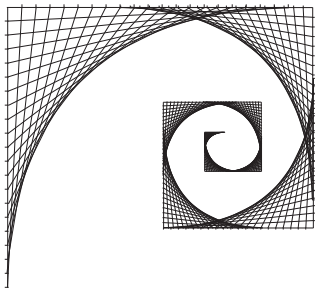
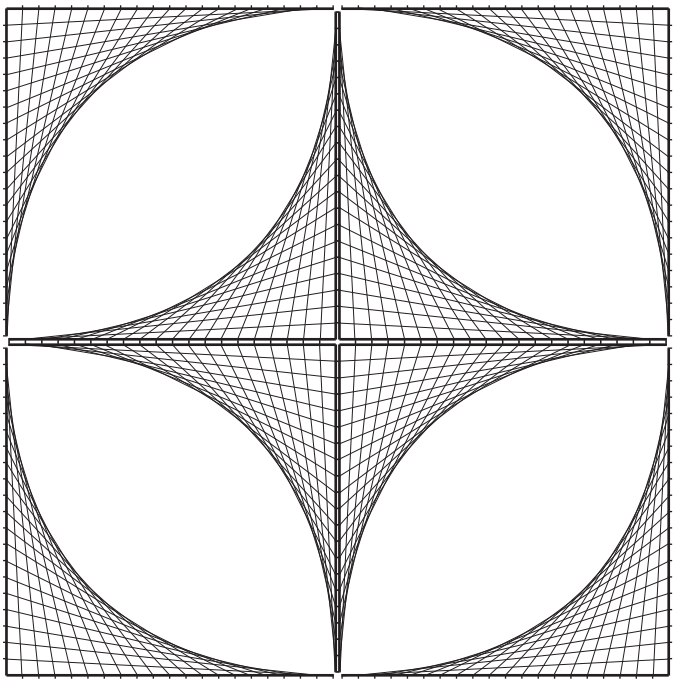
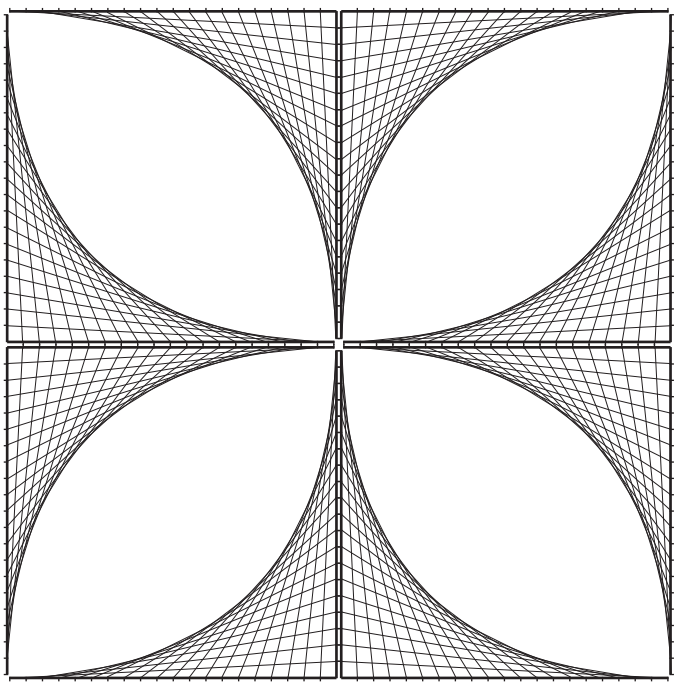


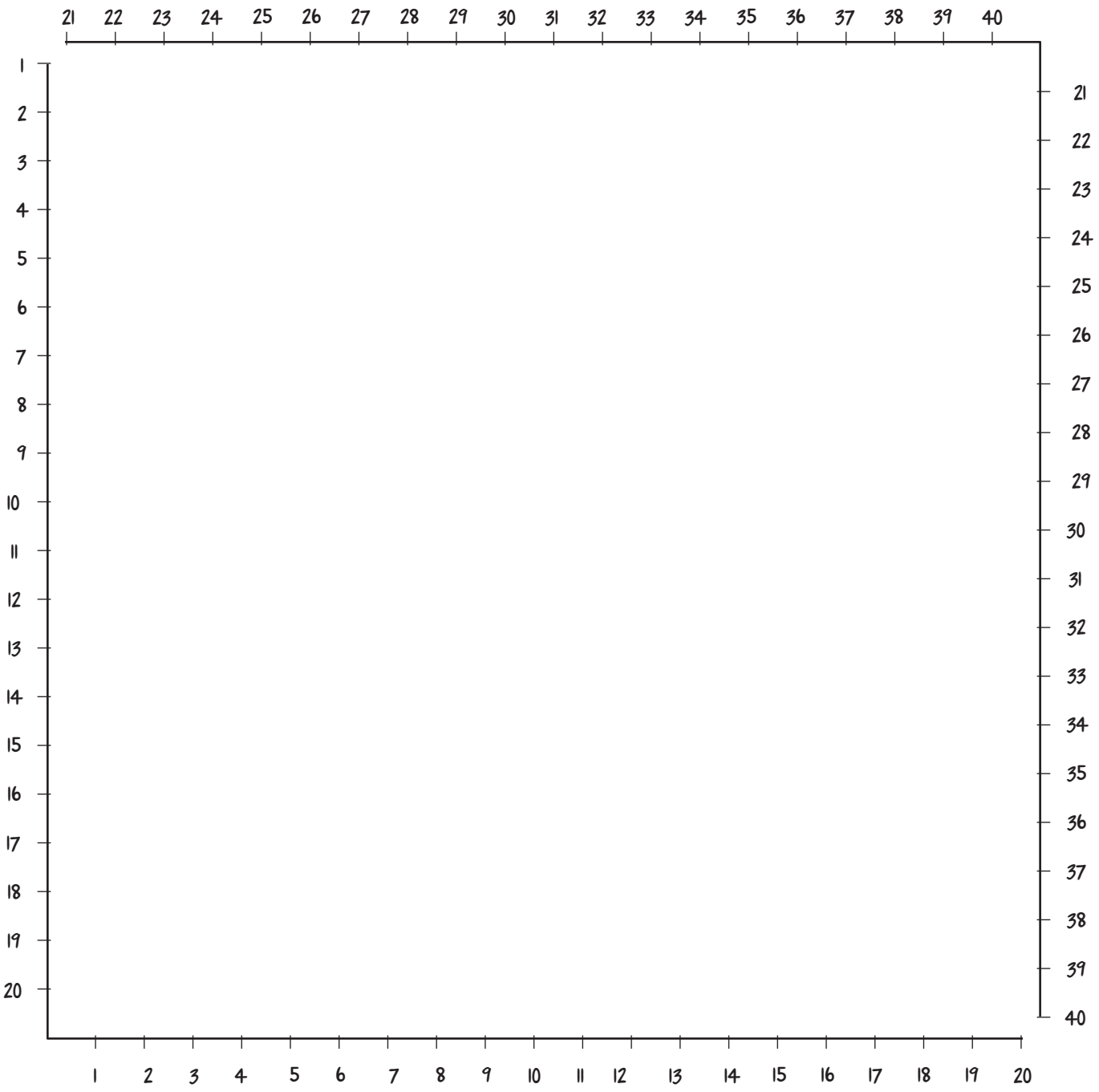






LINE DESIGNS

On each of the right angles join 1 to 1, 2 to 2 and so on.



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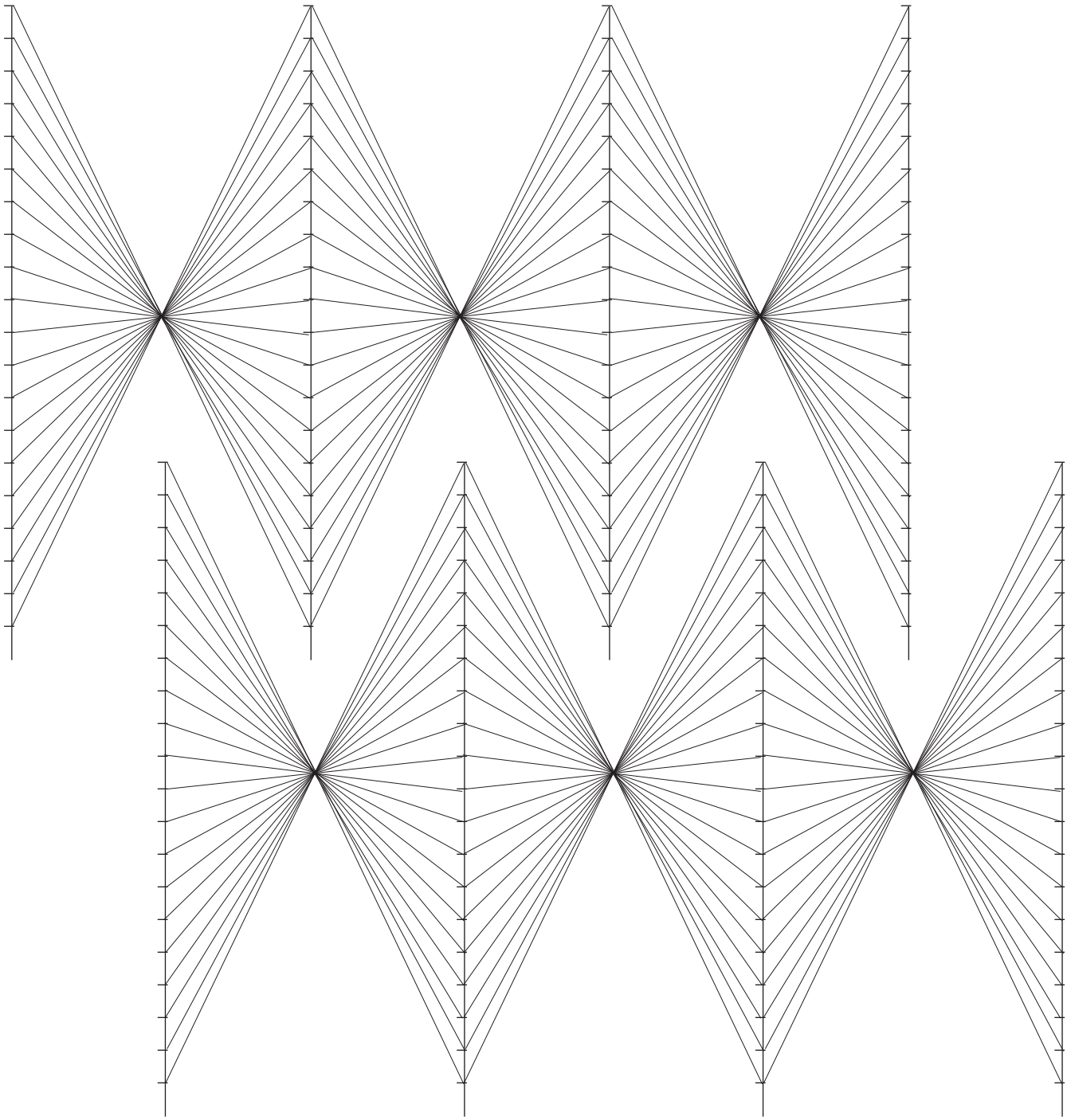
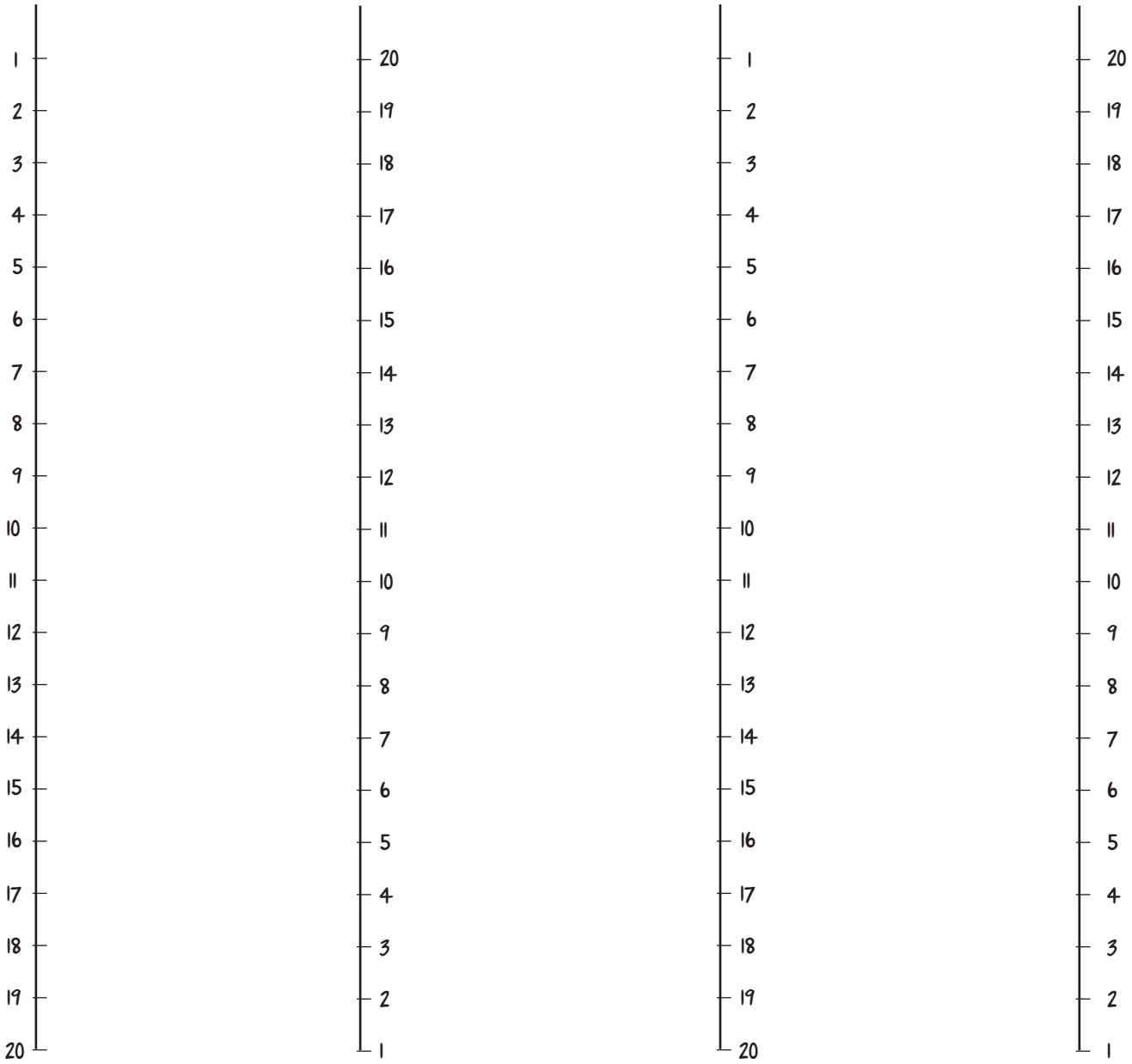


LINE DESIGNS

On each of the lines join 1 to 1, 2 to 2 and so on.



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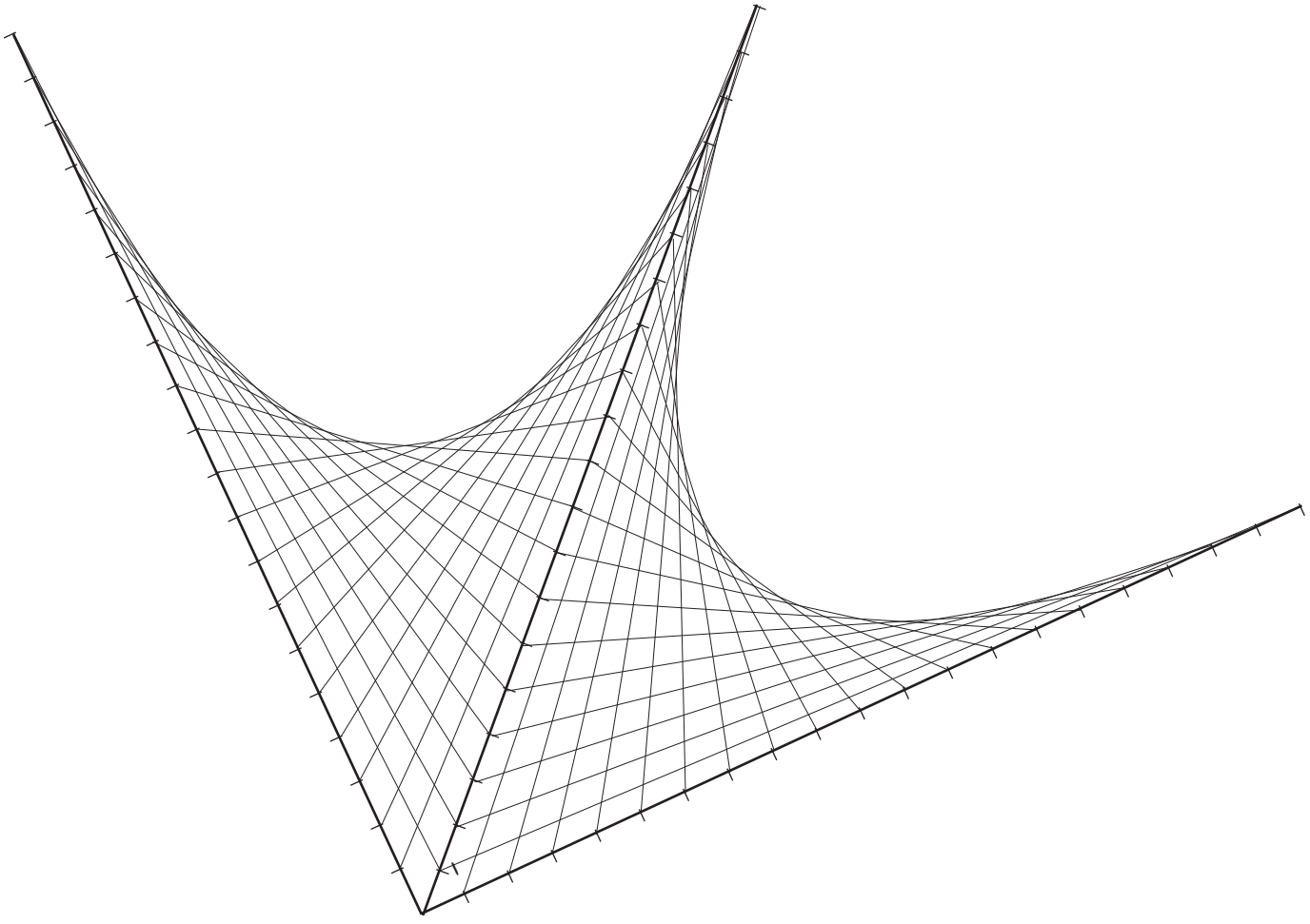
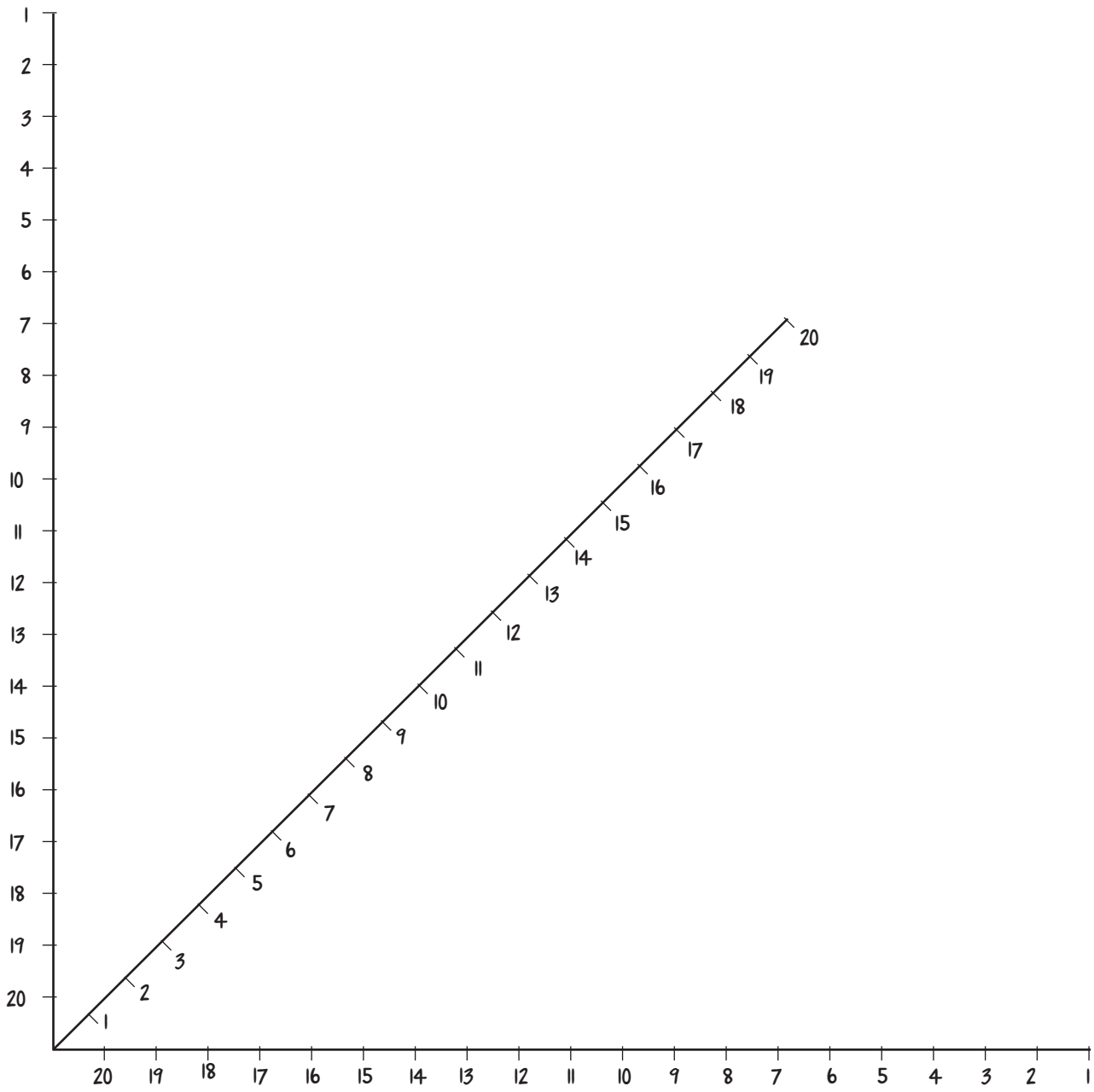


LINE DESIGNS

On each of the lines join 1 to 1, 2 to 2 and so on.



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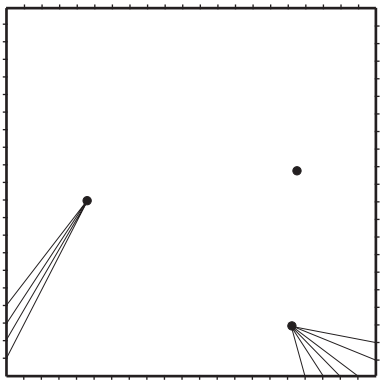
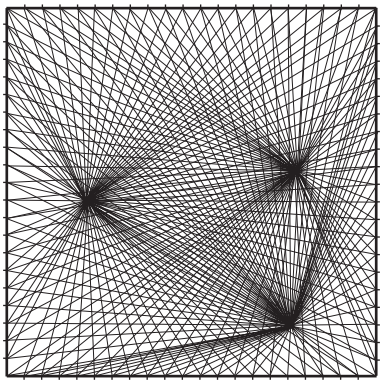
LINE DESIGNS

Place 2 or 3 dots anywhere inside the square. Draw lines from each mark around the square to the dots inside.





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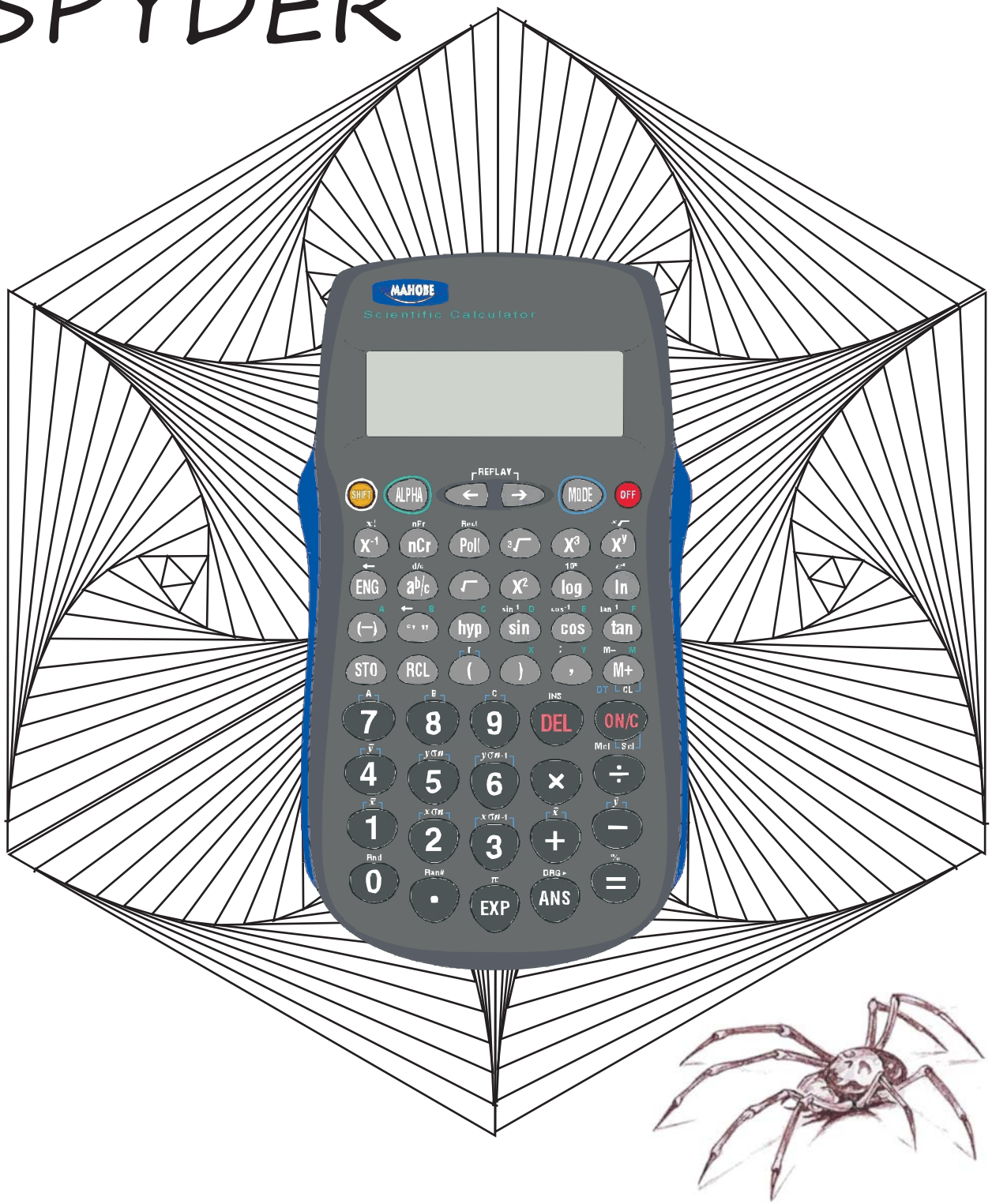

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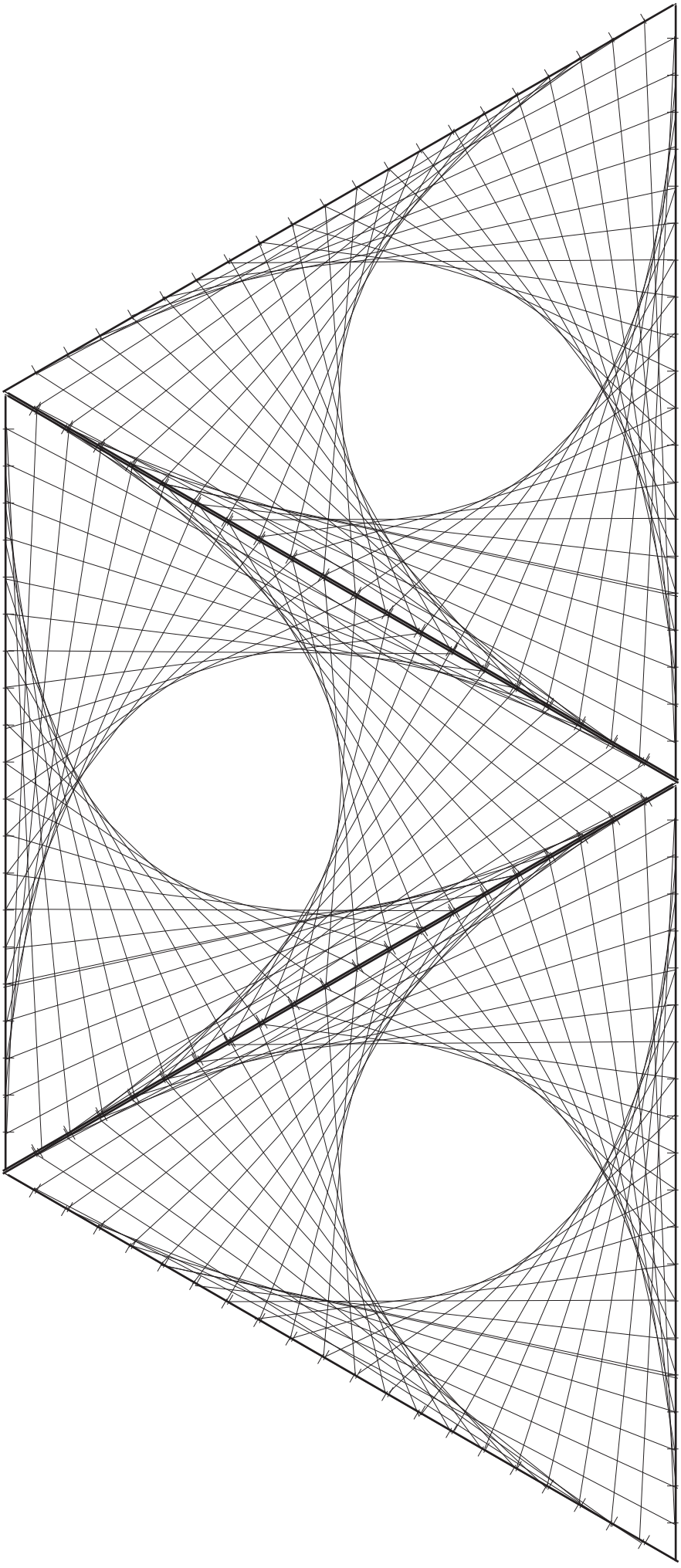
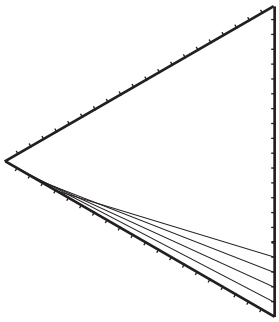
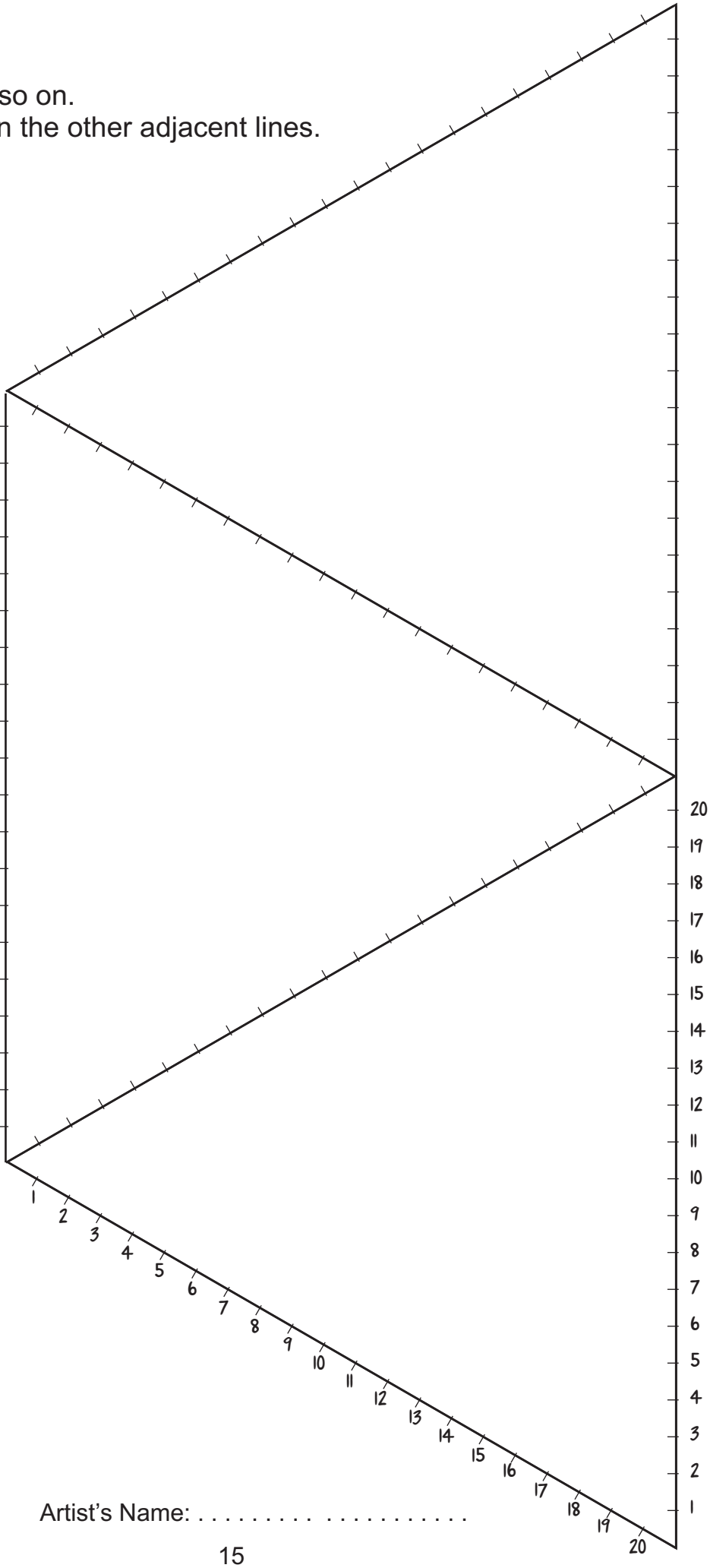


LINE DESIGNS

Join 1 to 1, 2 to 2 and so on.
Continue the pattern on the other adjacent lines.





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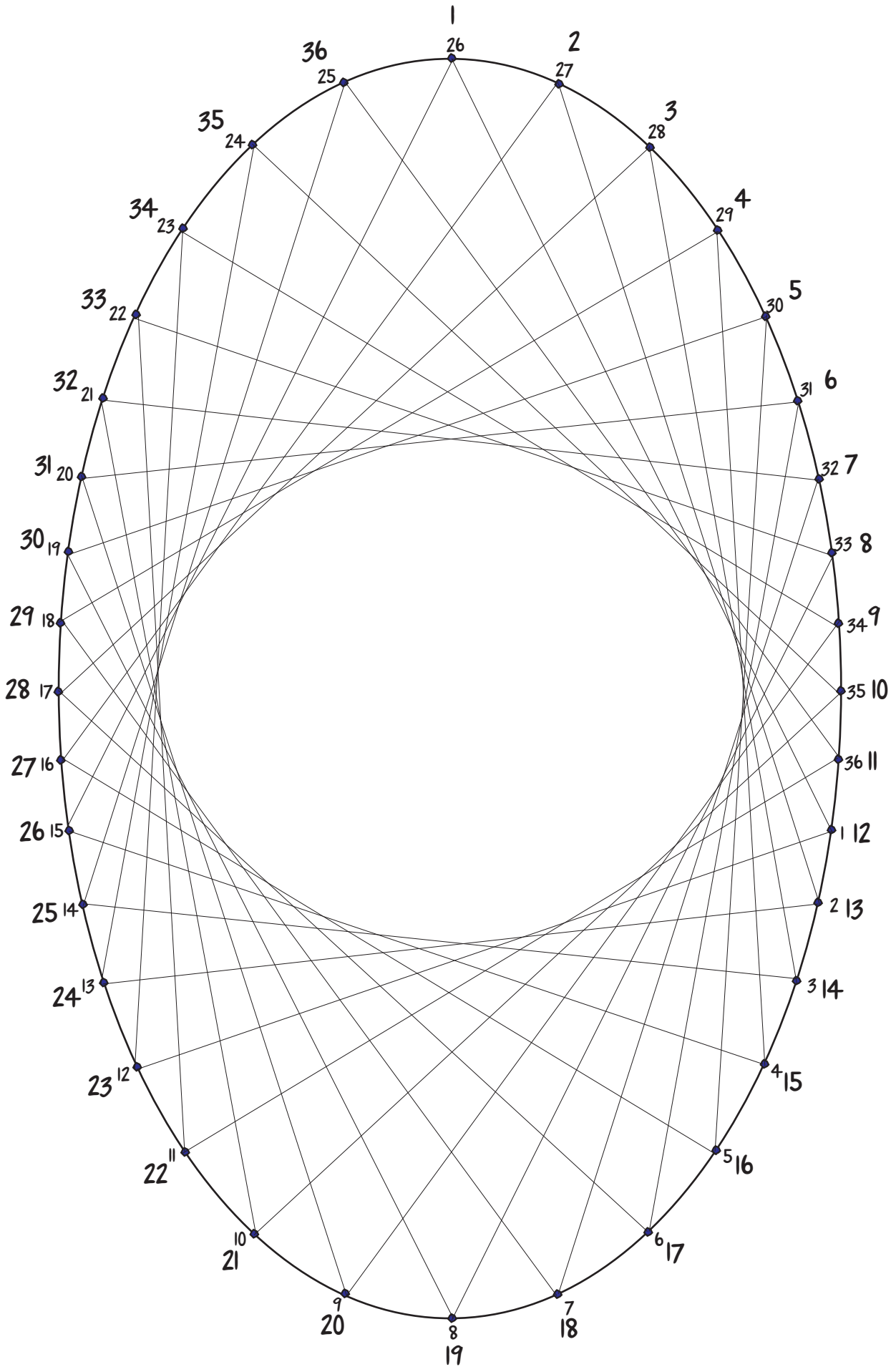
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4 29
5 30
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17 6
18 7
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21 10
22 11
23 12
24 13
25 14
26 15
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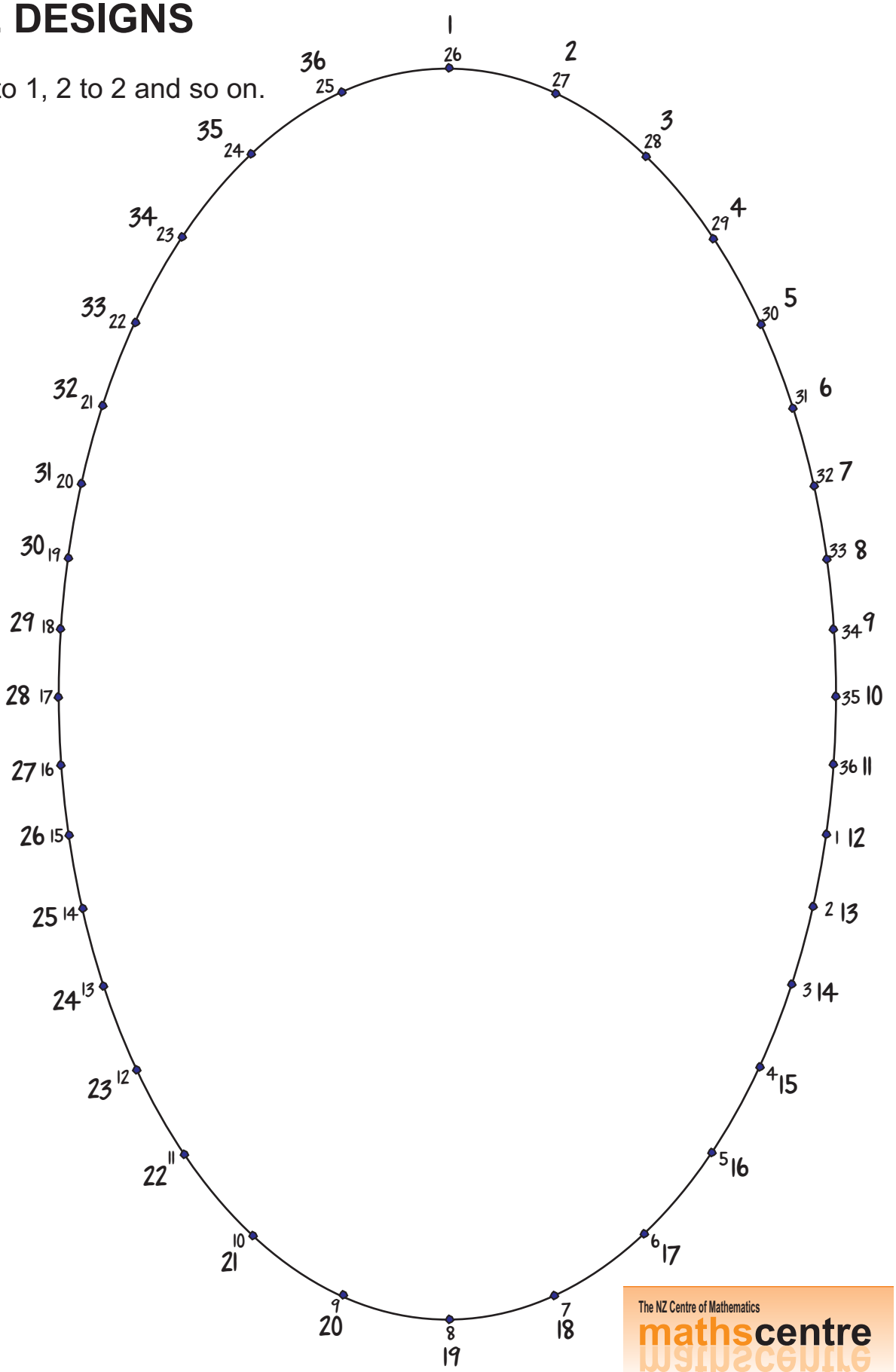
LINE DESIGNS

Join 1 to 1, 2 to 2 and so on.



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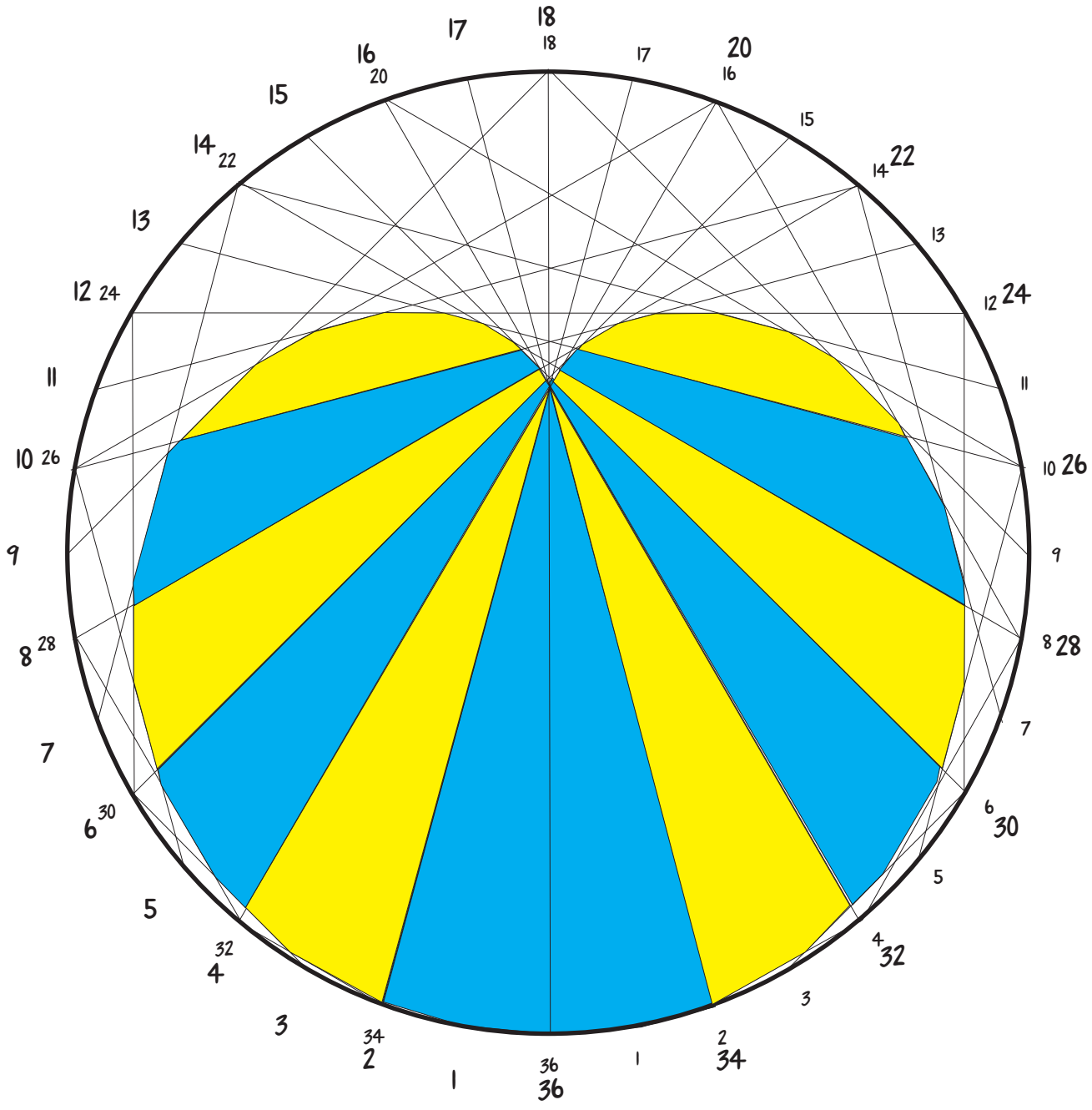
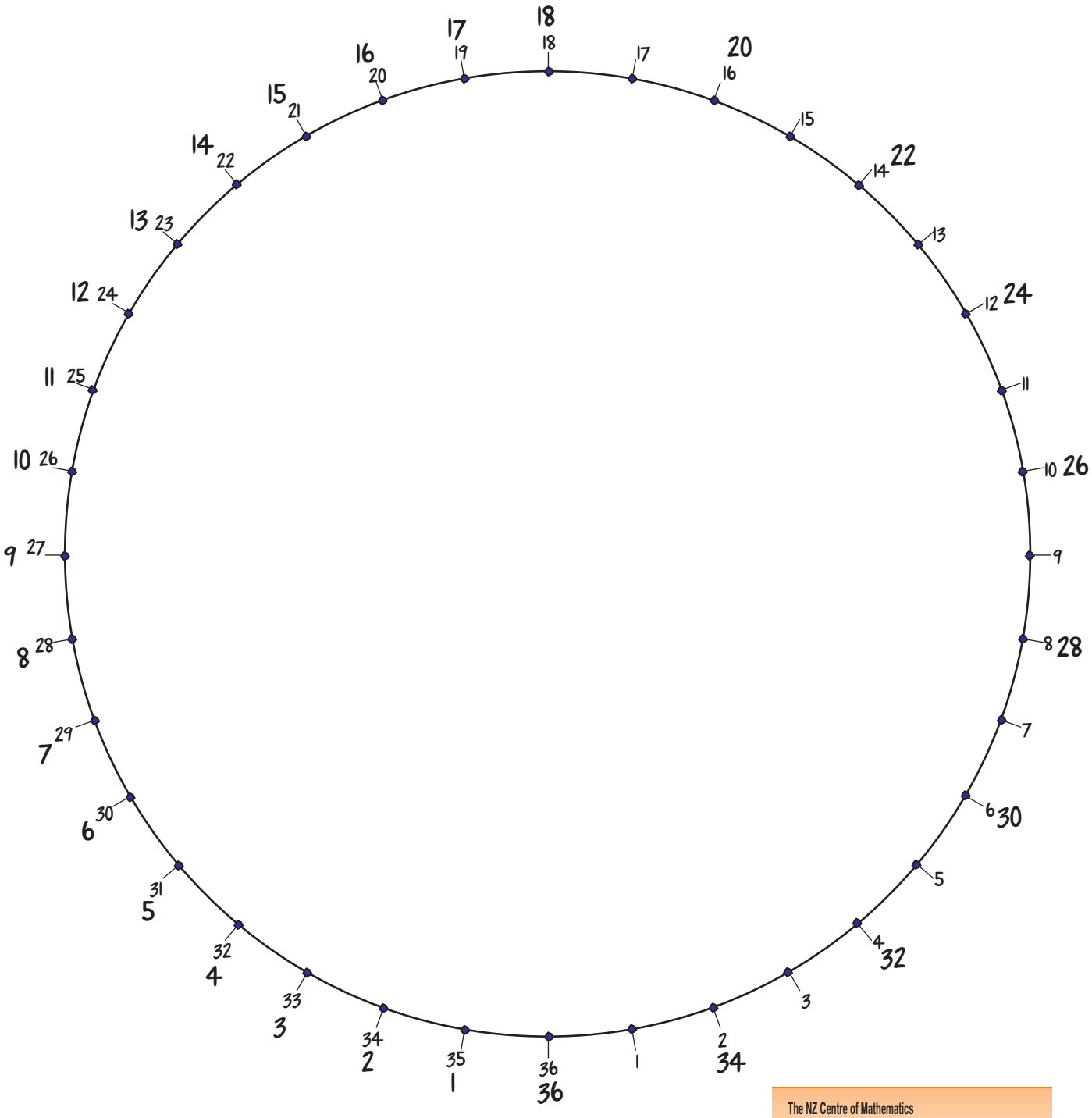


- A Simple Cardioid

LINE DESIGNS

Start with the small numbers from 1 to 18. Join each to its small double.
Do the same with the large numbers. Join each large number to its large double.



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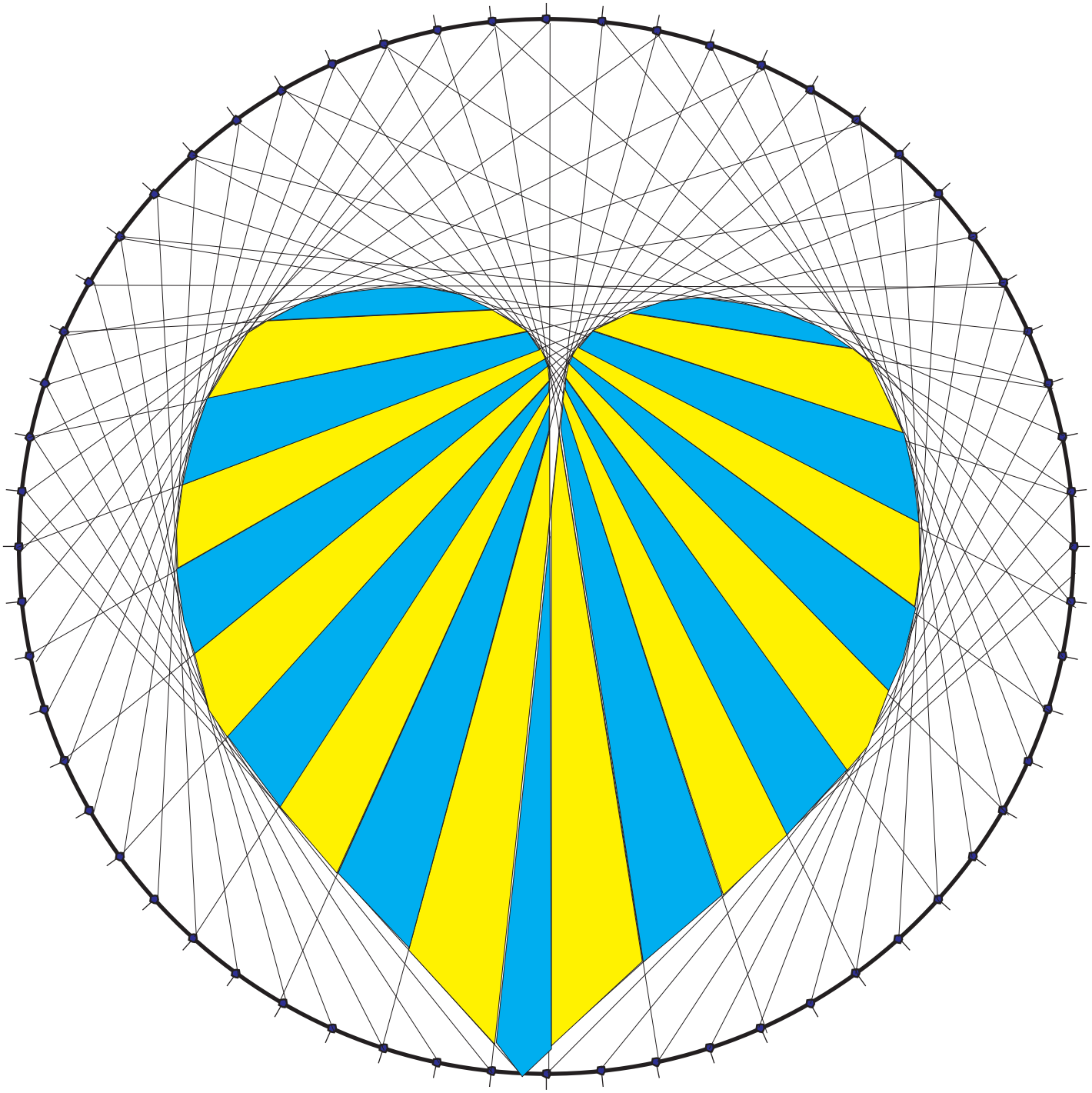
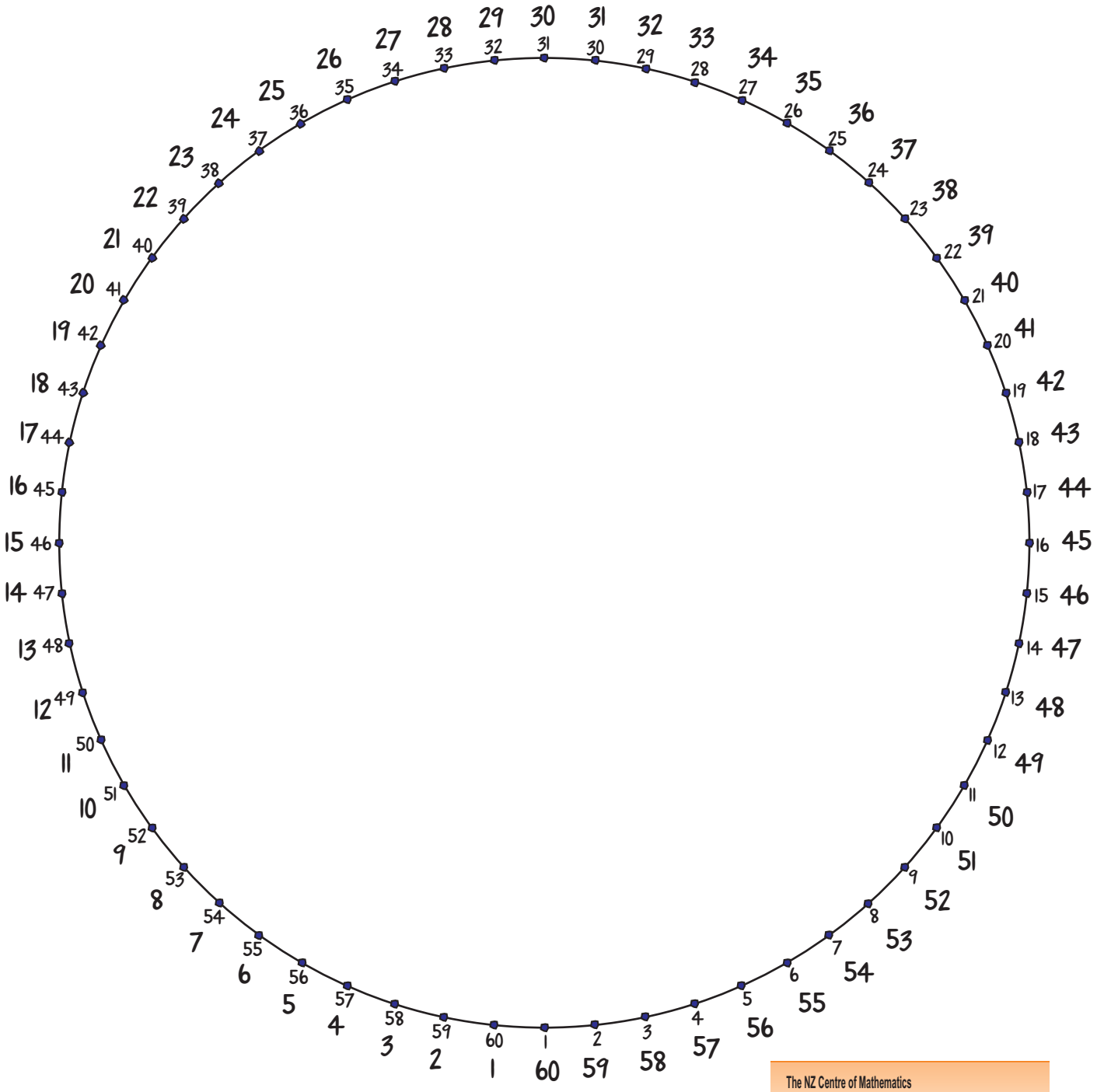


-A Cardioid

LINE DESIGNS

Draw a line between the small 1 and 16, 2 and 17, 3 and 18 and so on. Continue with this pattern until you have drawn a line between 15 and 30. From 16 onwards draw a line between the number and its double (16 and 32, 17 and 34 ....).
Stop after the line between 30 and 60. Now do the same for the large numbers.



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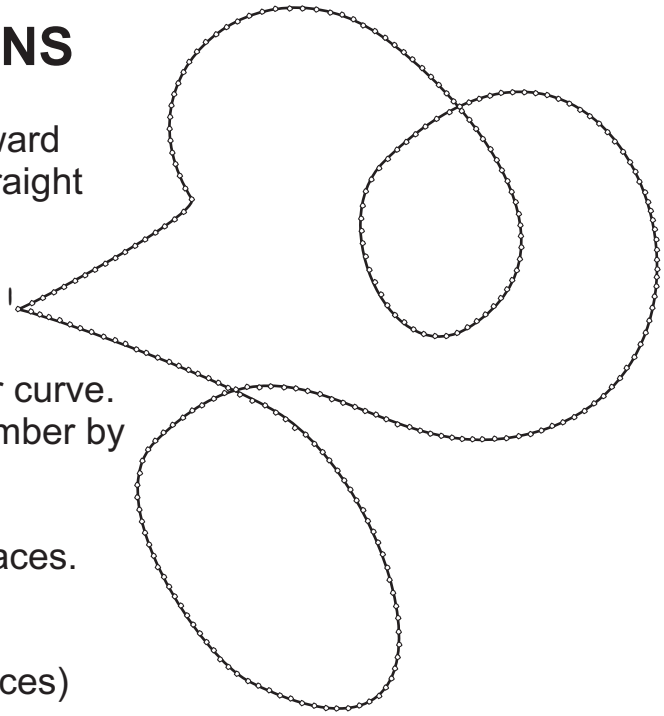
CRAZY CIRCLE LINE DESIGNS

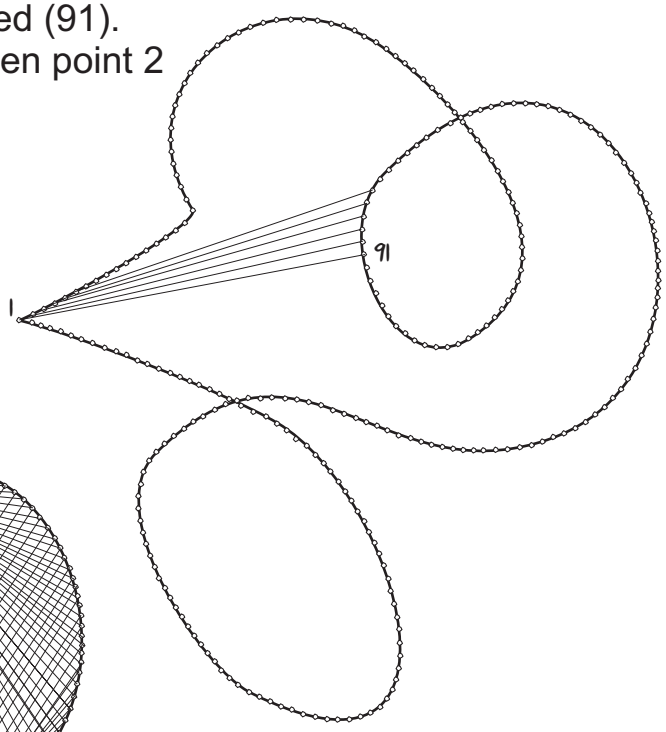


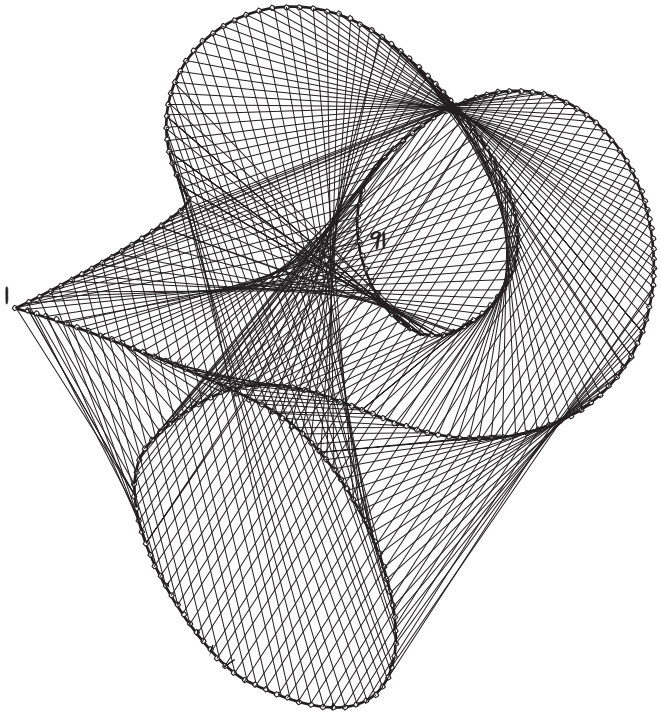
STEP1: Draw a curve with inward and outward twists of different dimensions, as well as straight and sharp edges.

STEP 2: Mark off 3mm spaces around your curve. Count how many spaces and divide the number by 3 (rounding your answer).

In the shape shown there are 272 spaces.
272 ÷ 3 = 90.667
= 91
(For best results try and have over 300 spaces)

STEP 3: Start at point 1 and draw a line between it and the number that you just calculated (91). Continue this by drawing a line between point 2 and 92, 3 and 93 and so on.





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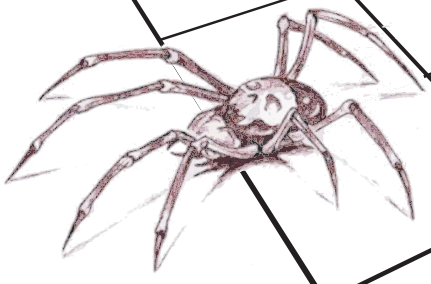
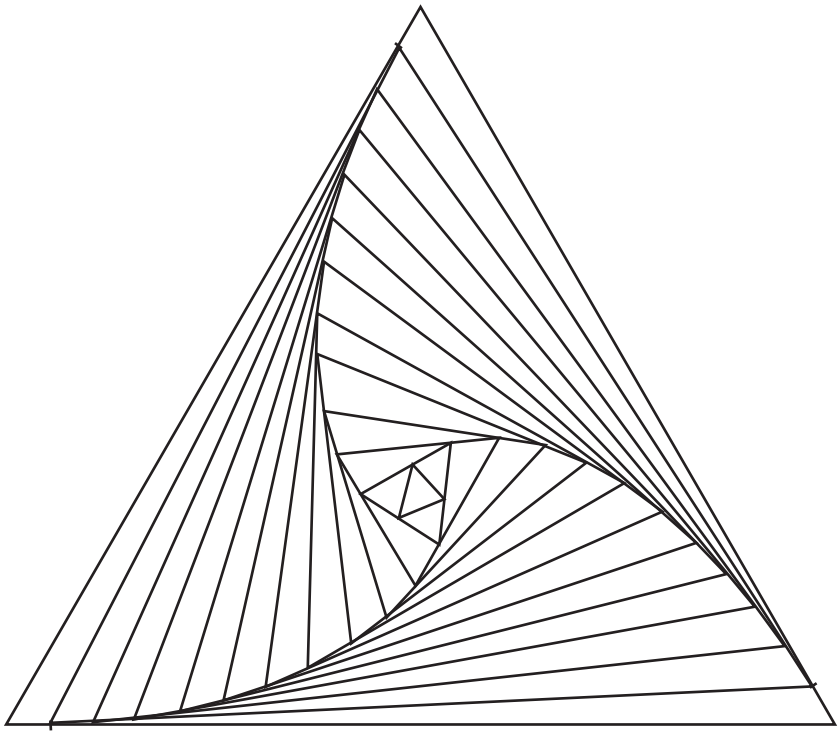
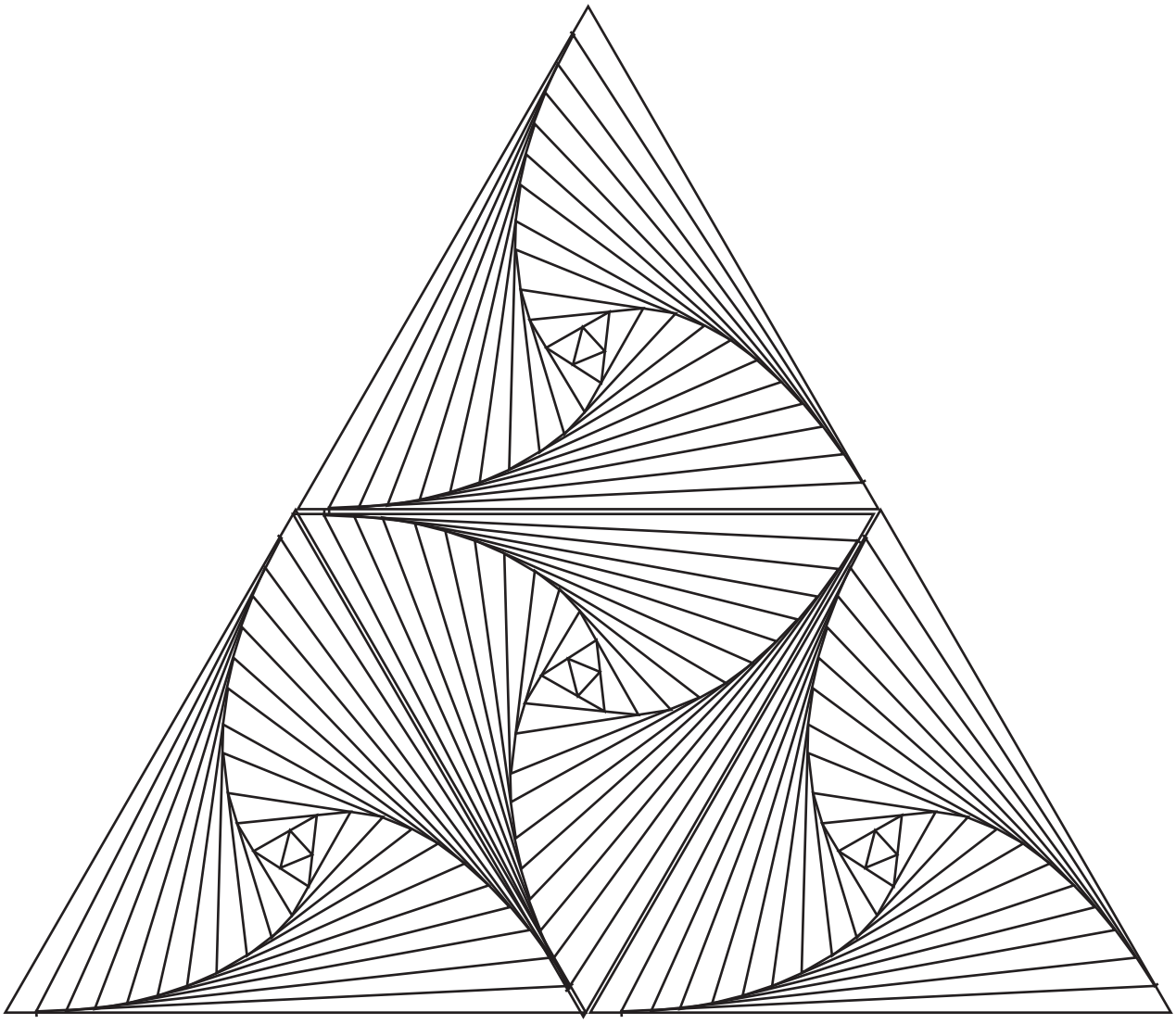
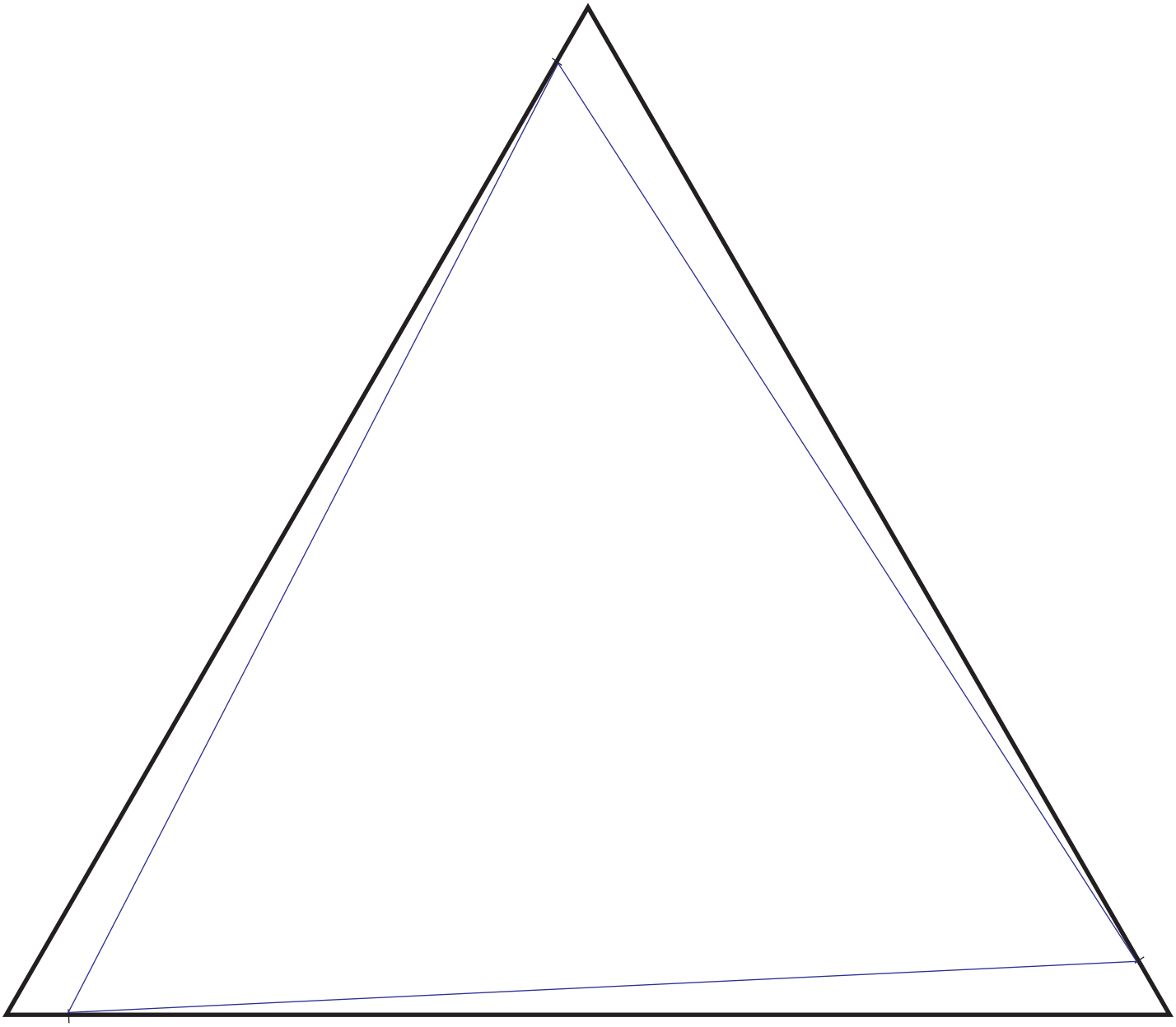






LINE DESIGNS

Measure 1 cm from each apex and draw a new triangle. Repeat this for the next triangle and keep on repeating until you have a very small triangle in the middle.



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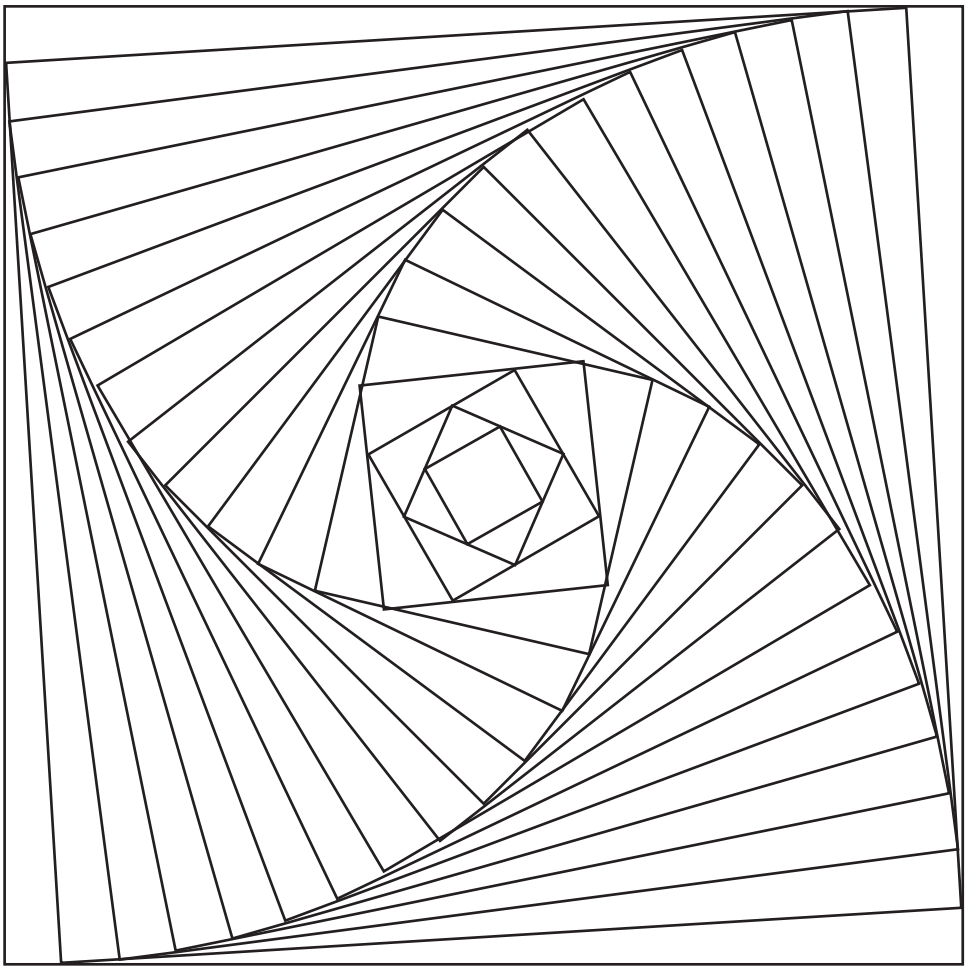
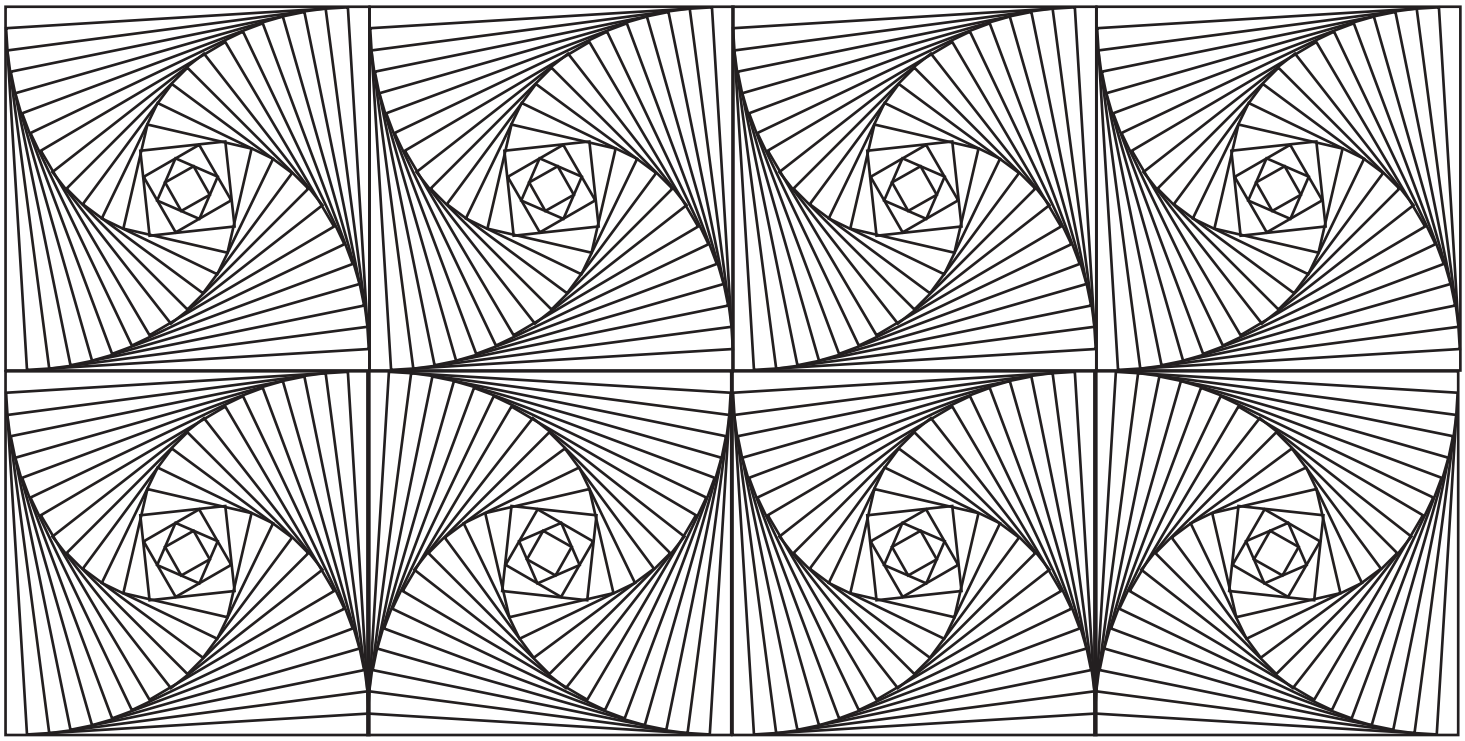
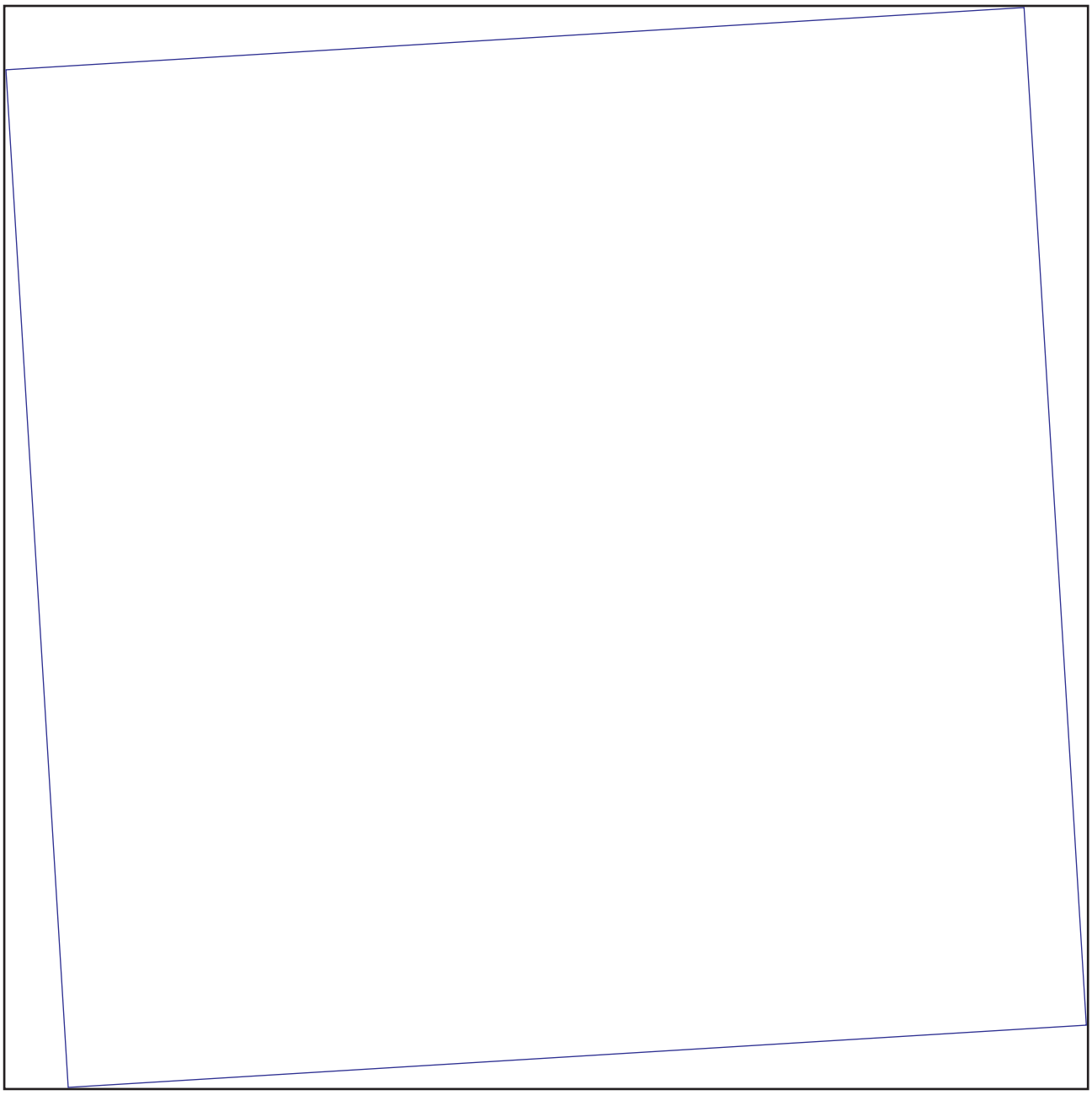




LINE DESIGNS

Measure 1 cm from each corner then draw a new square.
Keep repeating this until you have a very small square in the middle.



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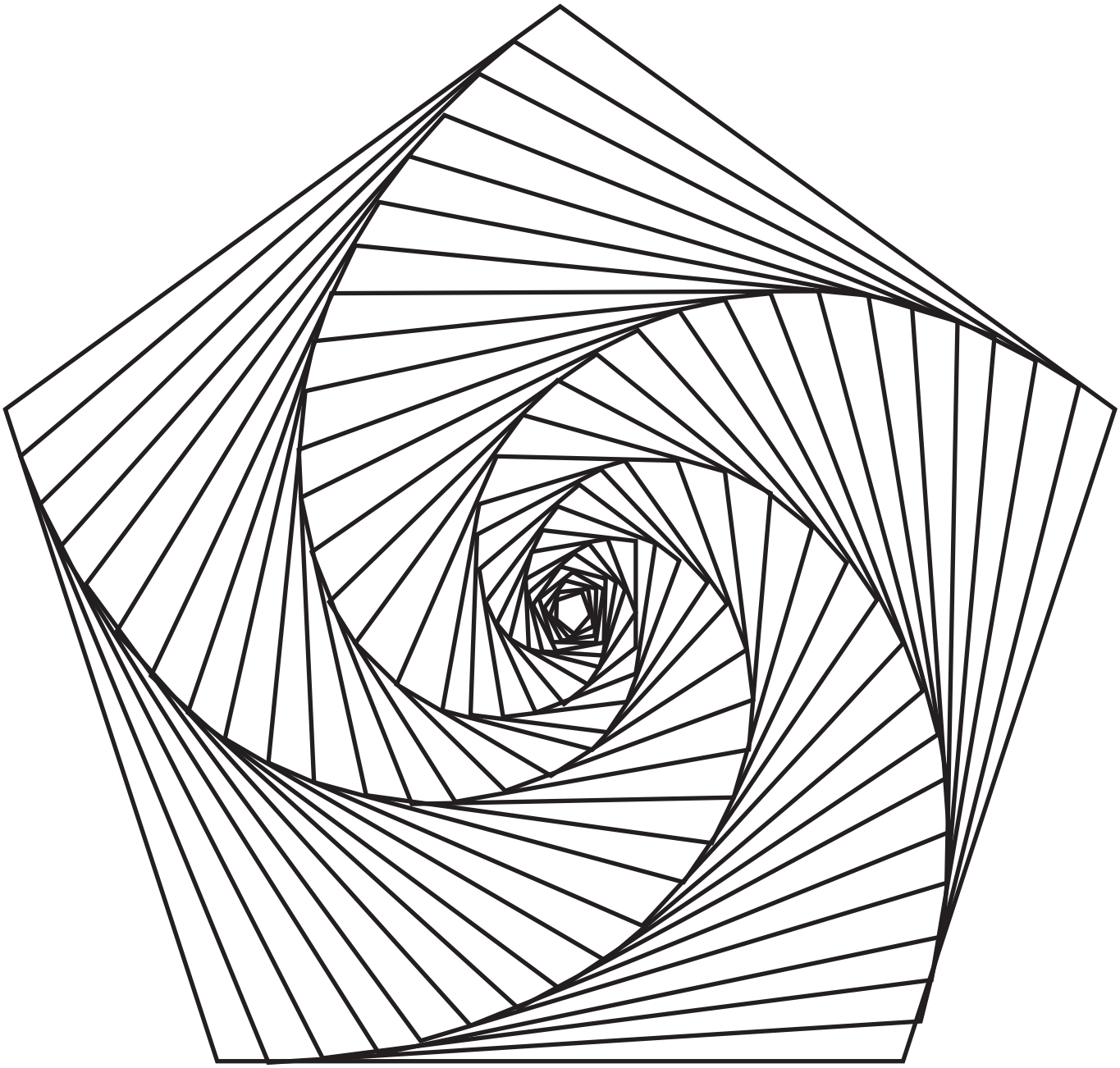
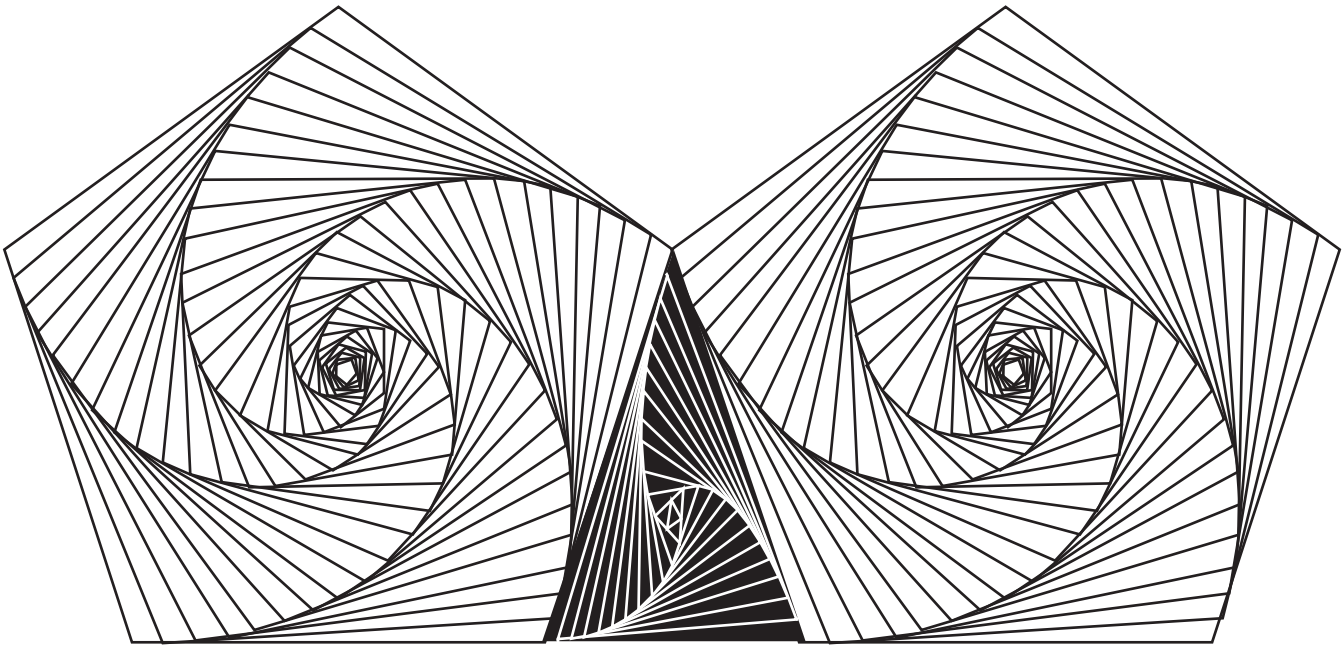
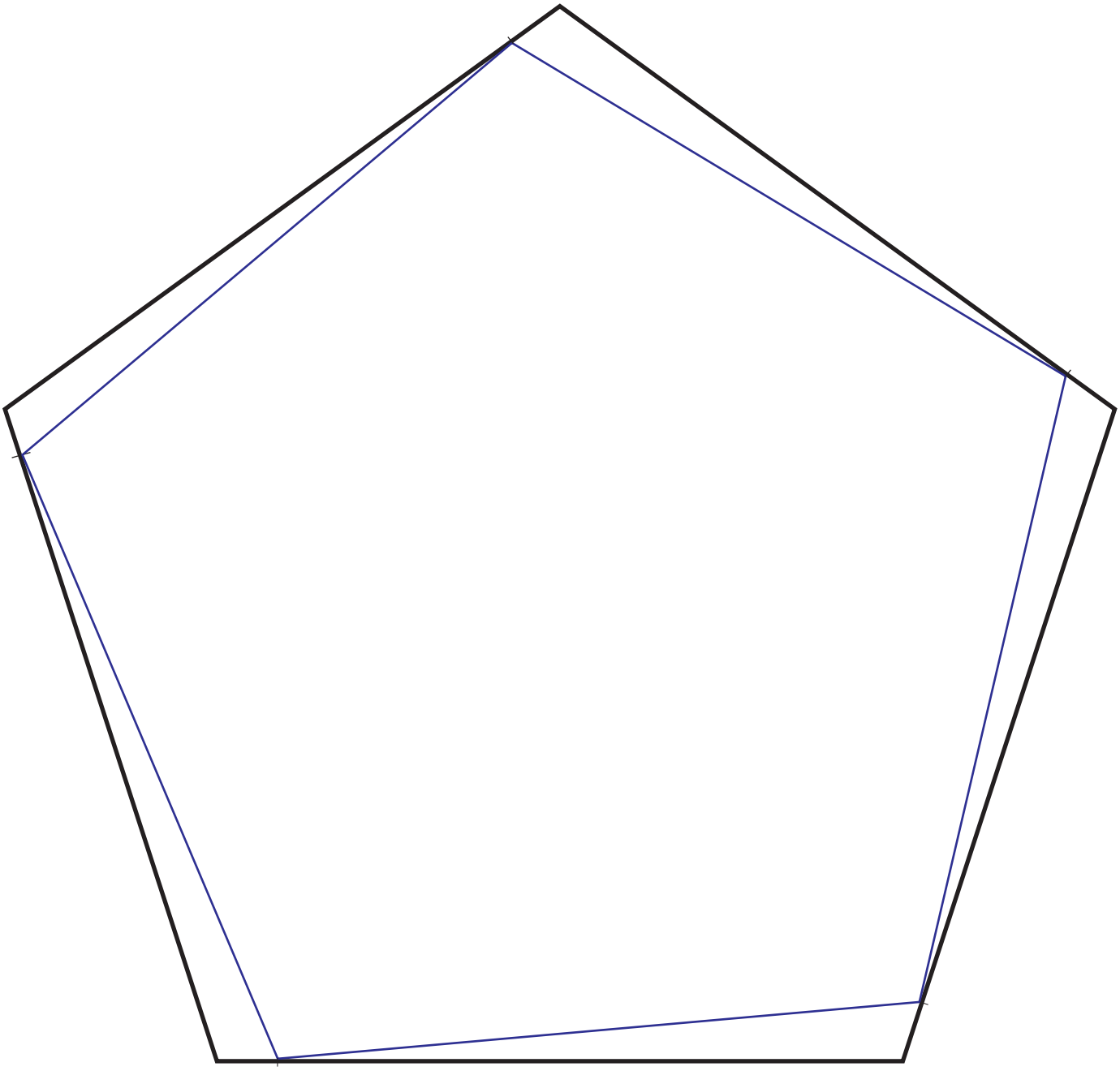




LINE DESIGNS

Measure 1 cm from each corner then draw a new pentagon.
Keep repeating this until you have a very small pentagon in the middle.



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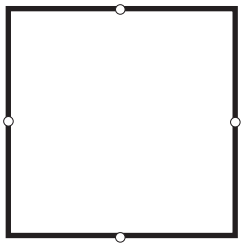
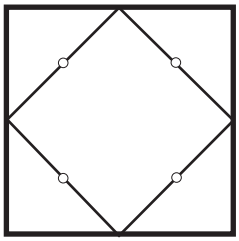
LINE DESIGNS

Measure and mark the half way points of each square.
Join these points to make another square.





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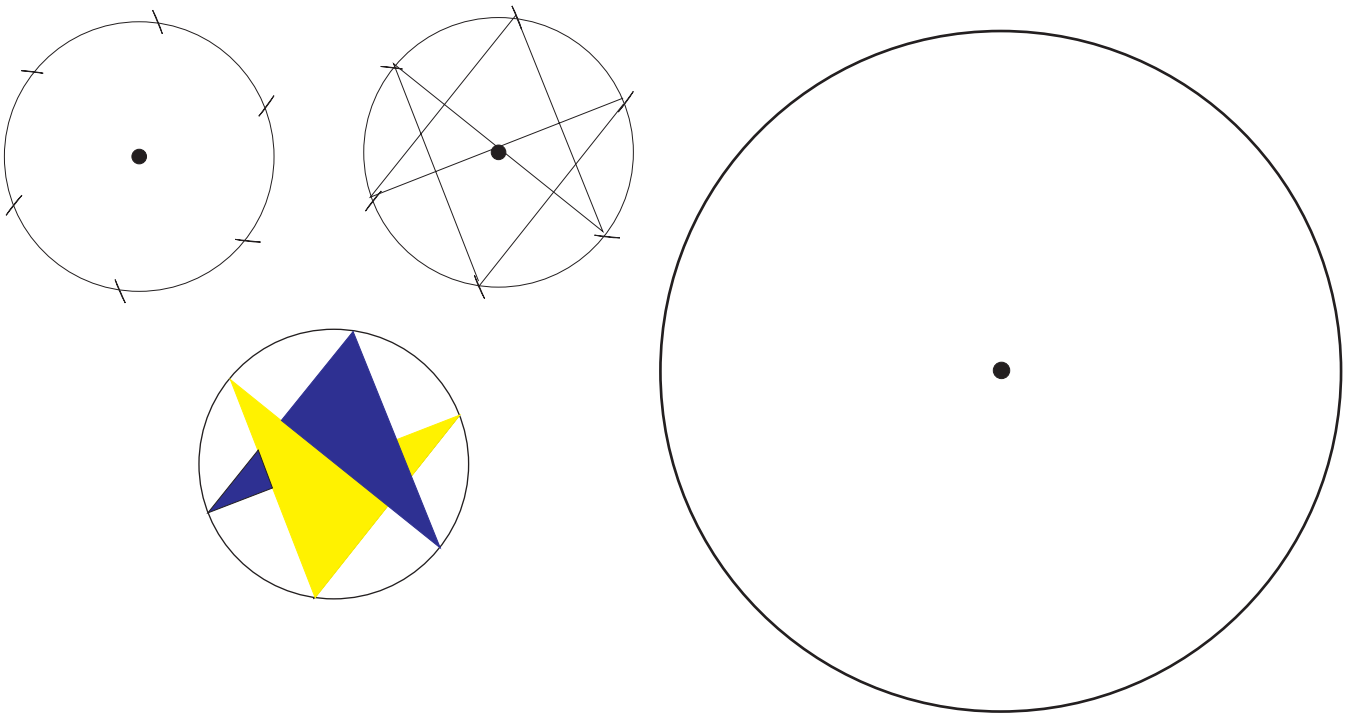
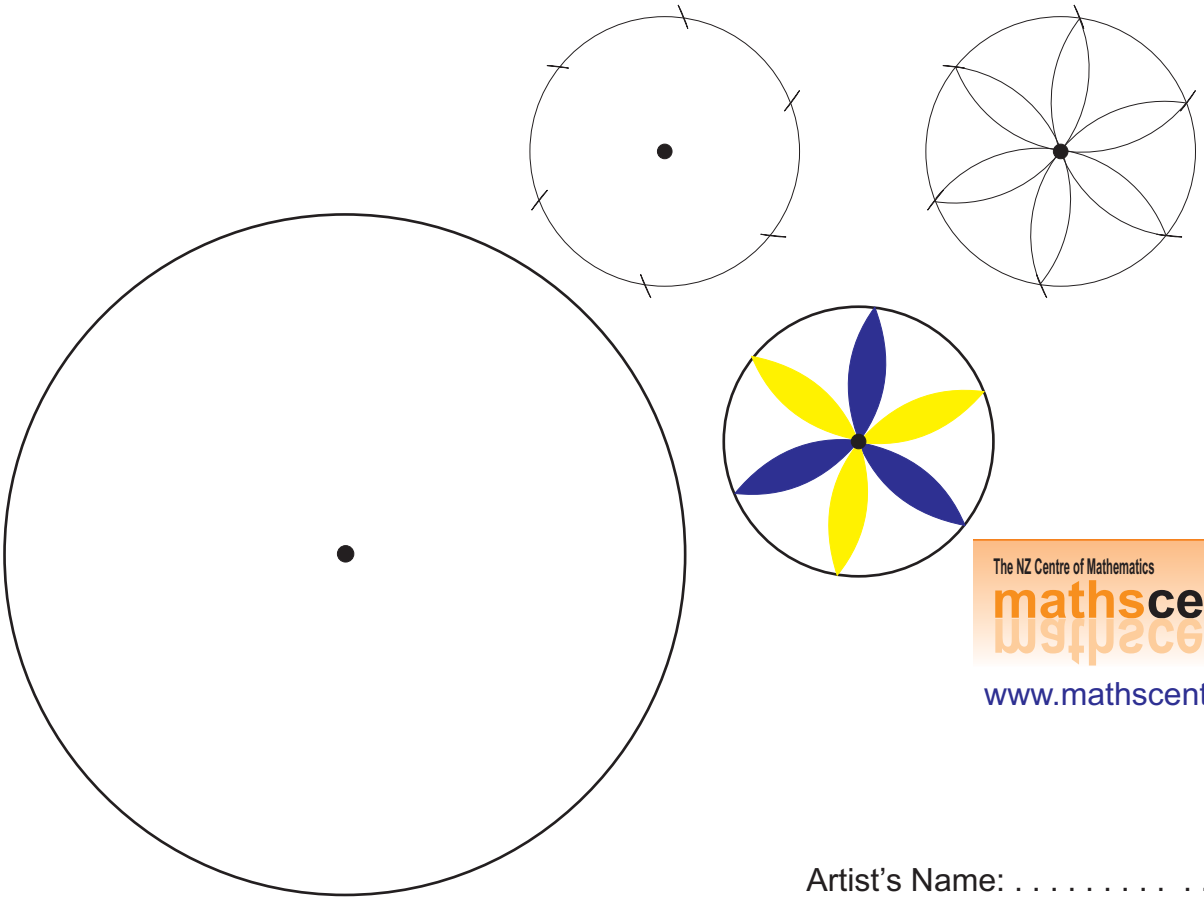
FUN WITH CIRCLES

Design 1: The circles below each have a radius of 45 mm. Use the radius to mark around the circumference. Draw the shape shown below. Rub out any unwanted lines and colour your design.



Design 2: Use the radius to mark around the circumference. Draw arcs with the same radius using each of your marks as a centre point. Colour your design.



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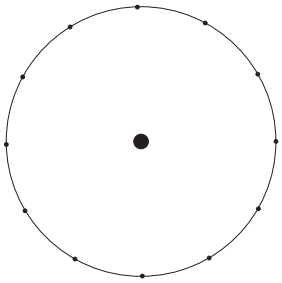
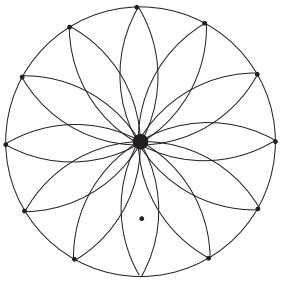
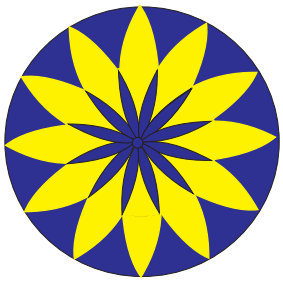
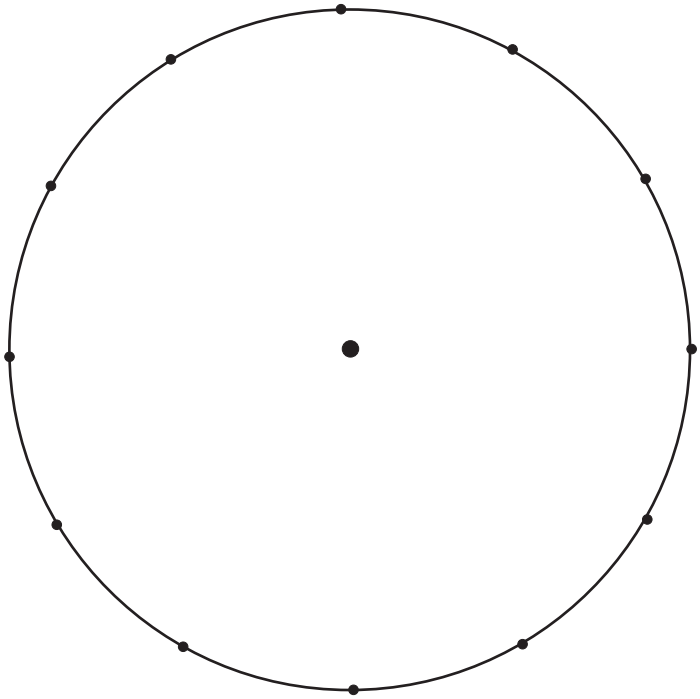
FUN WITH CIRCLES

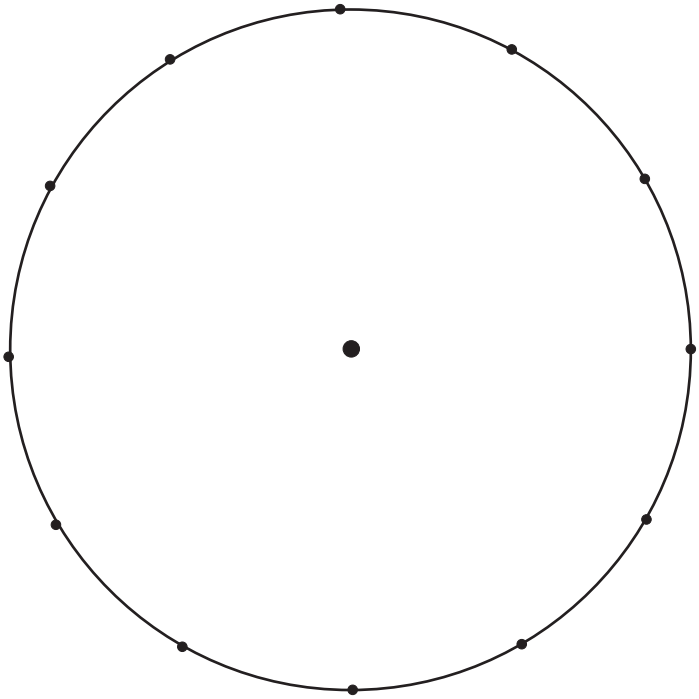
The circles below each have a radius of 45 mm. Using a pencil and compass, draw arcs with the same radius using each of the marks as a centre point. Colour each of your designs.

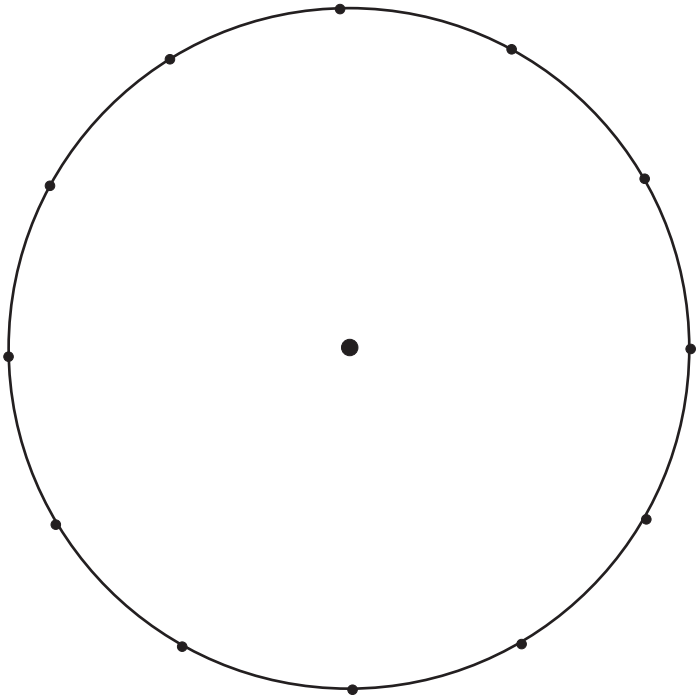












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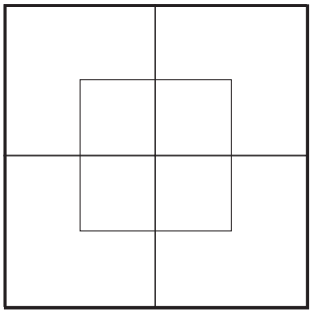
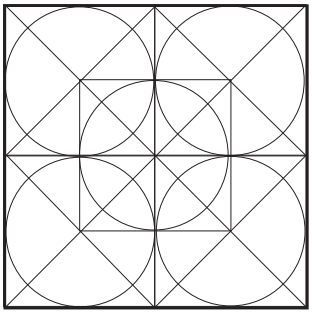
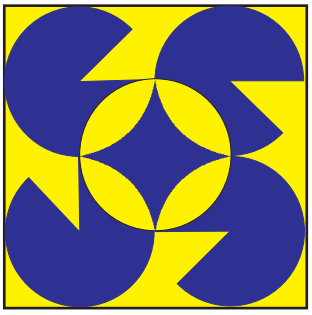
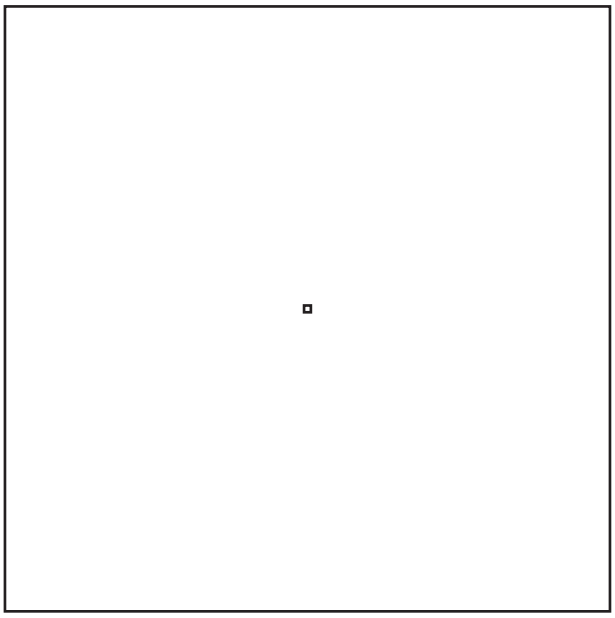
FUN WITH CIRCLES

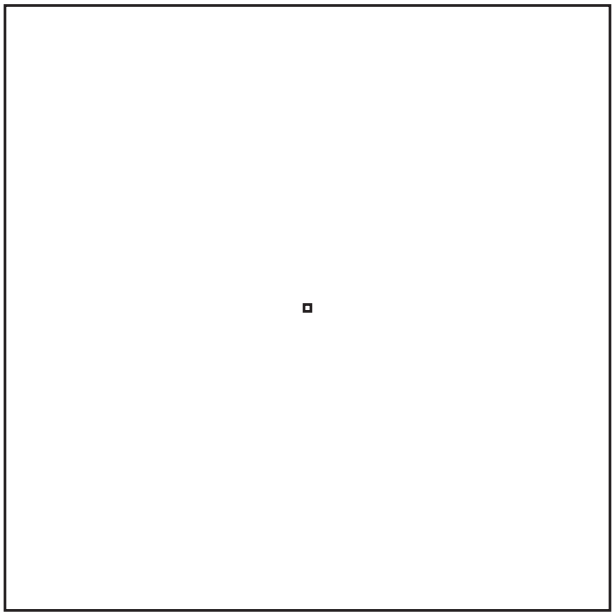
Below are three squares with sides of 80 mm. Divide each square into 5 smaller squares with one in the centre. Draw diagonals across each square. Use the centre where they cross as the centre of a circle. Colour each design differently.

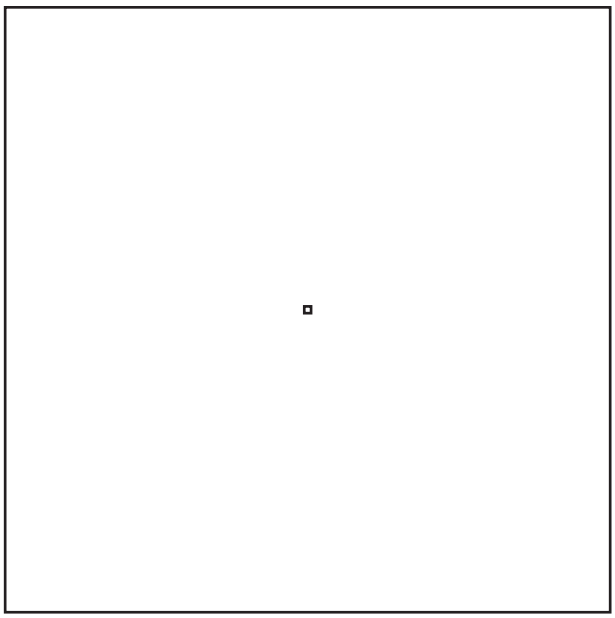












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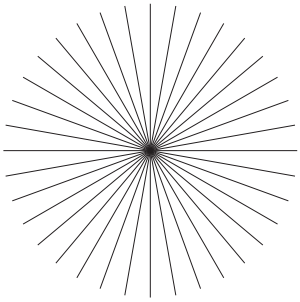
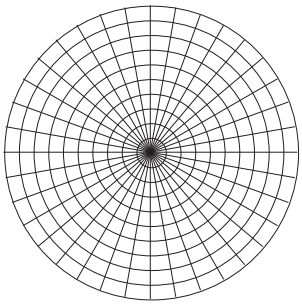
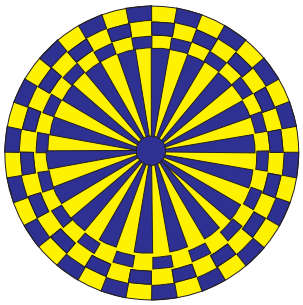
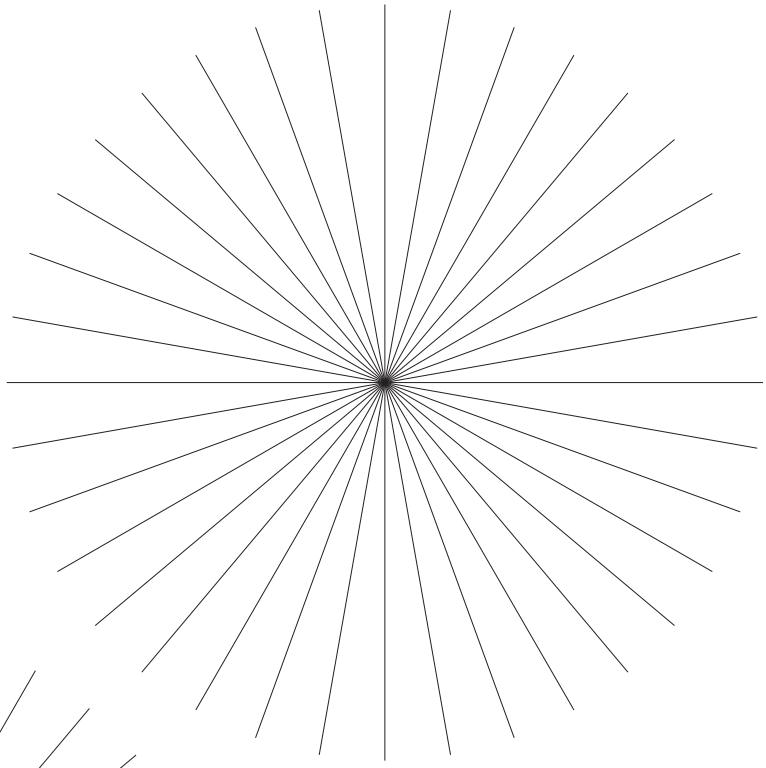
FUN WITH CIRCLES

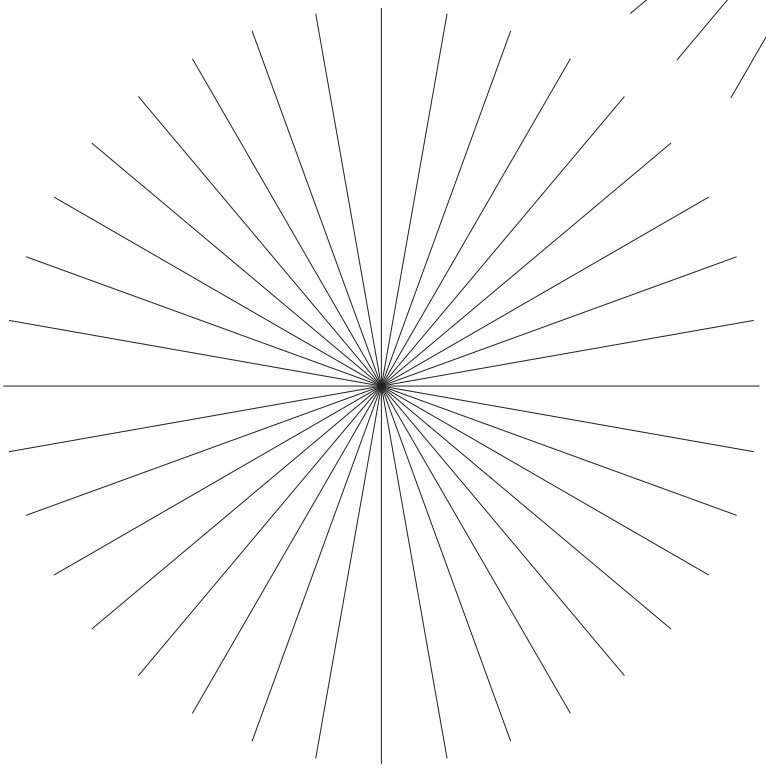
On the templates below draw 10 circles each one 9 mm apart.
Colour each of your designs.











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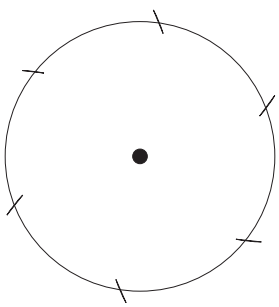
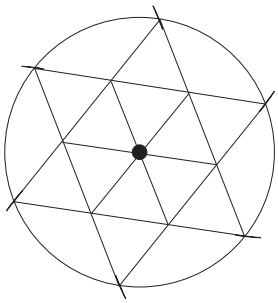
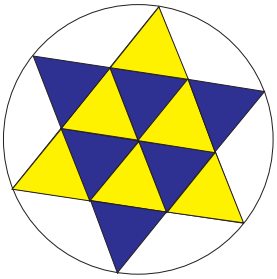
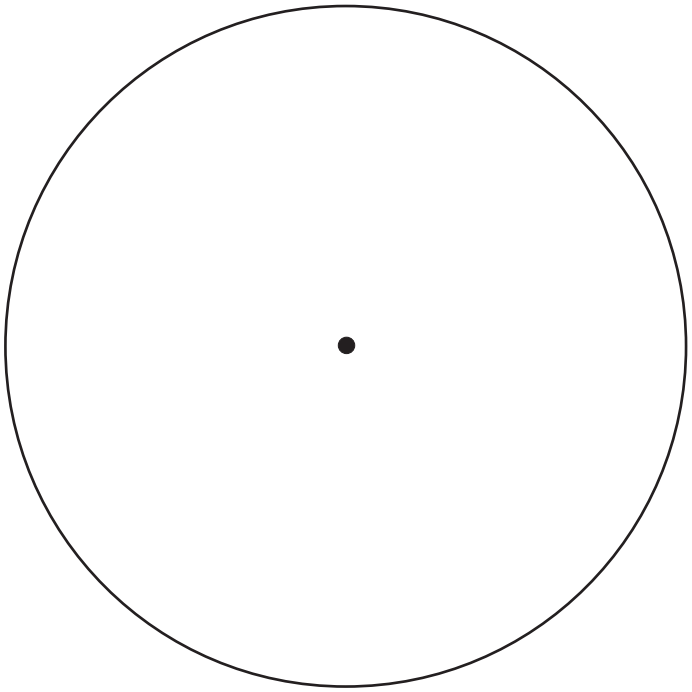
FUN WITH CIRCLES

Design 1: The circle below has a radius of 45 mm. Use the radius to mark around the circumference. Draw the shape shown below. Rub out any unwanted lines and colour your design.

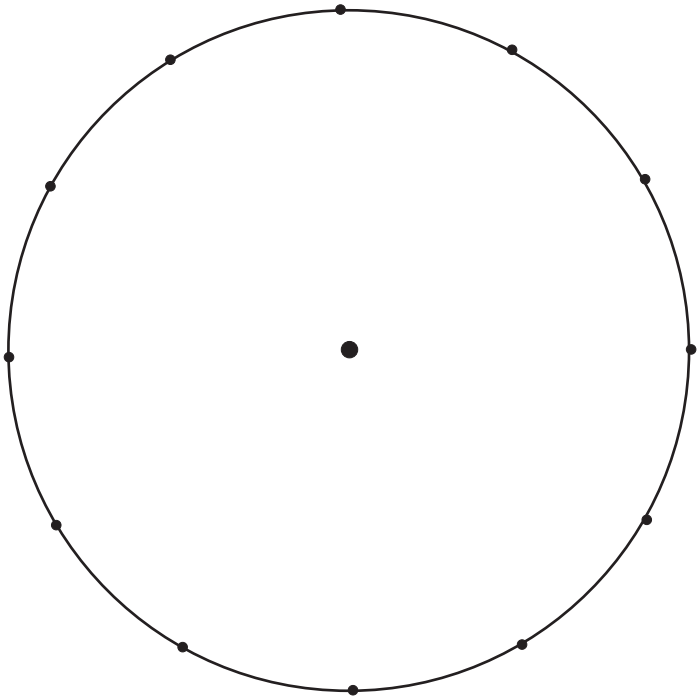


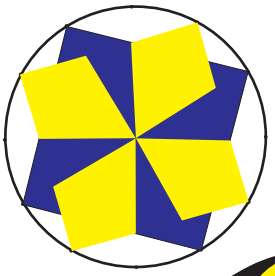


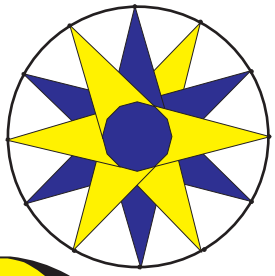


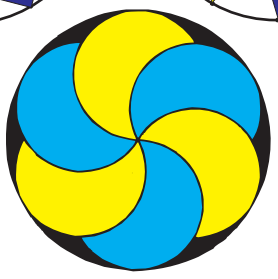


Design 2: What can you design with this circle?









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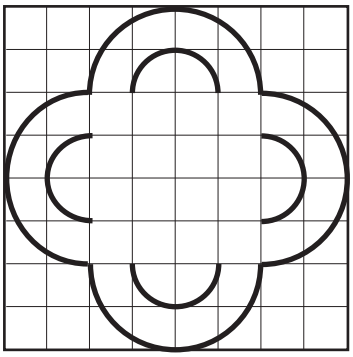
FUN WITH LINES AND CIRCLES

Draw the chain figure in the square below.



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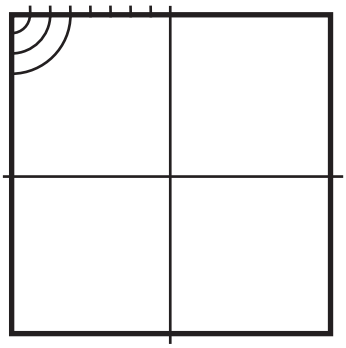
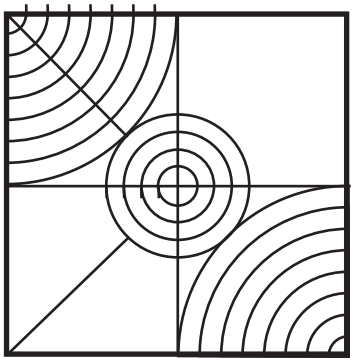
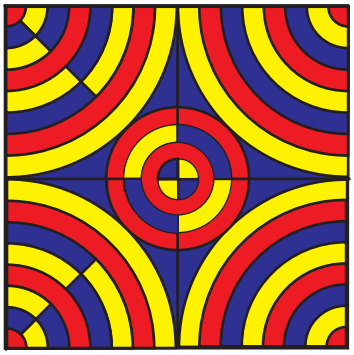
FUN WITH LINES AND CIRCLES

Draw the figure in the square below. Colour your design.







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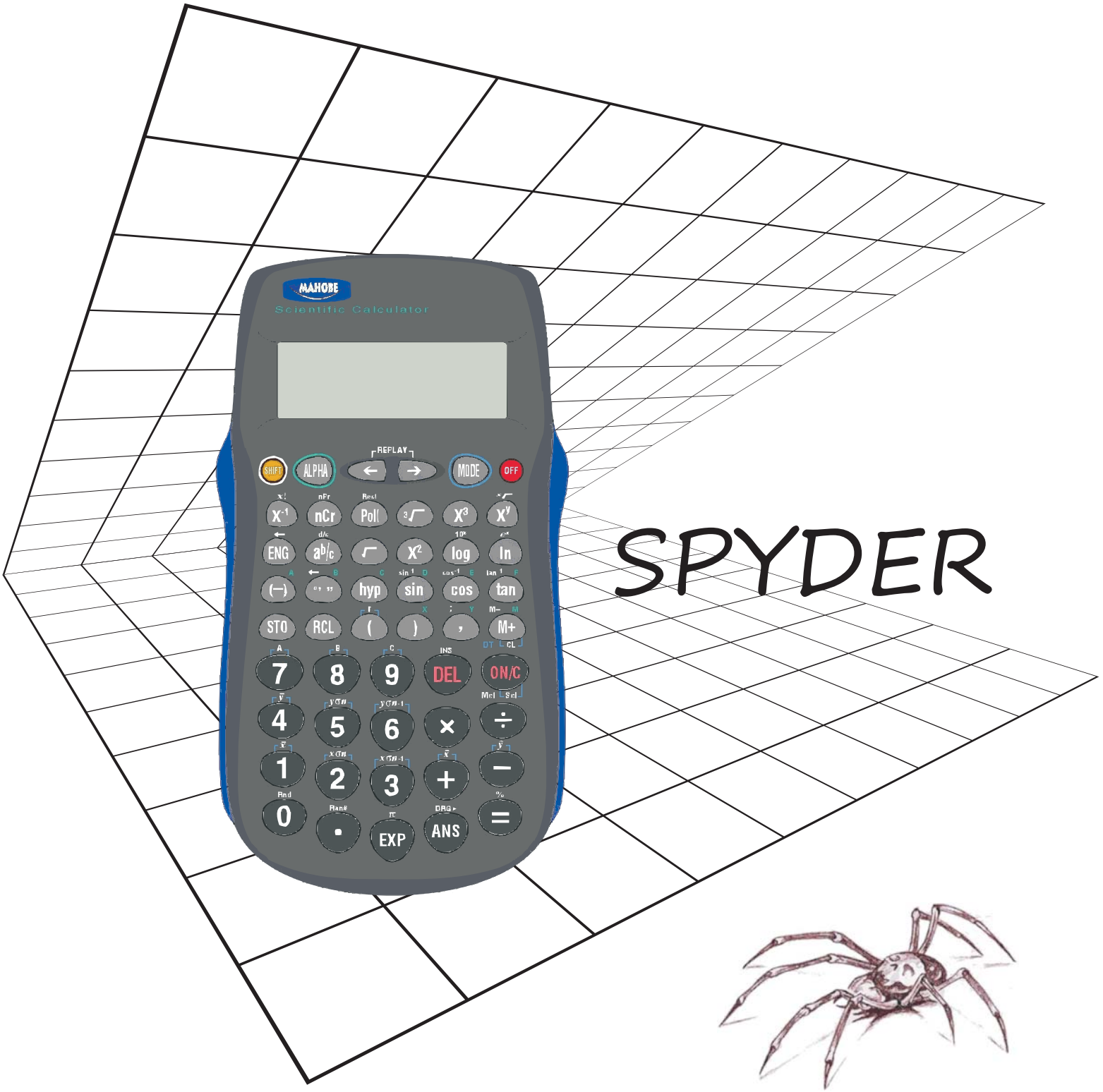

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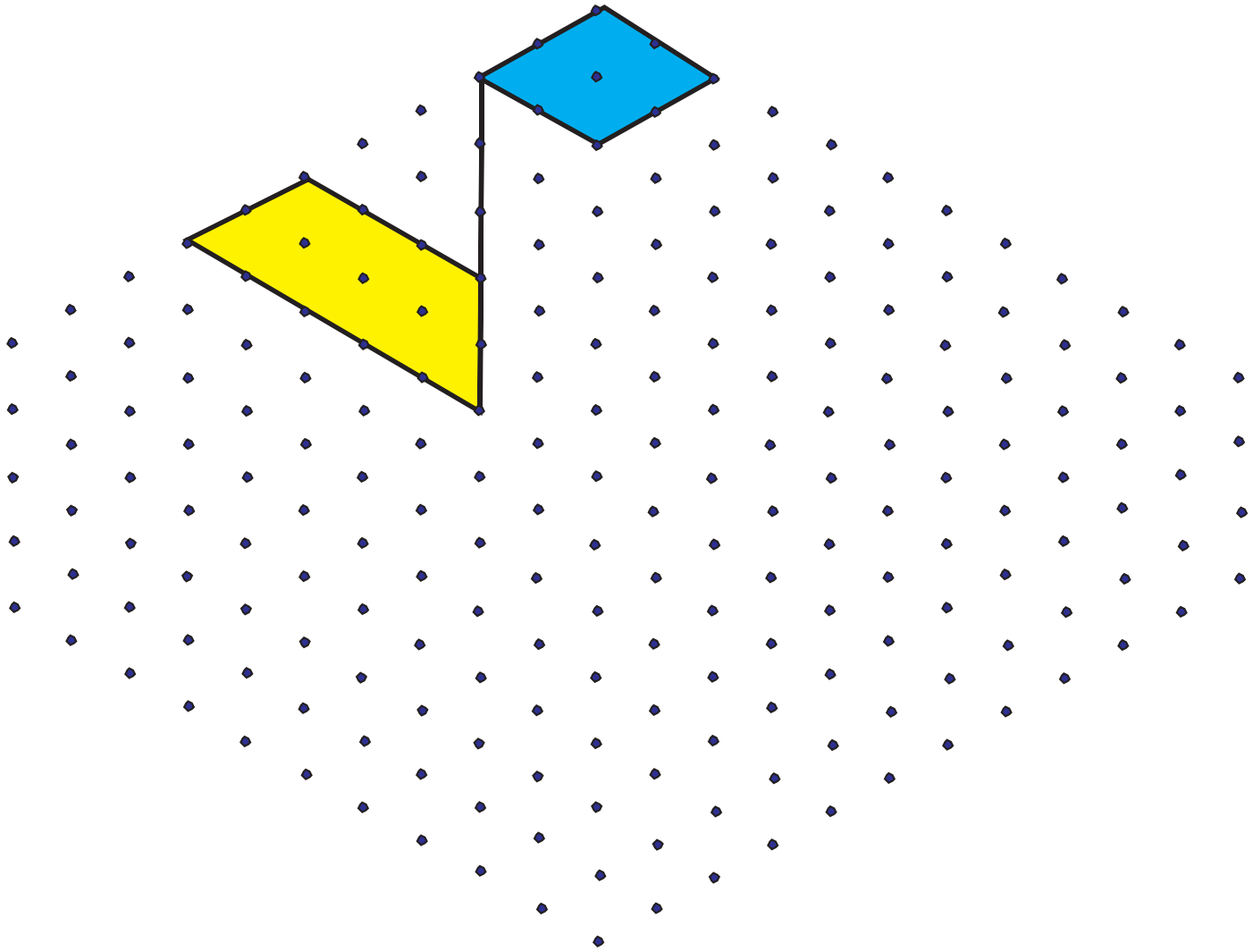
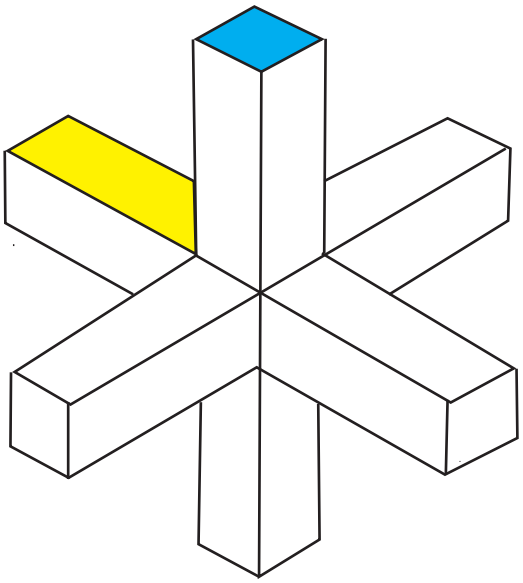
THREE DIMENSIONAL SHAPES

Finish sketching the solid.





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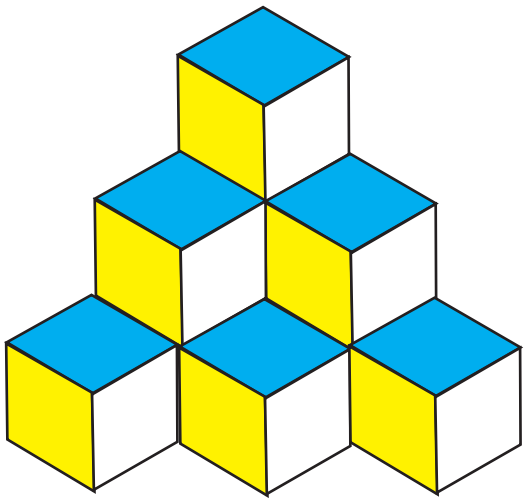

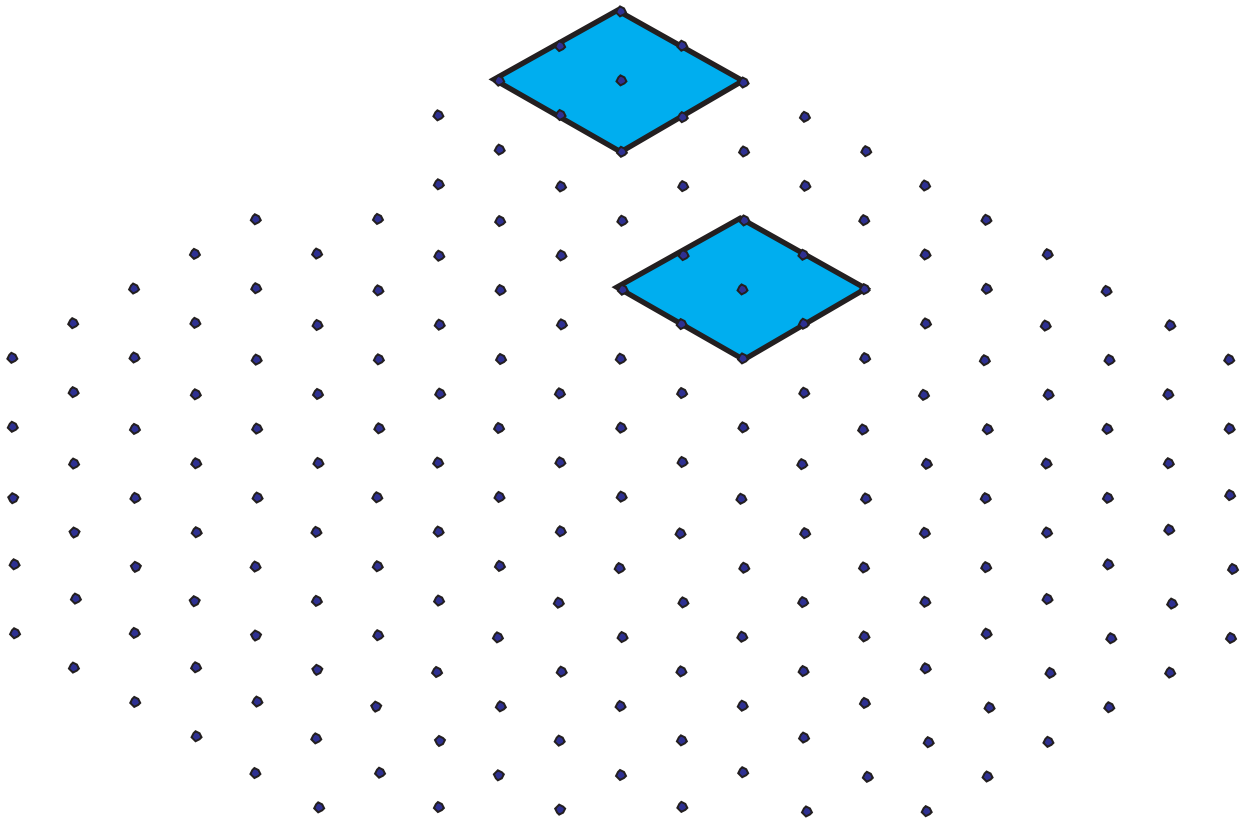

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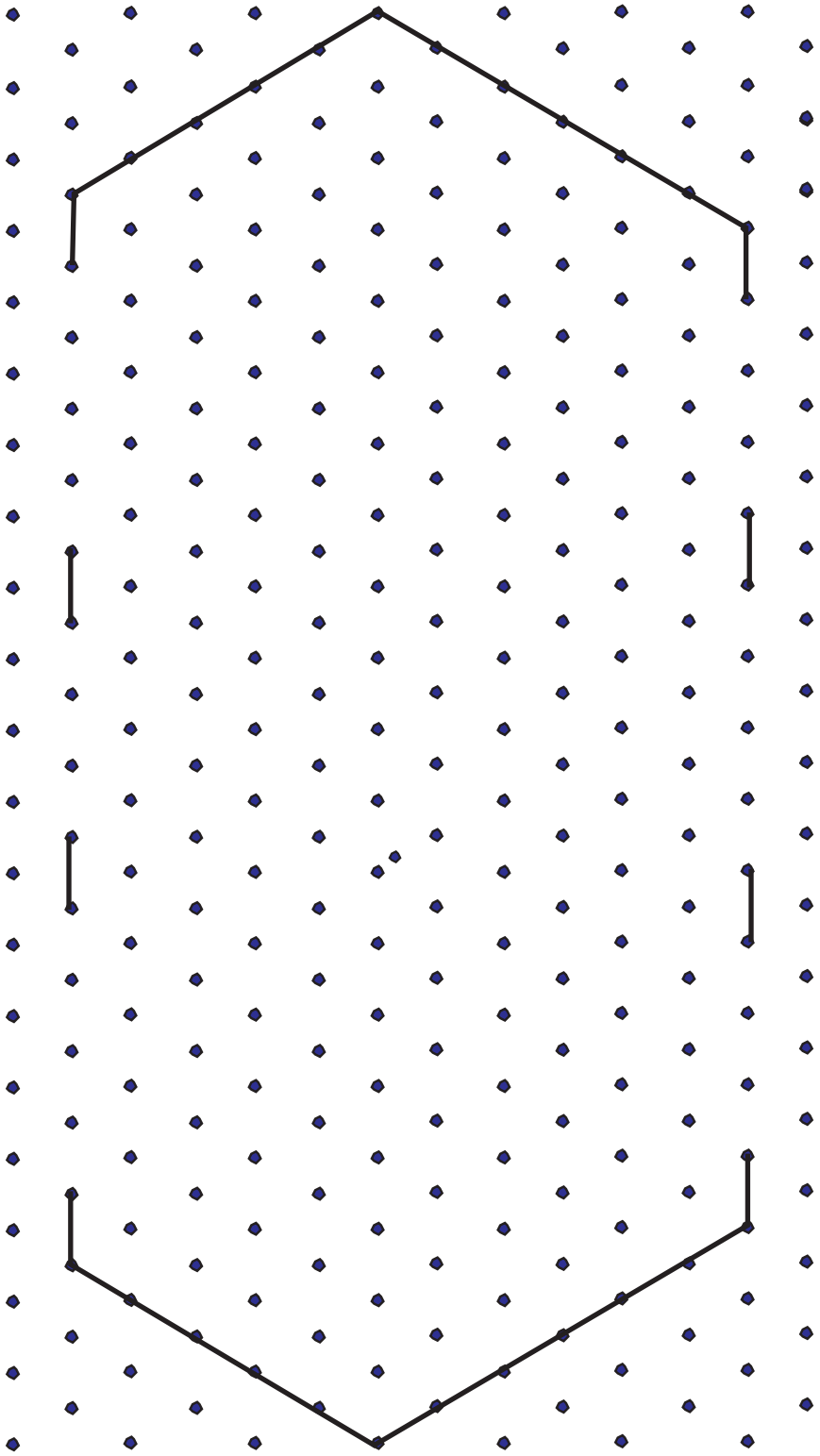
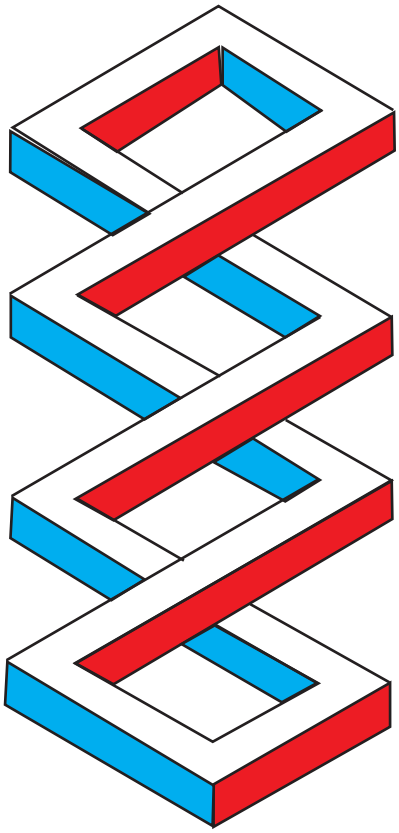
IMPOSSIBLE SOLID STRUCTURES

Finish sketching the impossible solid.





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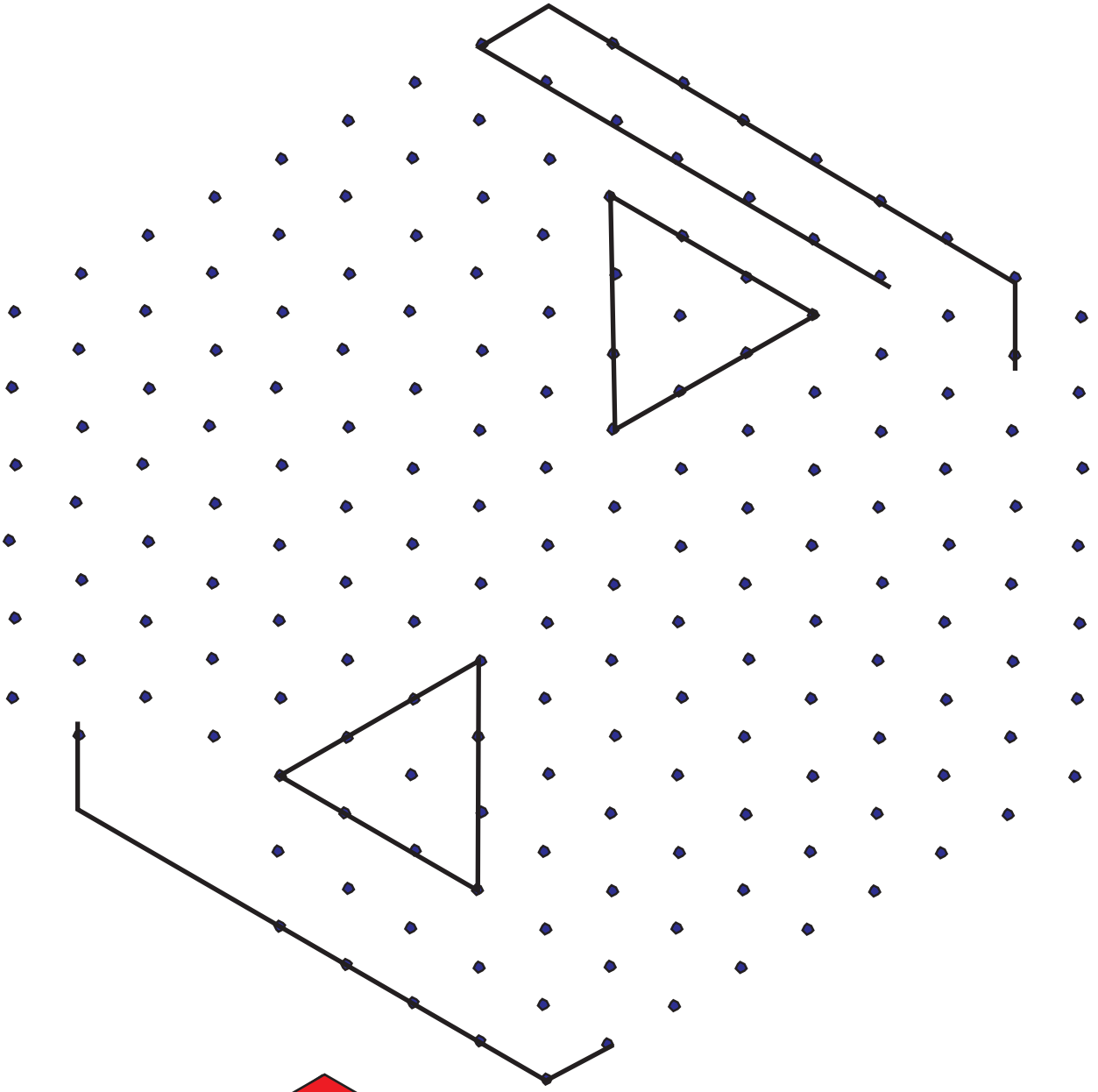

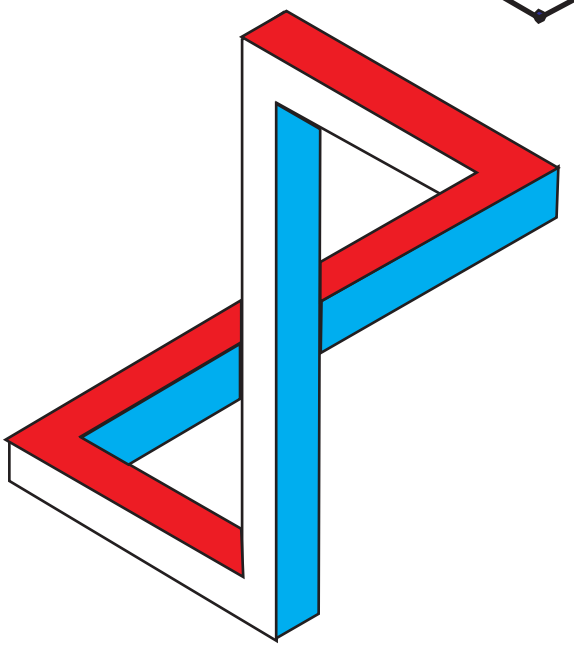

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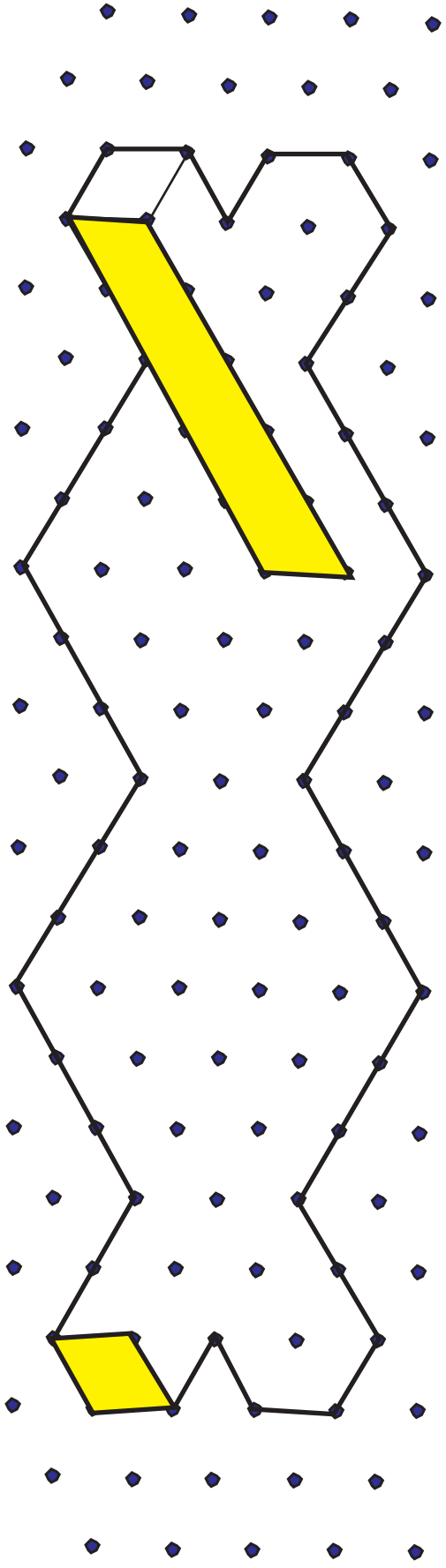

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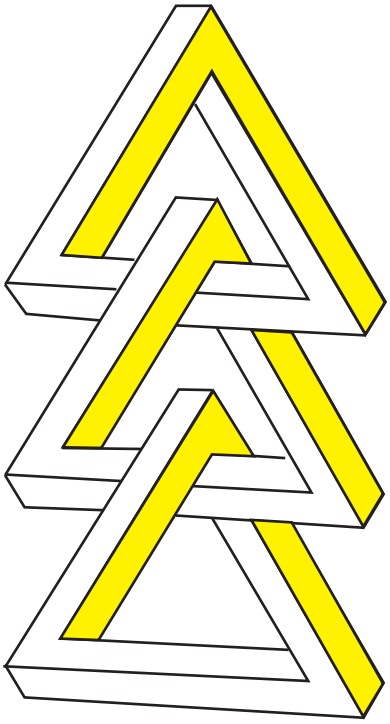

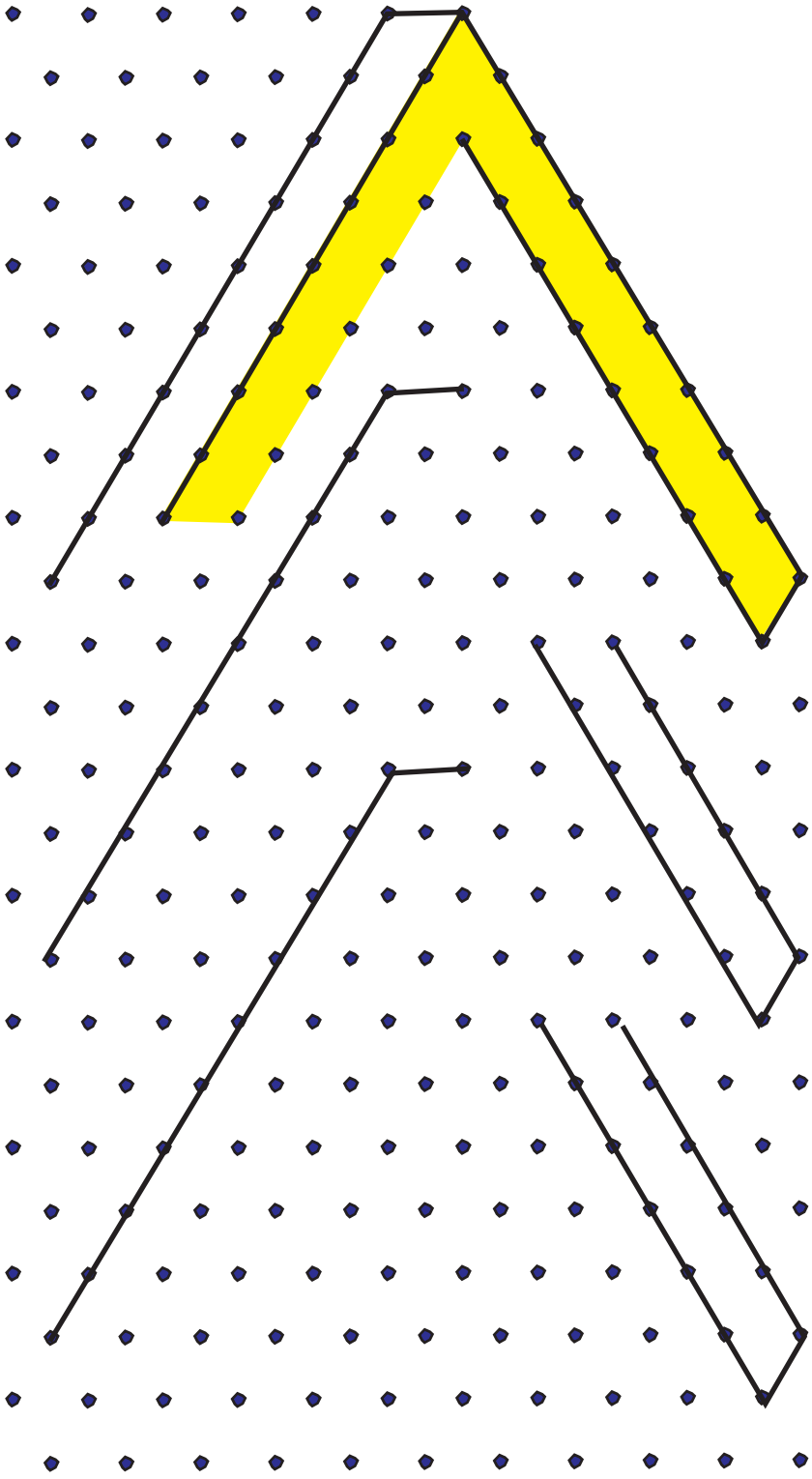

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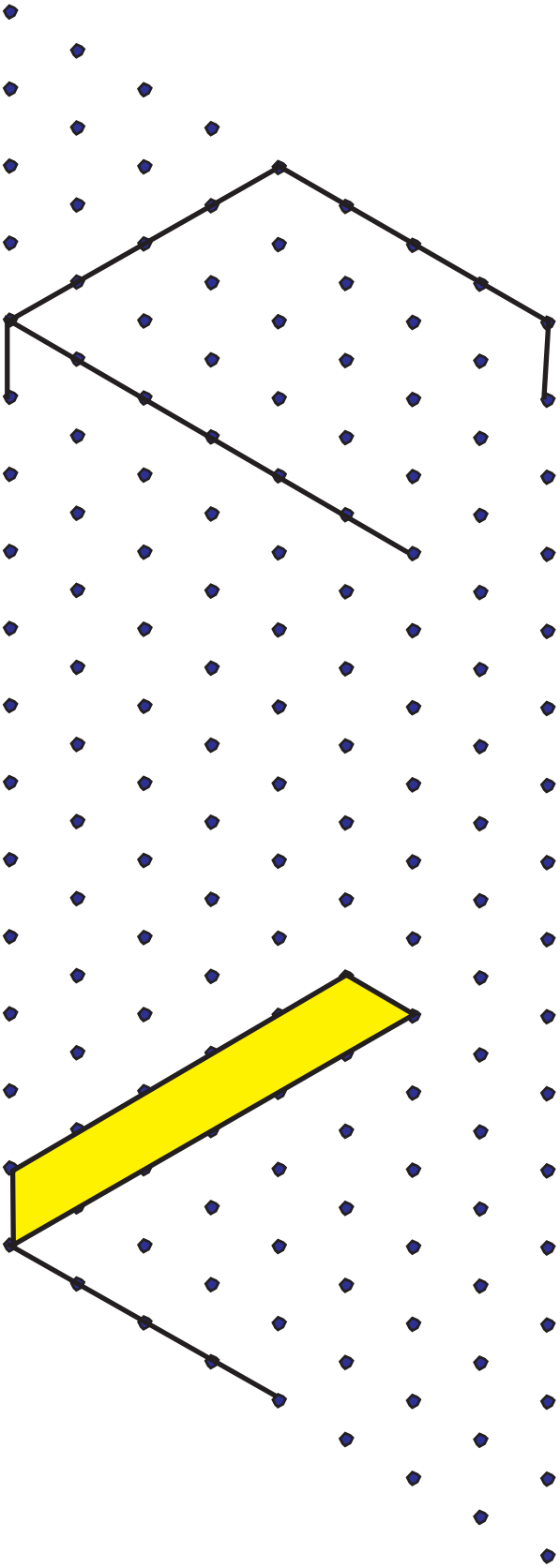

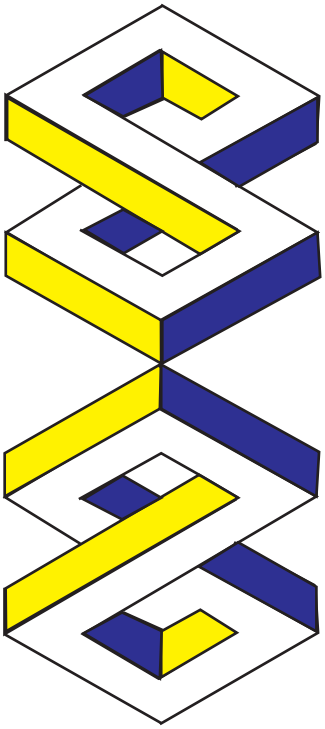

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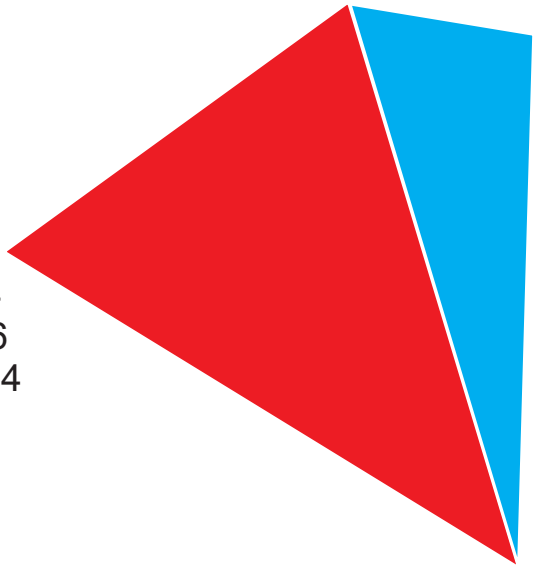
PLATONIC SOLIDS

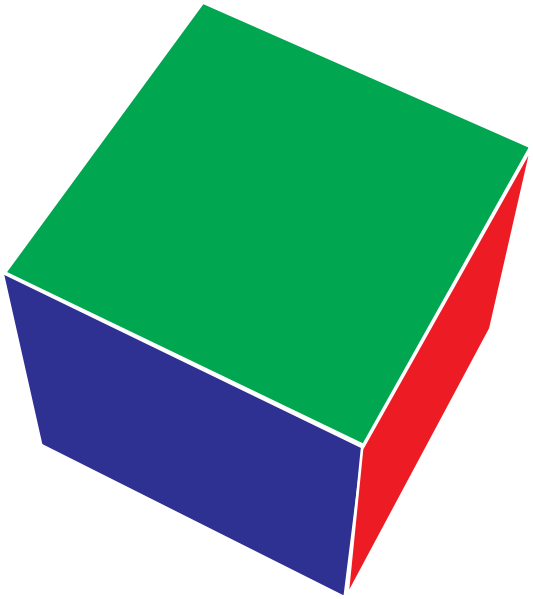
Tetrahedron

Number of faces: 4
Number of edges: 6
Number of vertices: 4



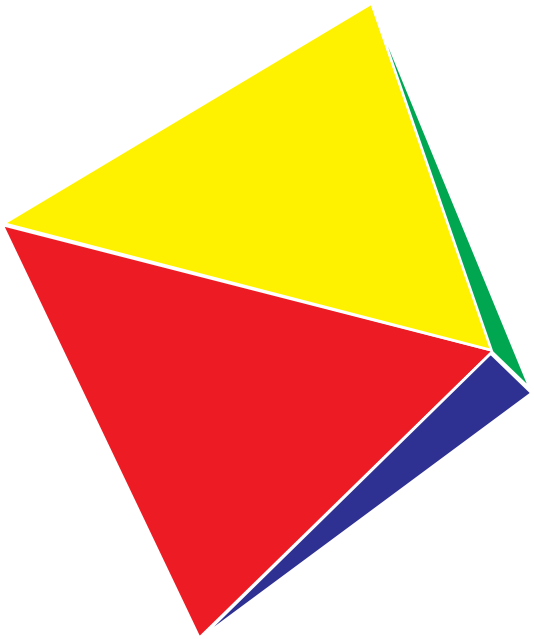
Hexahedron (Cube)

Number of faces: 6
Number of edges: 12
Number of vertices: 8



Octahedron

Number of faces: 8
Number of edges: 12
Number of vertices: 6



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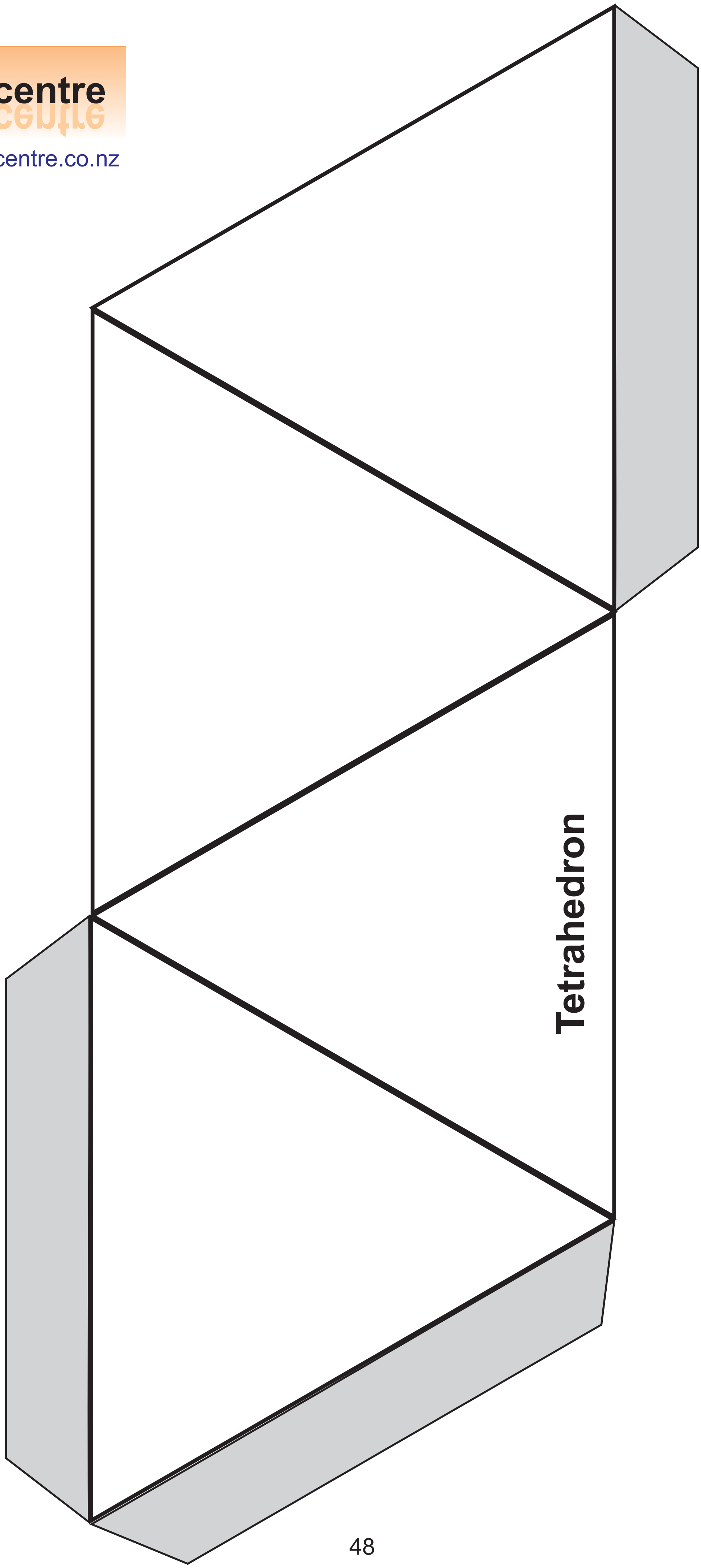

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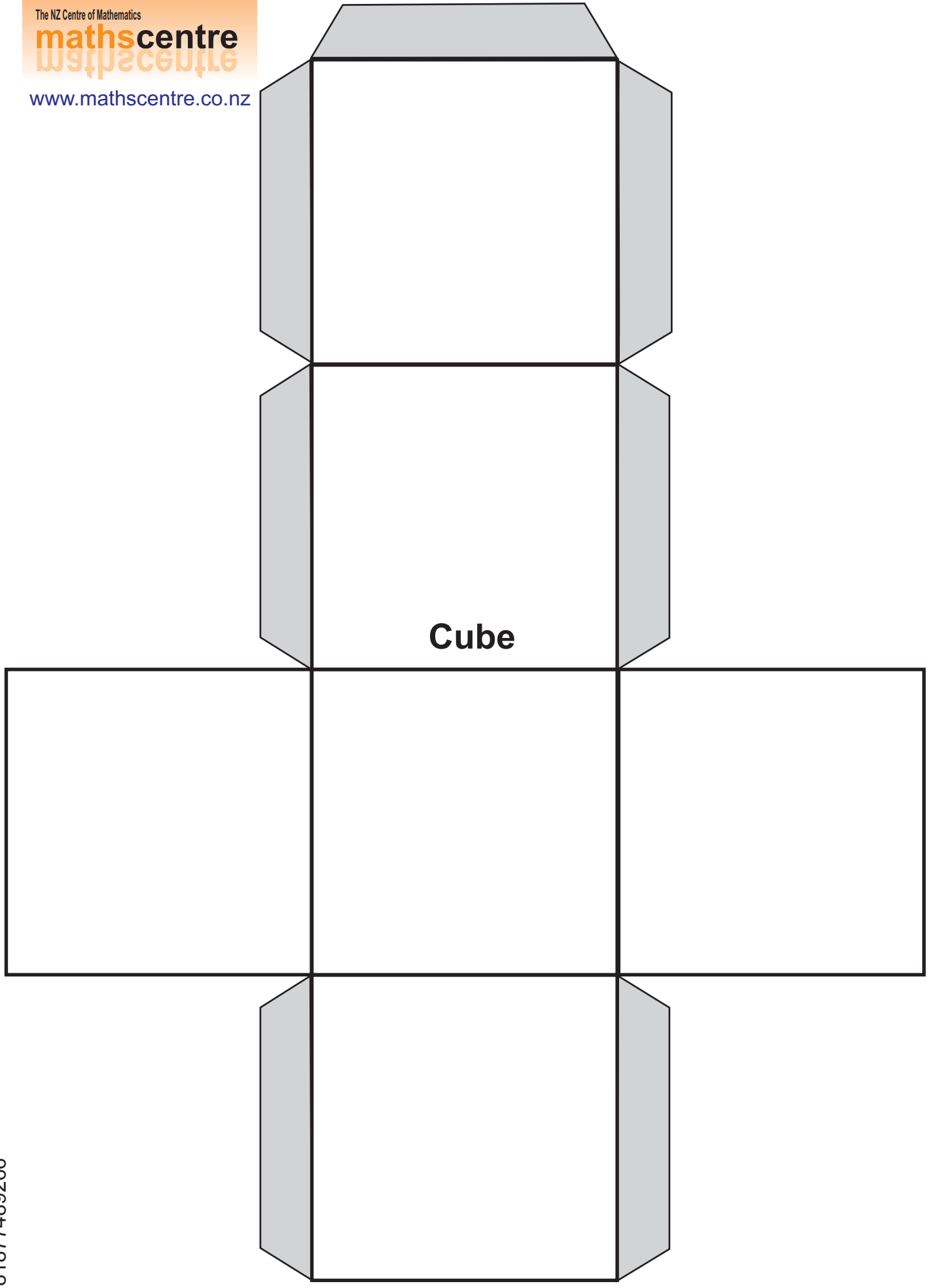

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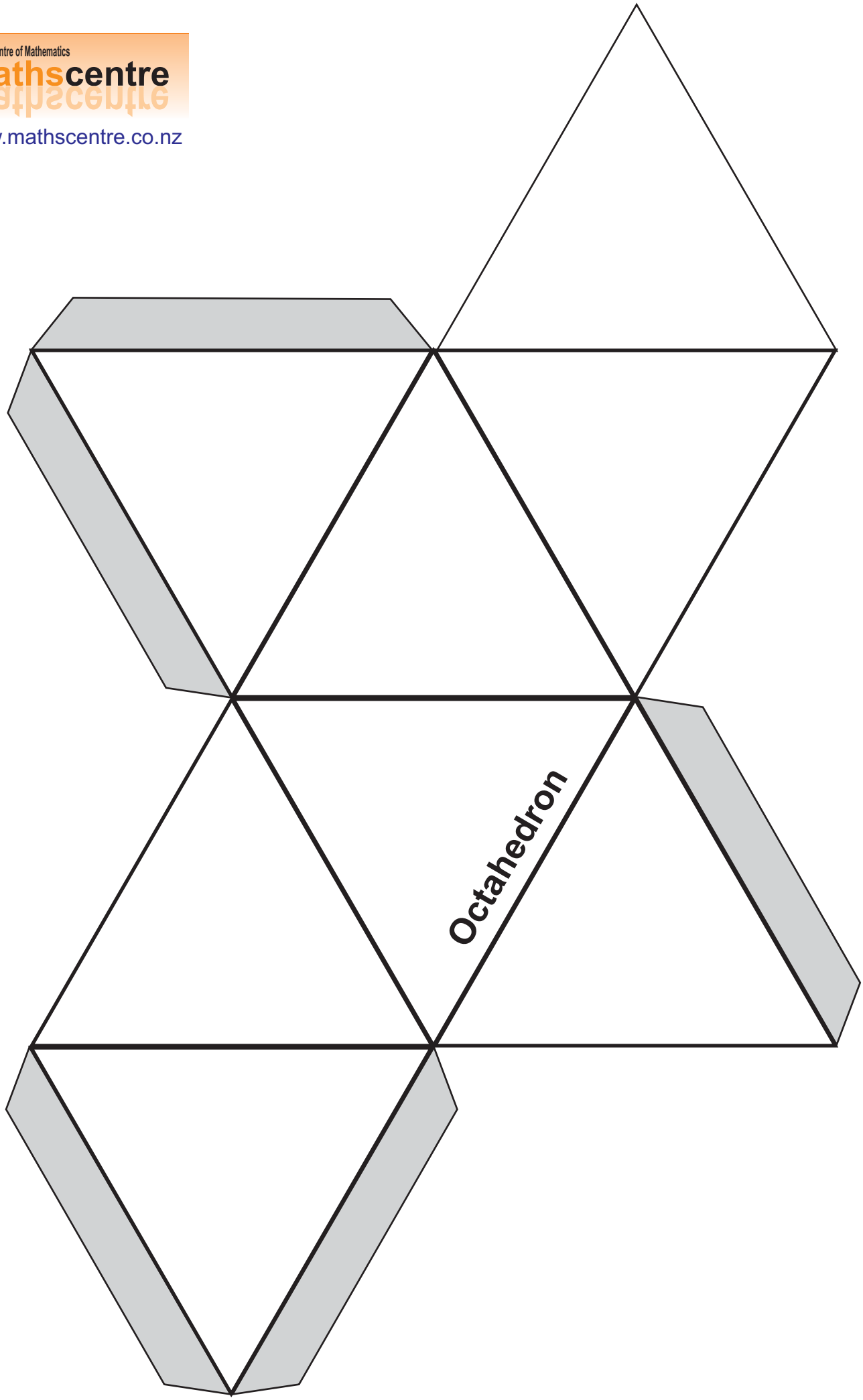

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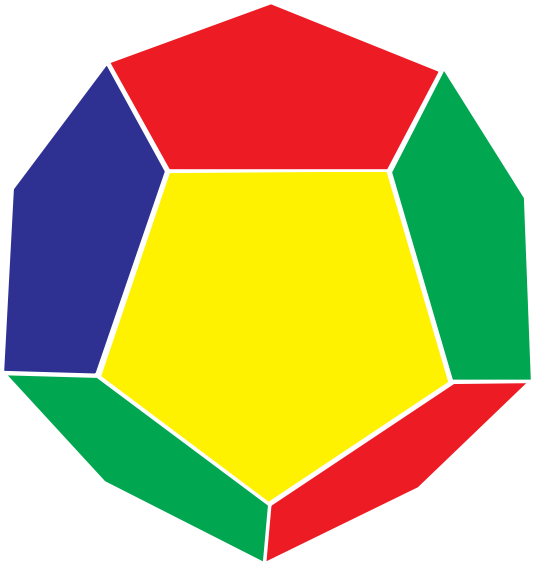
PLATONIC SOLIDS

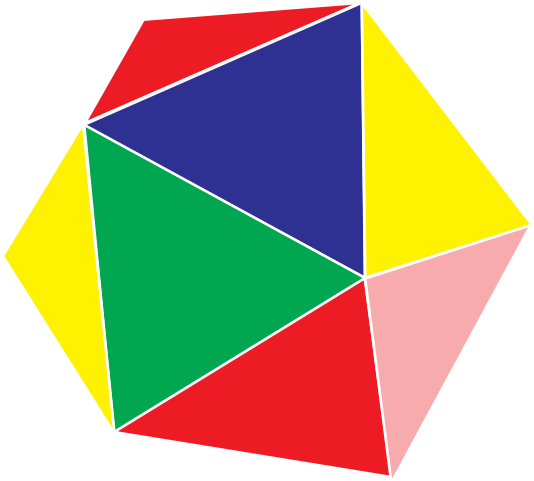
Dodecahedron

Number of faces: 12
Number of edges: 30
Number of vertices: 20



Icosahedron

Number of faces: 20
Number of edges: 30
Number of vertices: 12



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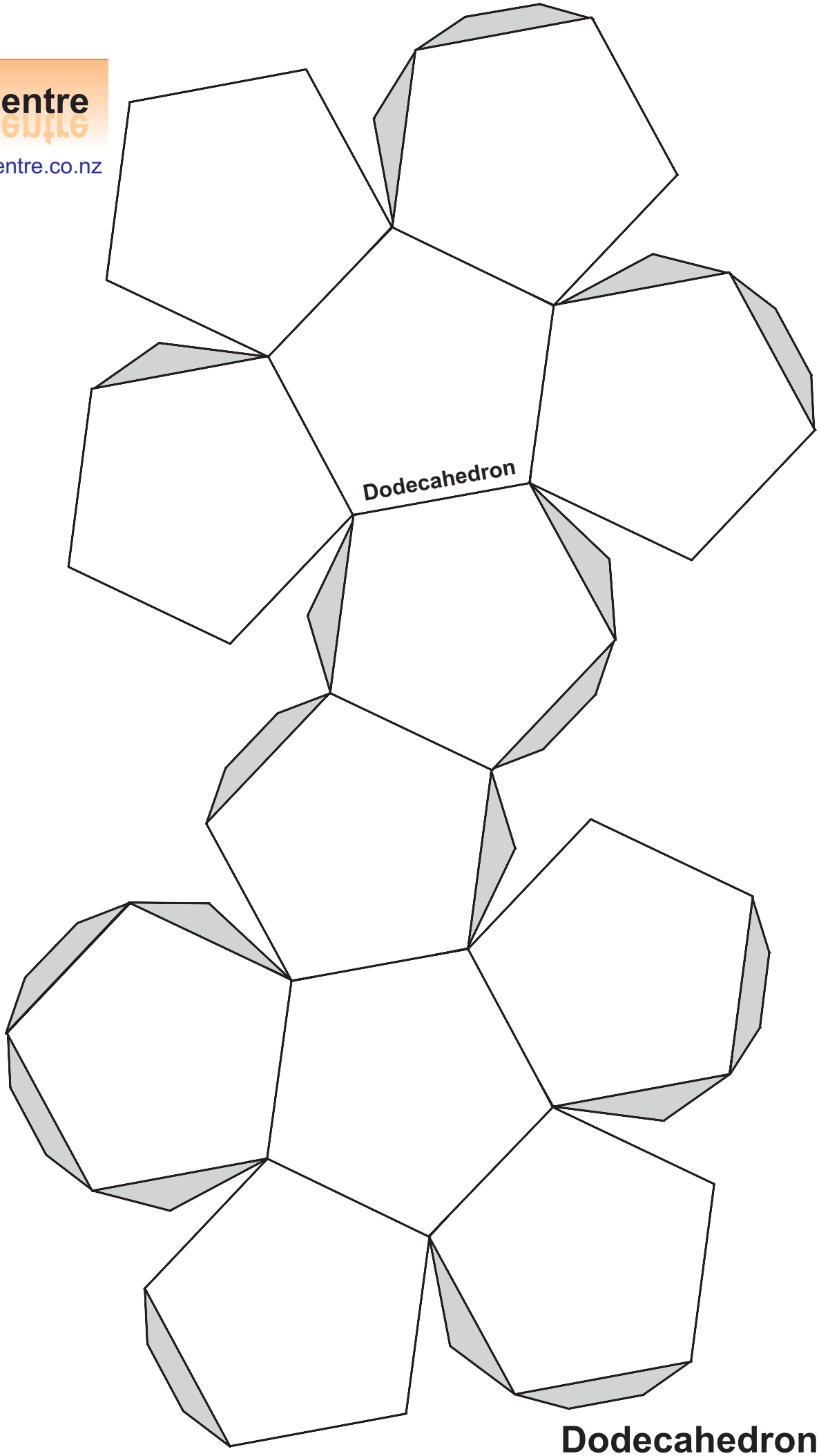

Dodecahedron

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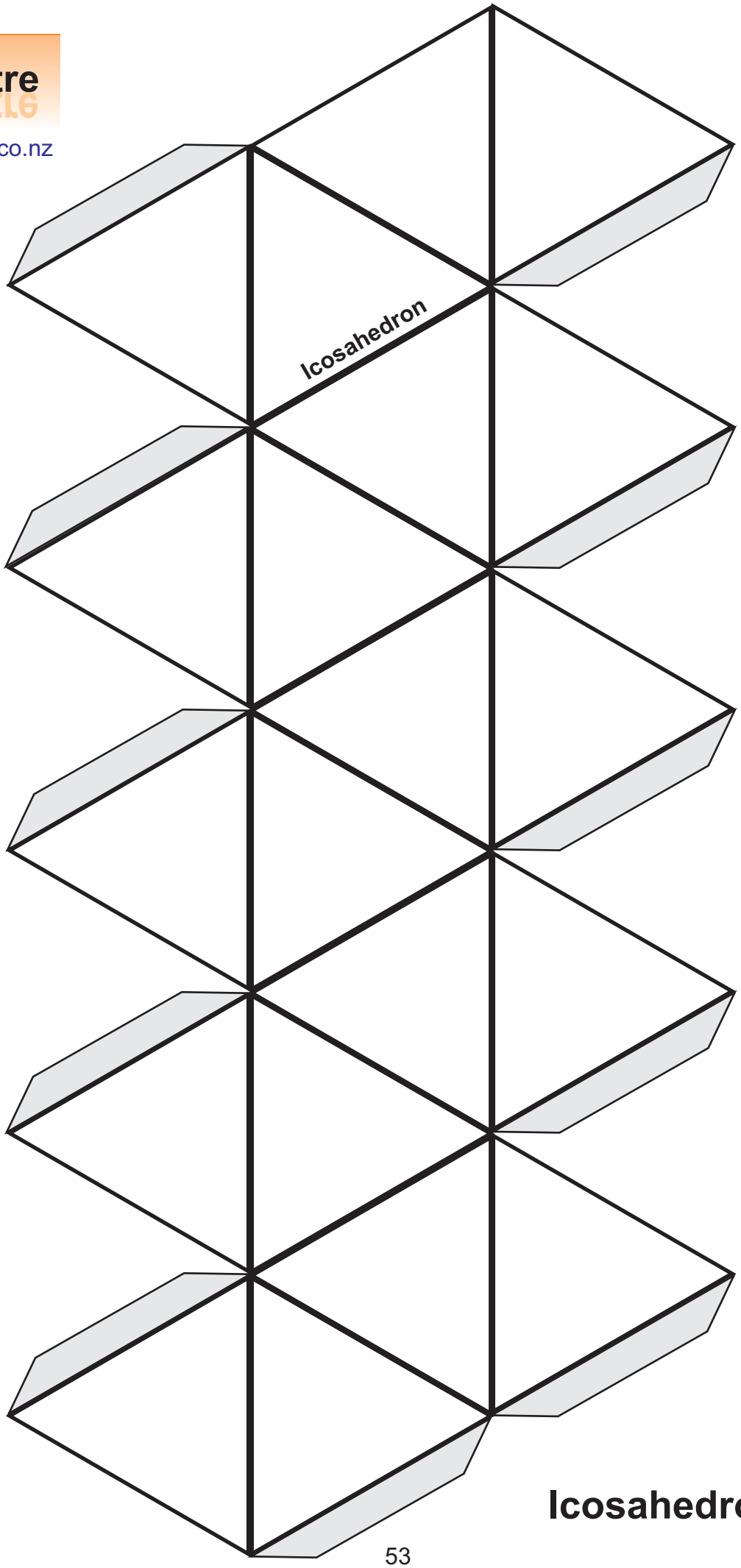

Icosahedron

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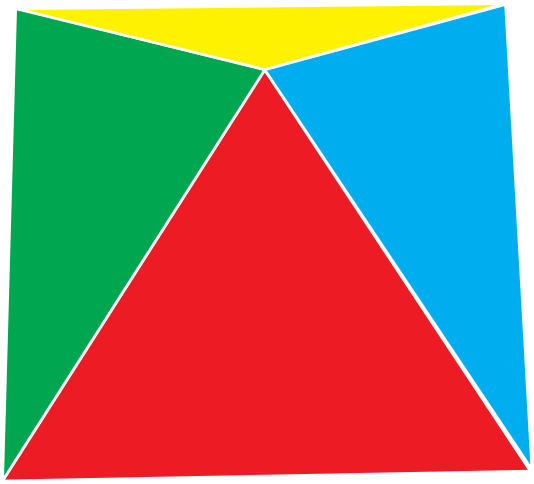
POLYHEDRA

Square Pyramid

Number of faces: 5
Number of edges: 8
Number of vertices: 5



Truncated Icosahedron

Number of faces: 32
Number of edges: 90
Number of vertices: 60

(otherwise known as a football)

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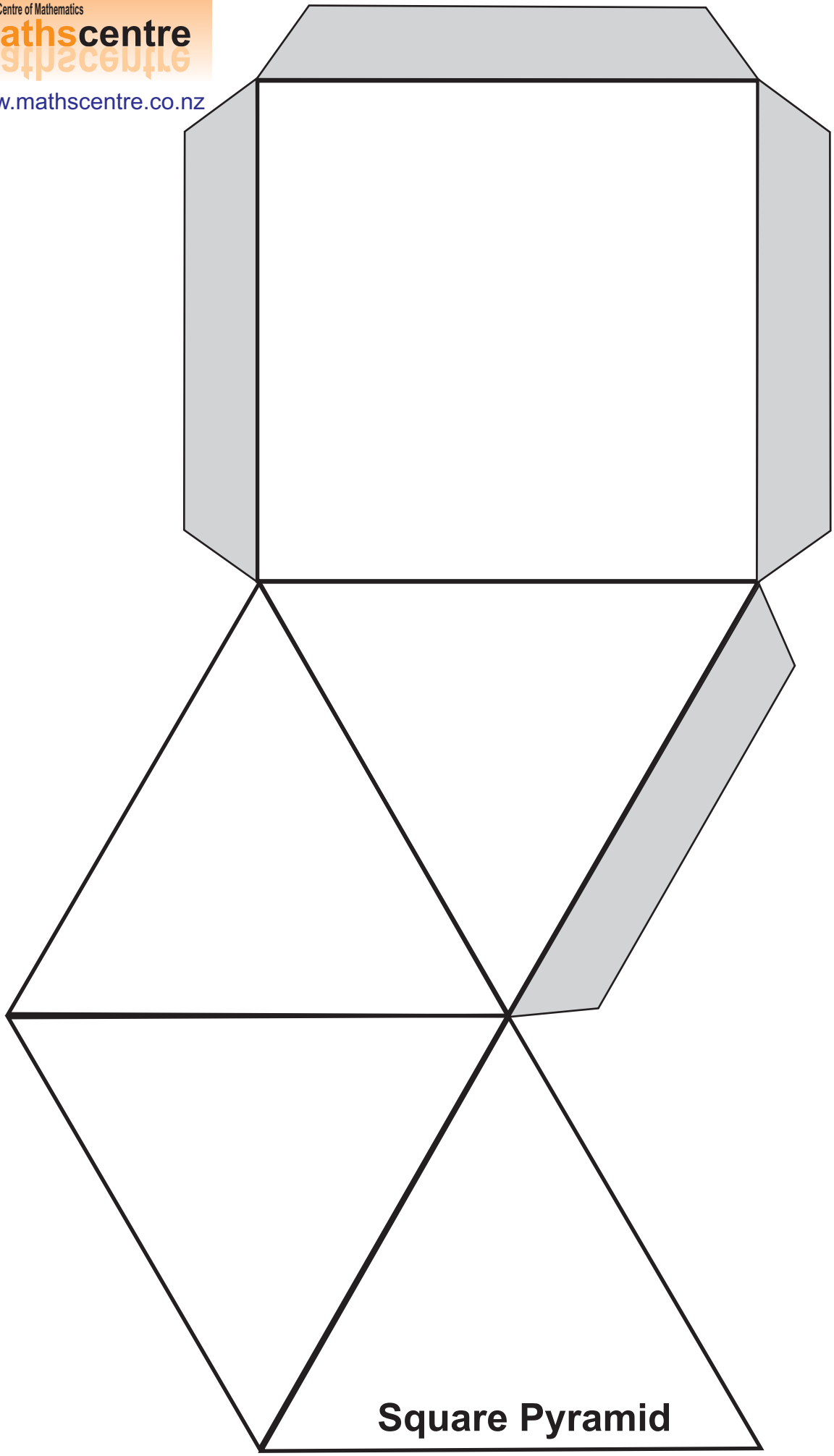

Square Pyramid

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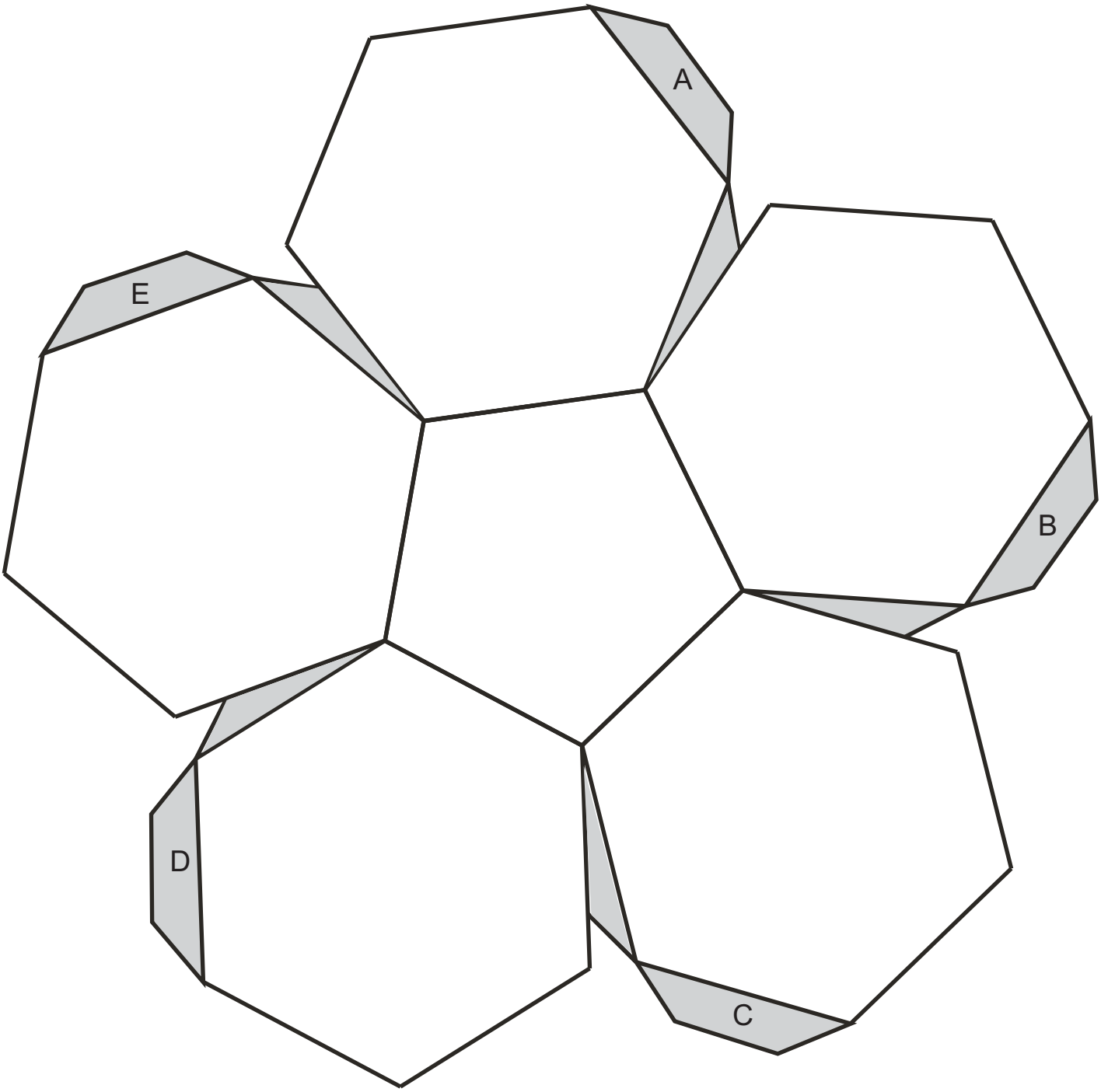
Truncated Icosahedron (6 pieces)

1 of 6 pieces



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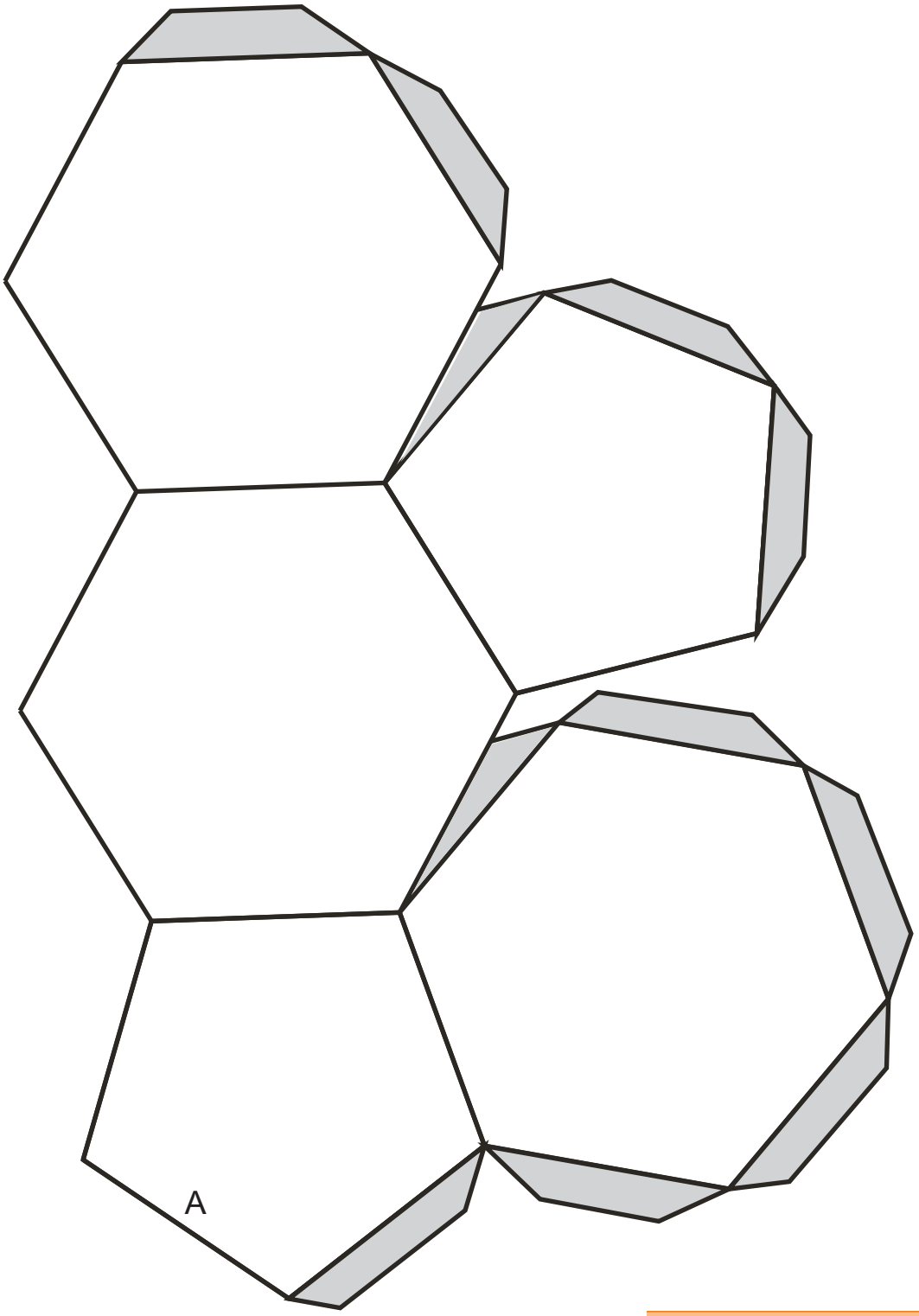
Truncated Icosahedron (6 pieces)



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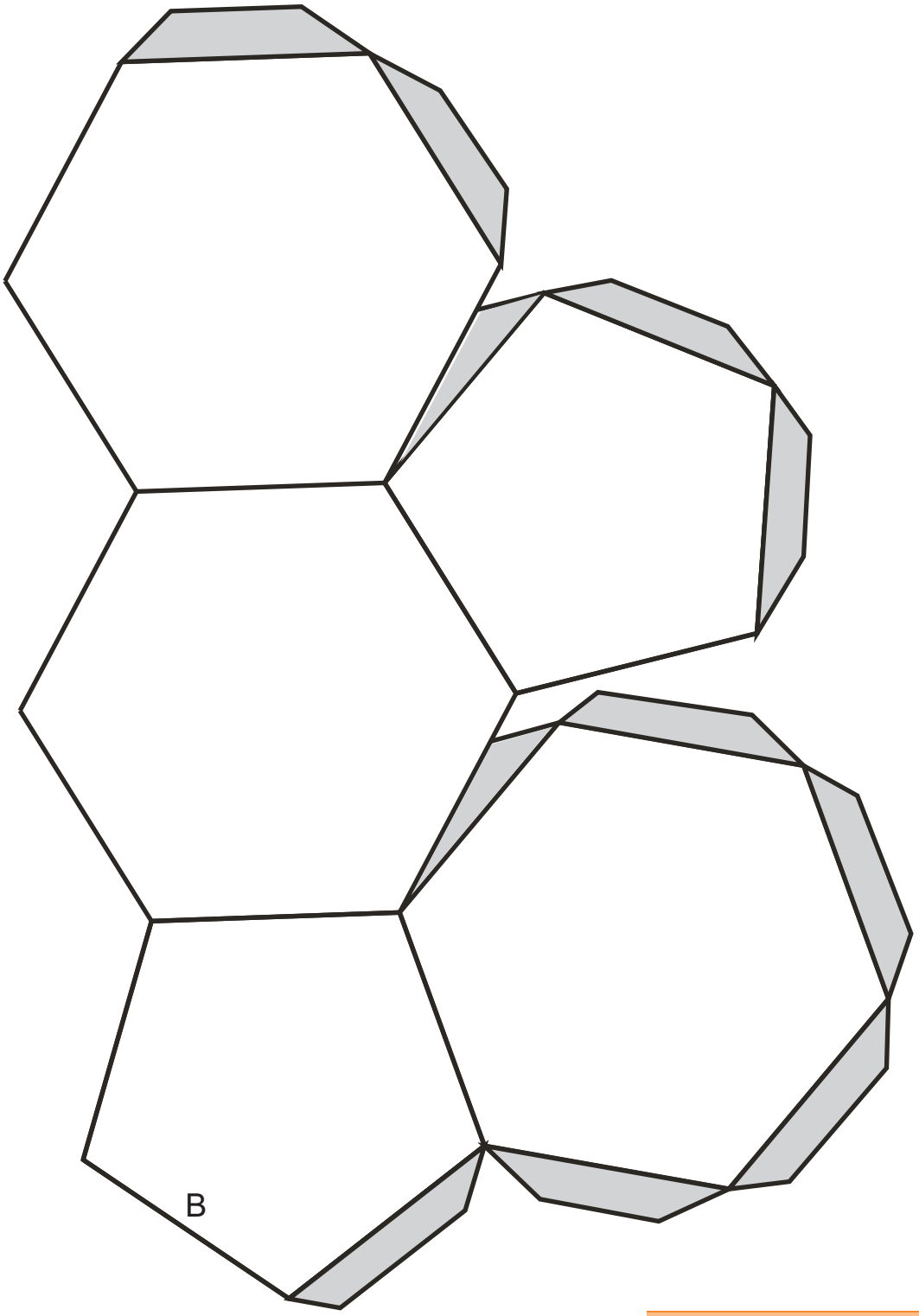

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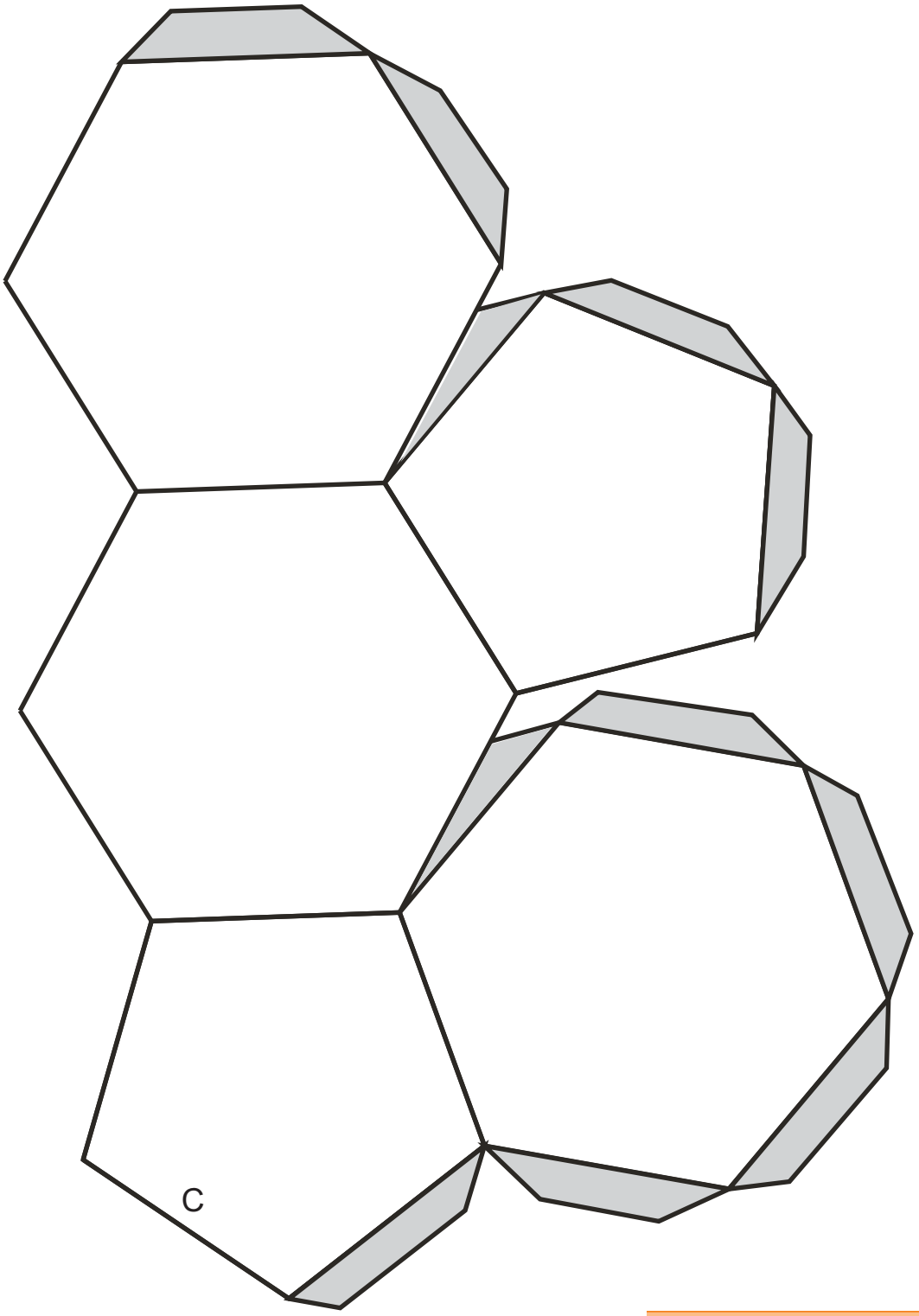
Truncated Icosahedron (6 pieces)



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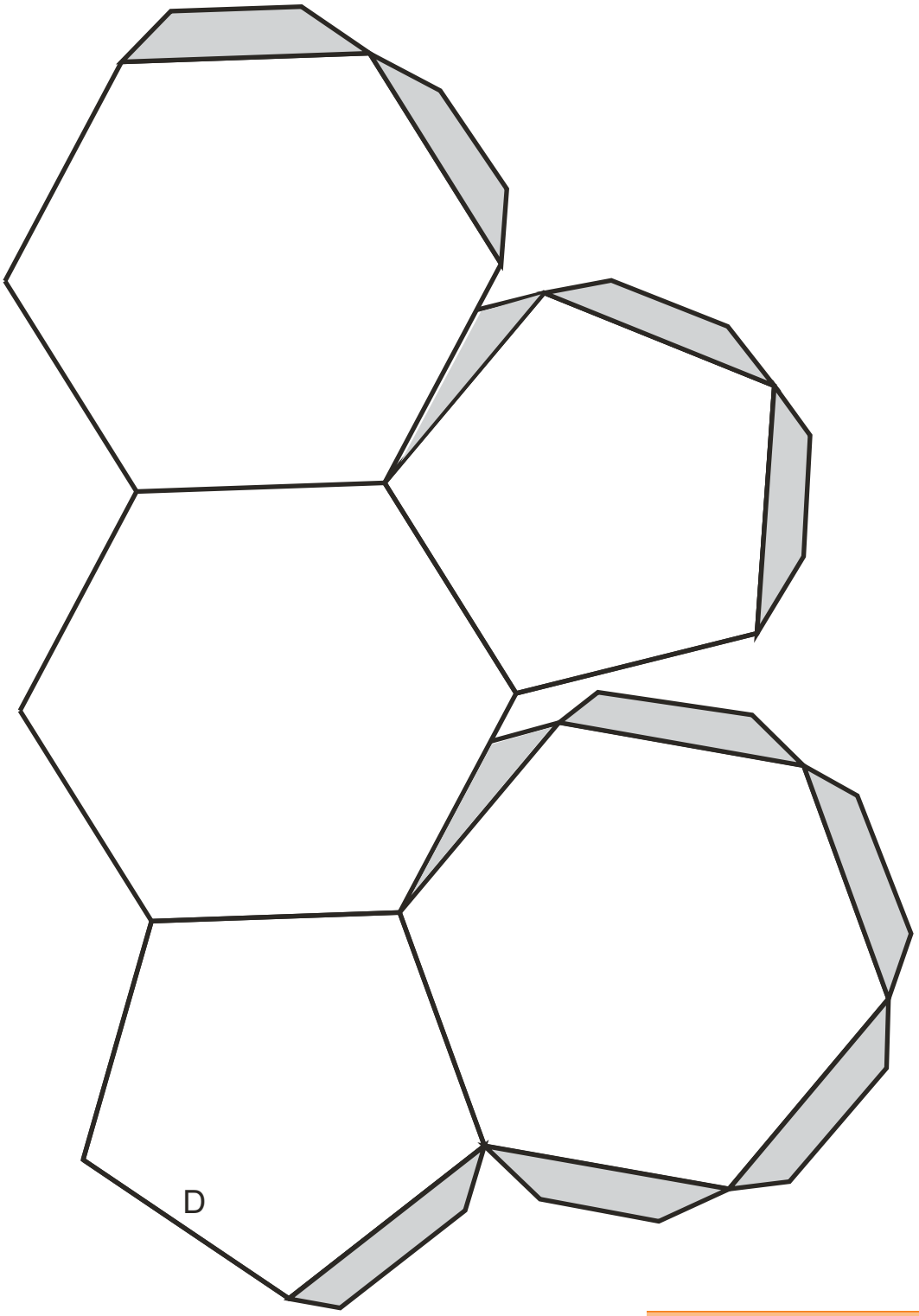
Truncated Icosahedron (6 pieces)

5 of 6 pieces



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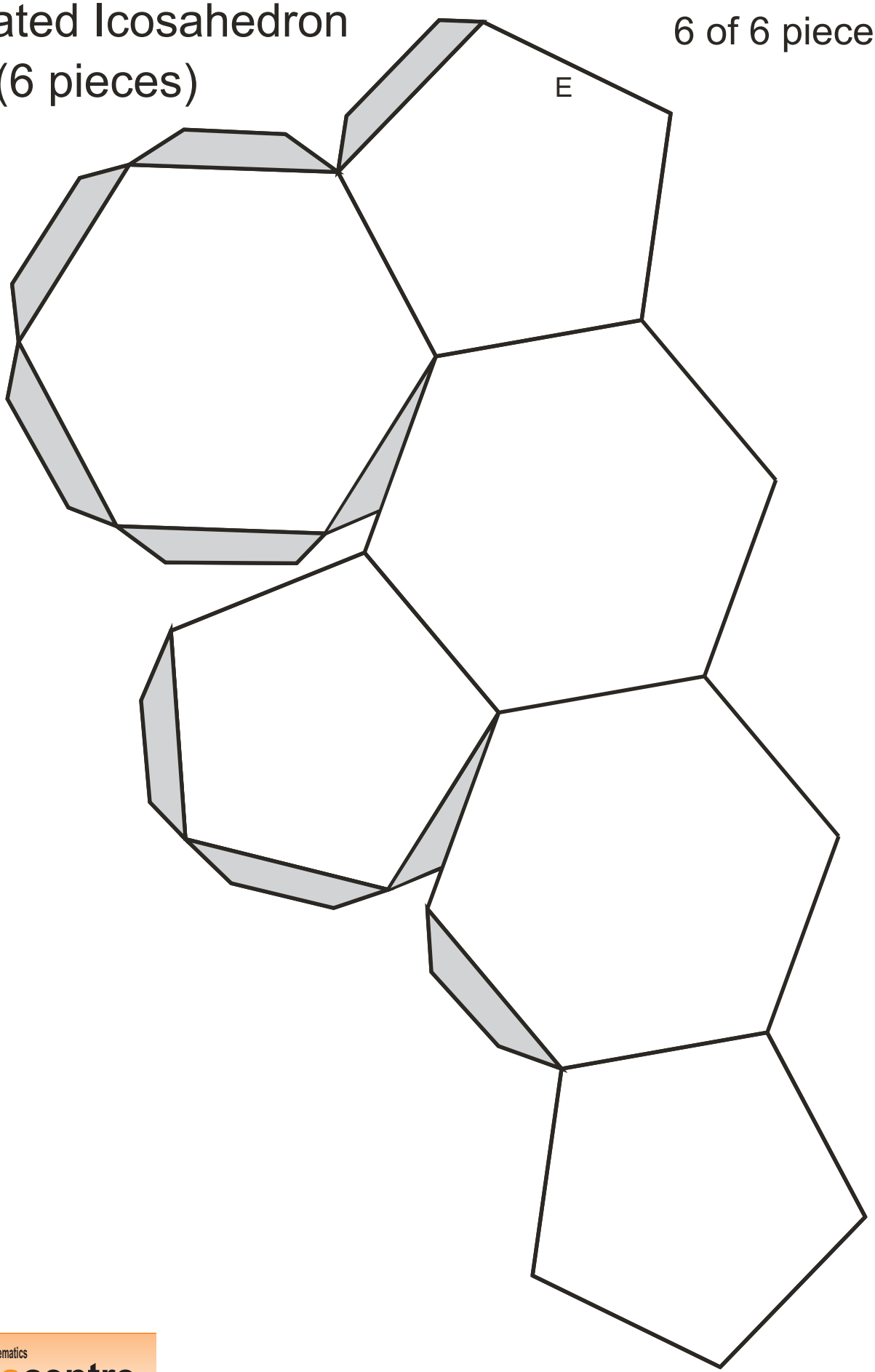
Truncated Icosahedron (6 pieces)

6 of 6 pieces



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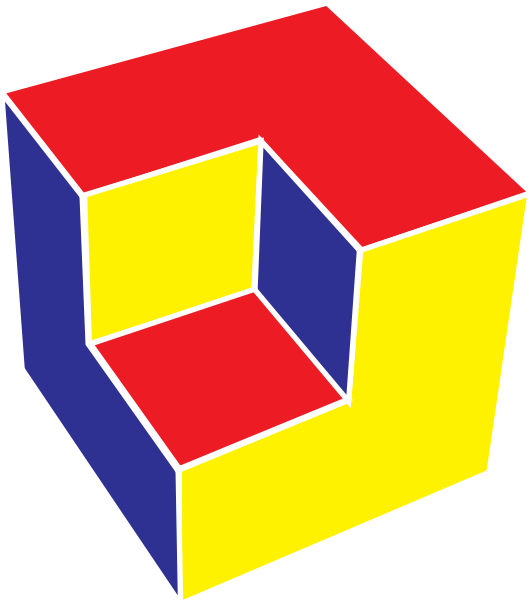
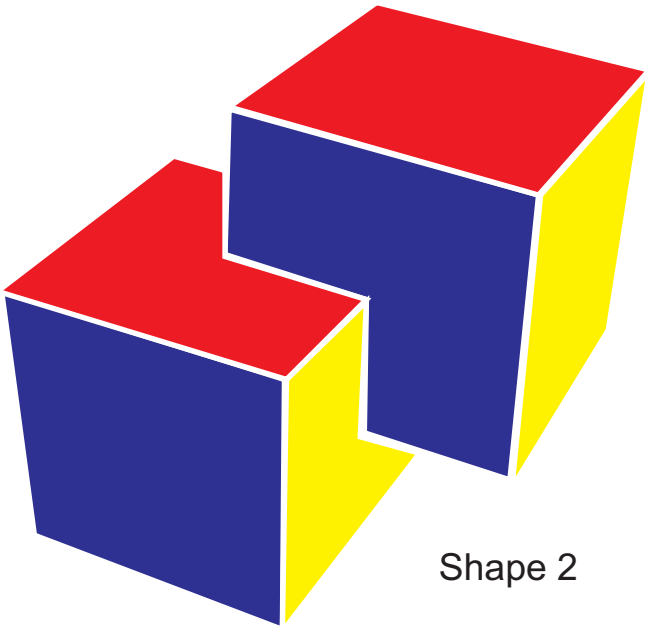
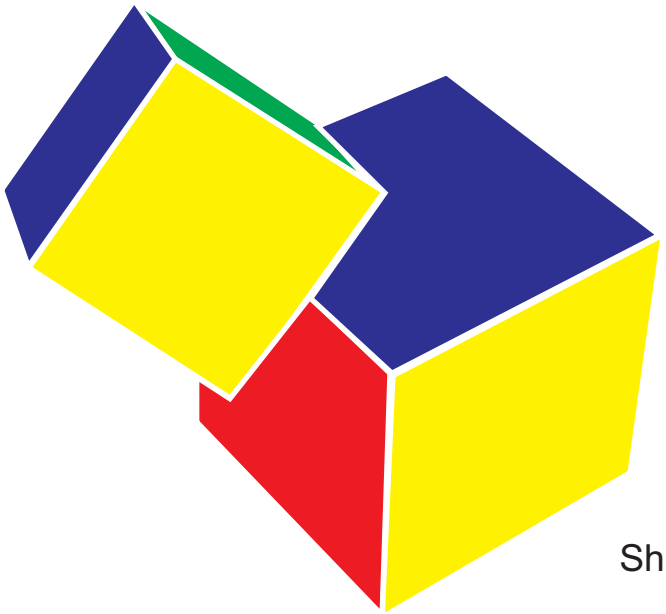
CUBIC SHAPES



Shape 1



Shape 2



Shape 3

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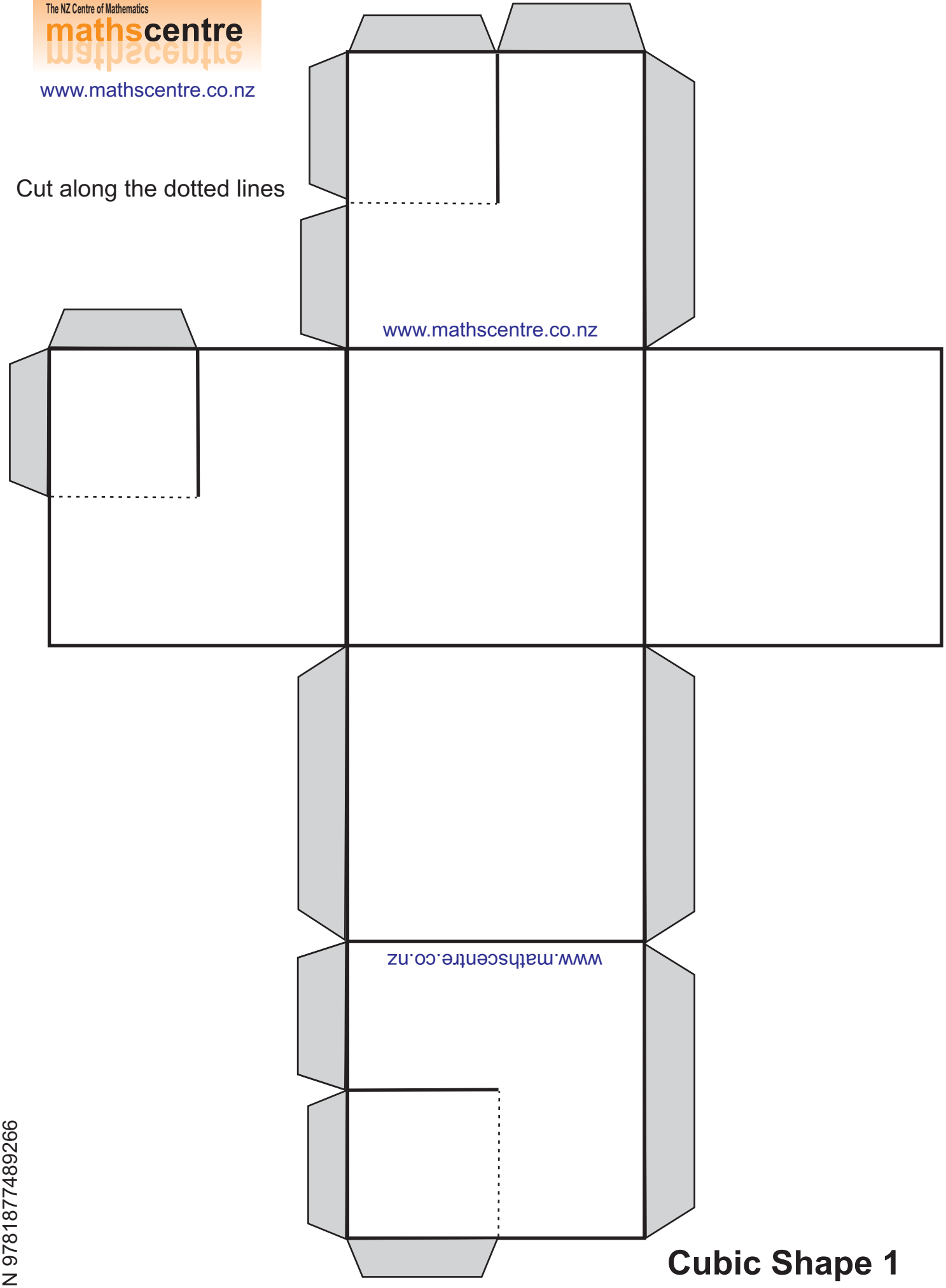
Cut along the dotted lines



Cubic Shape 1

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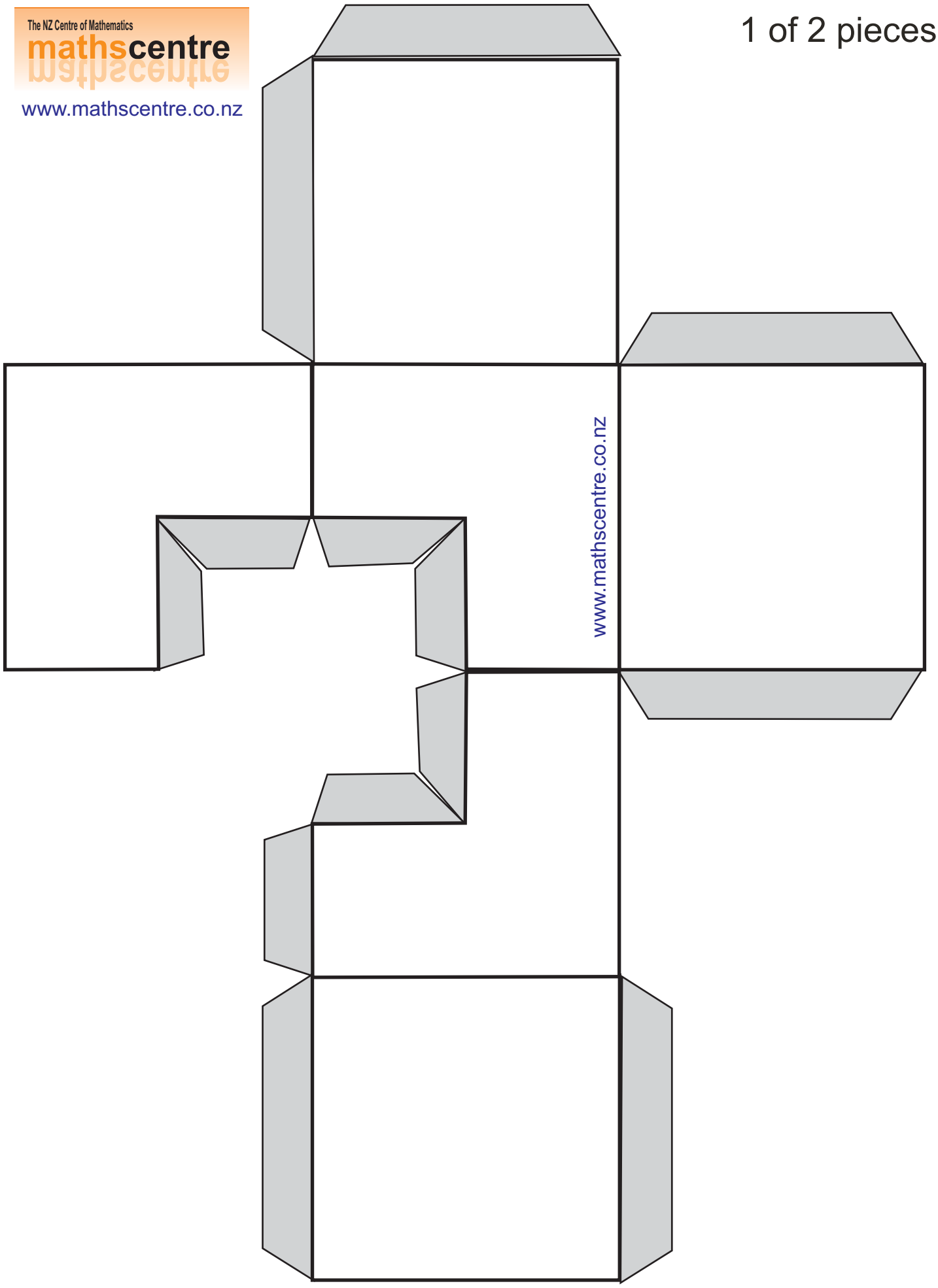
1 of 2 pieces



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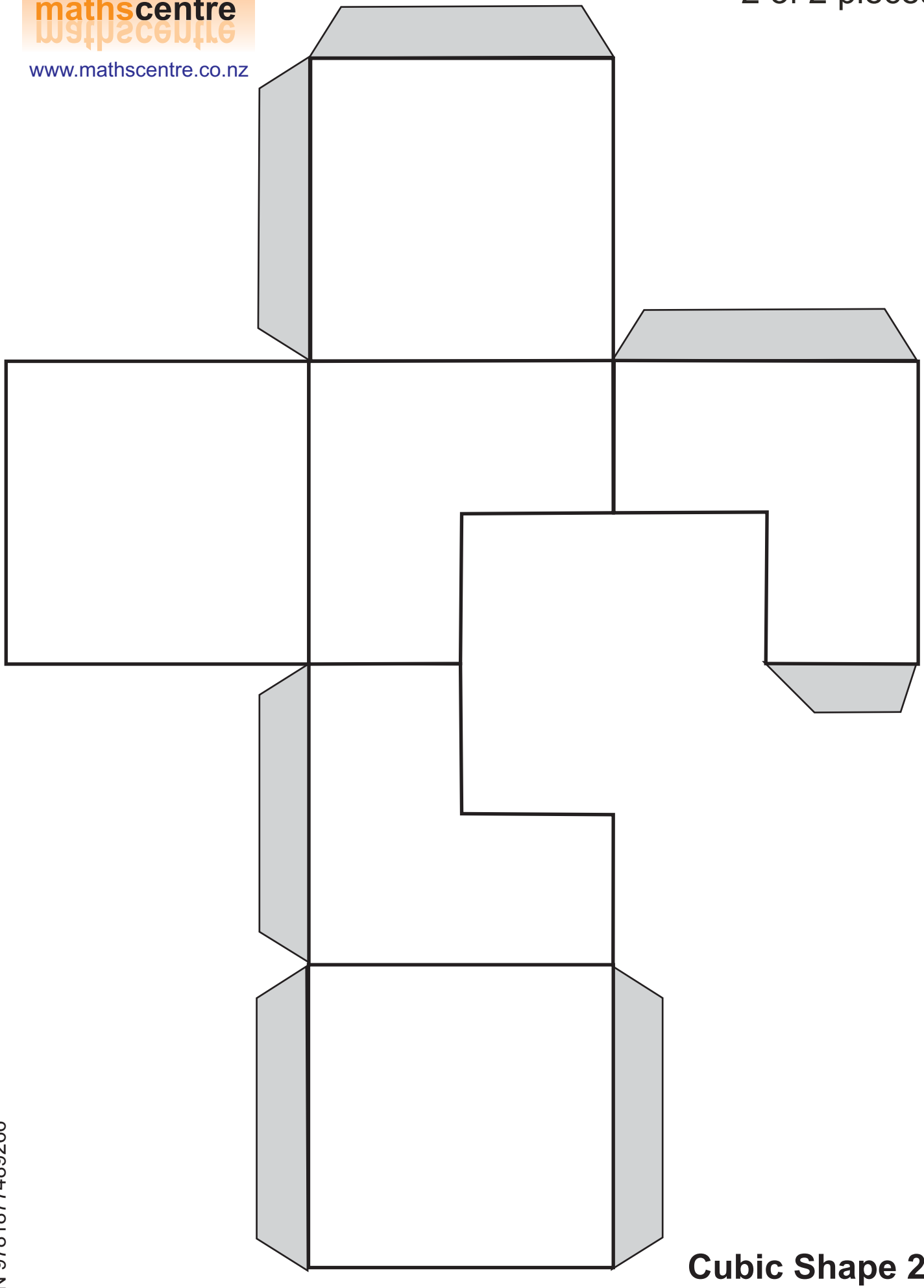

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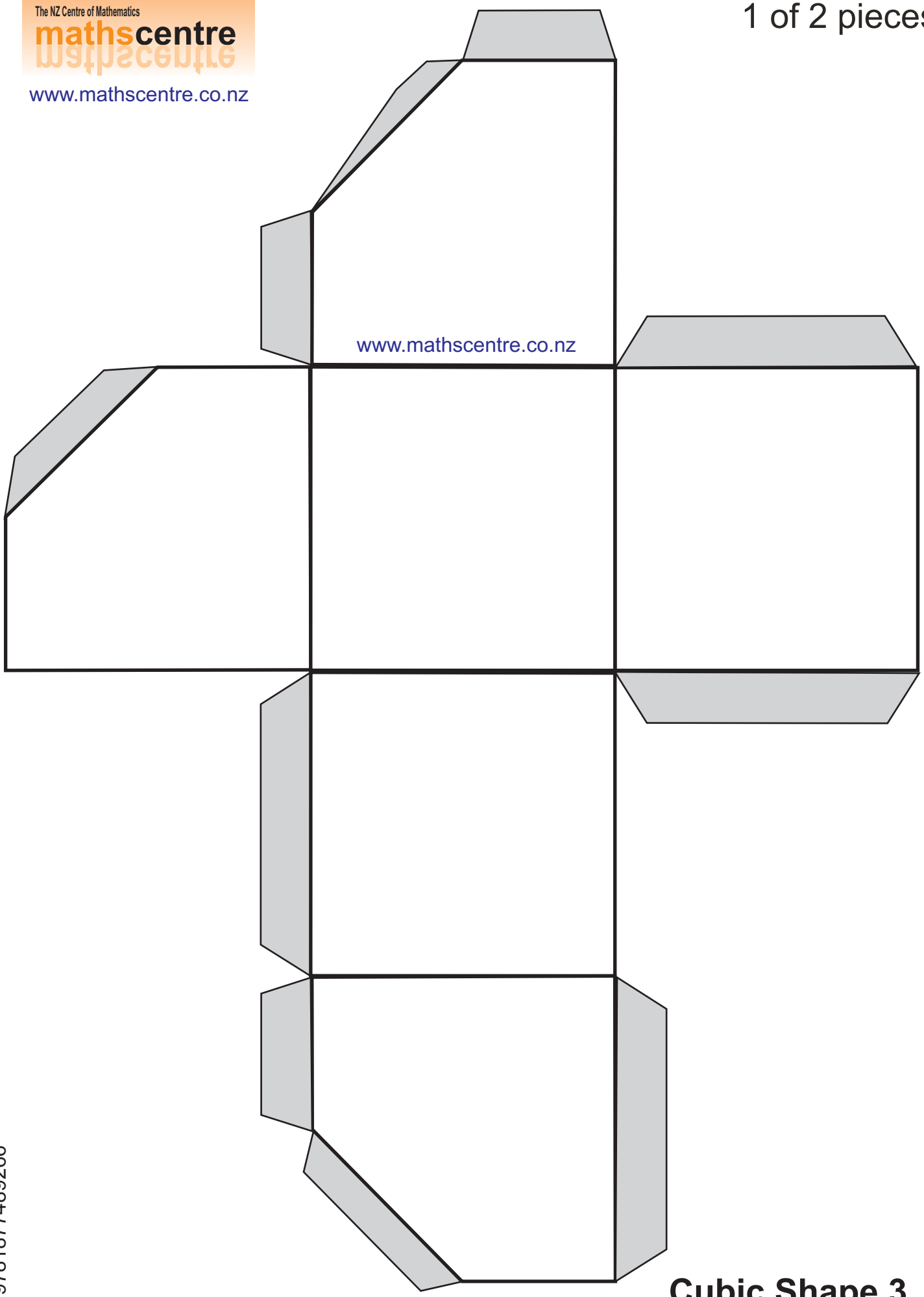
1 of 2 pieces



Cubic Shape 3

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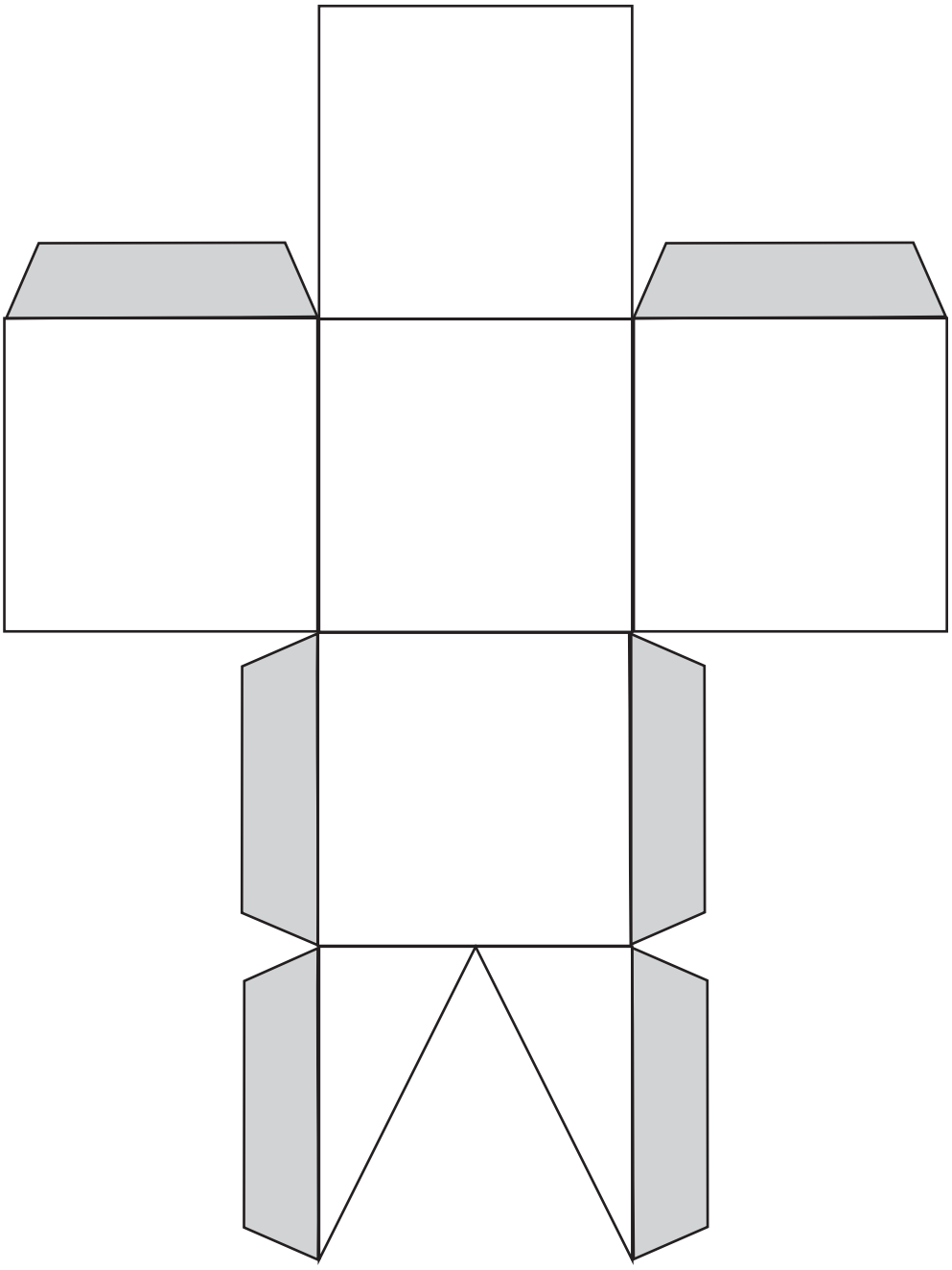

Cubic Shape 3

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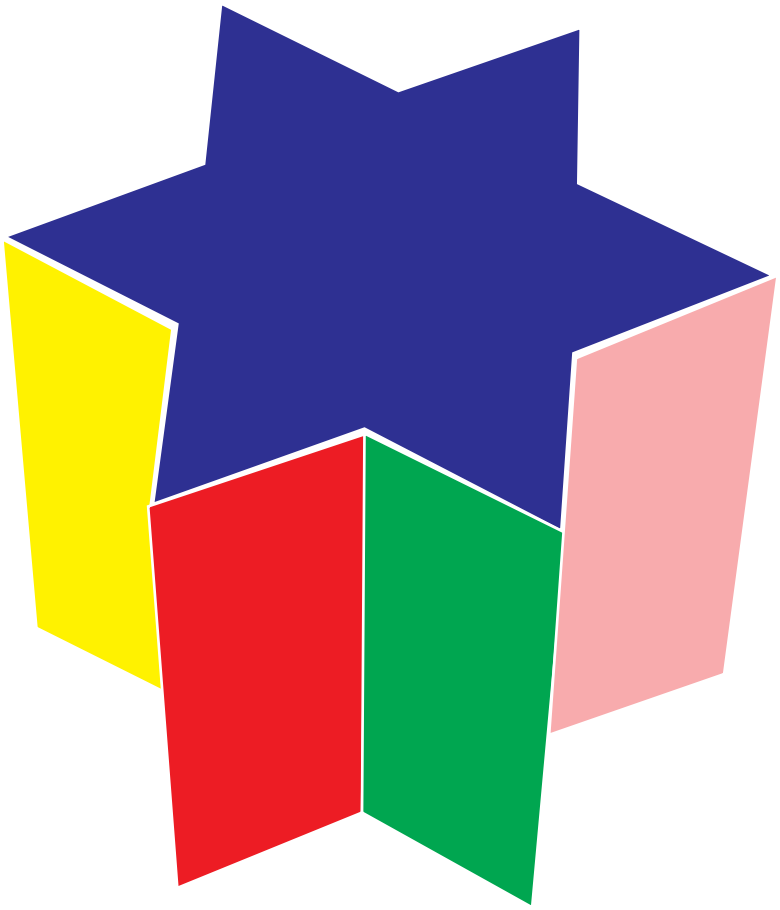
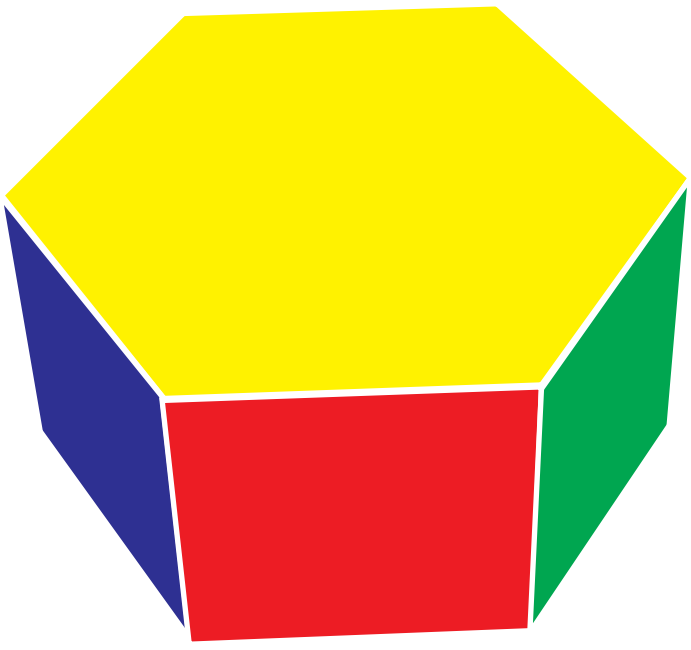
HEXAGRAMMIC PRISM



HEXAGONAL PRISM



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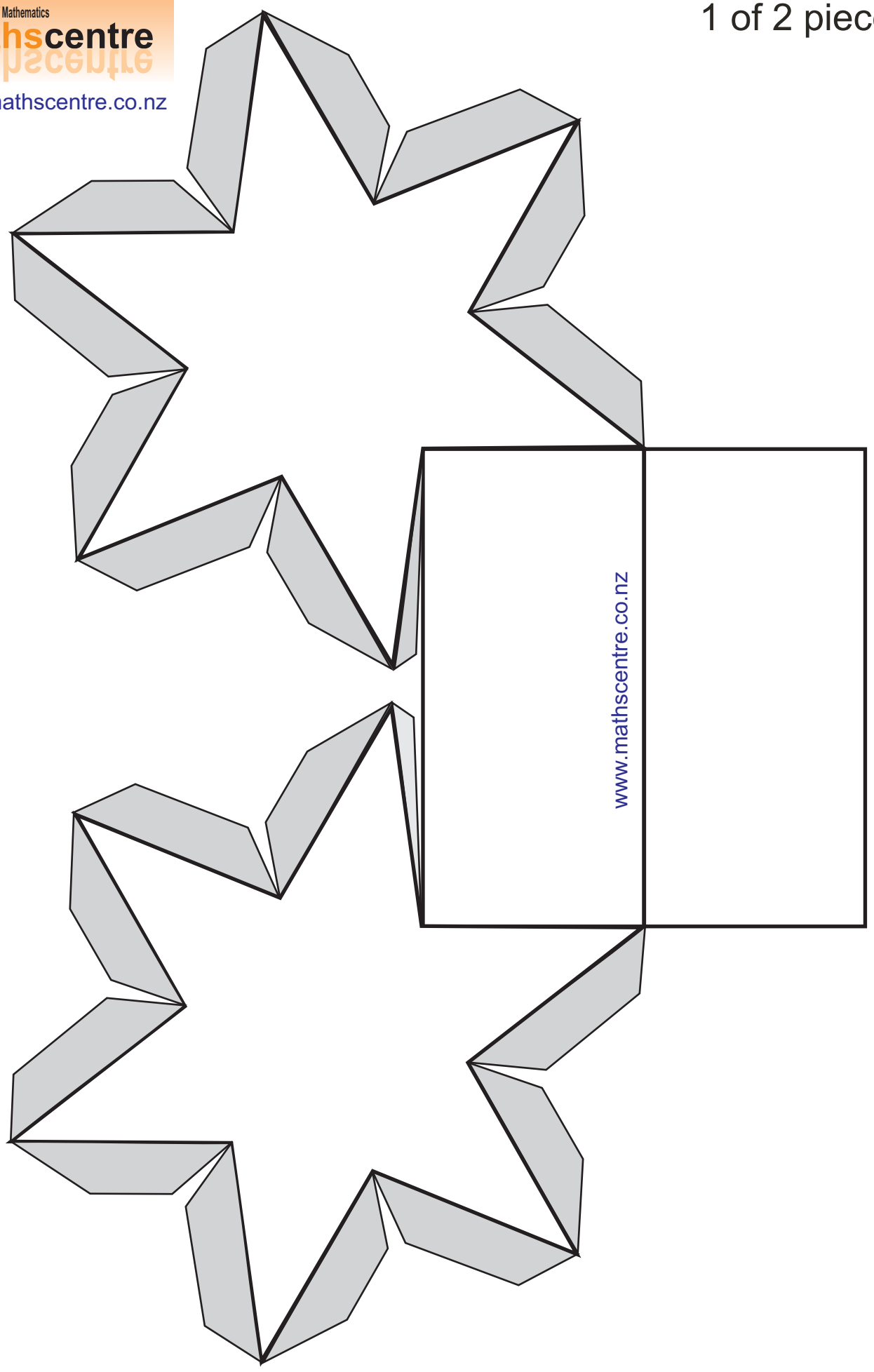
1 of 2 pieces



Hexagrammic Prism

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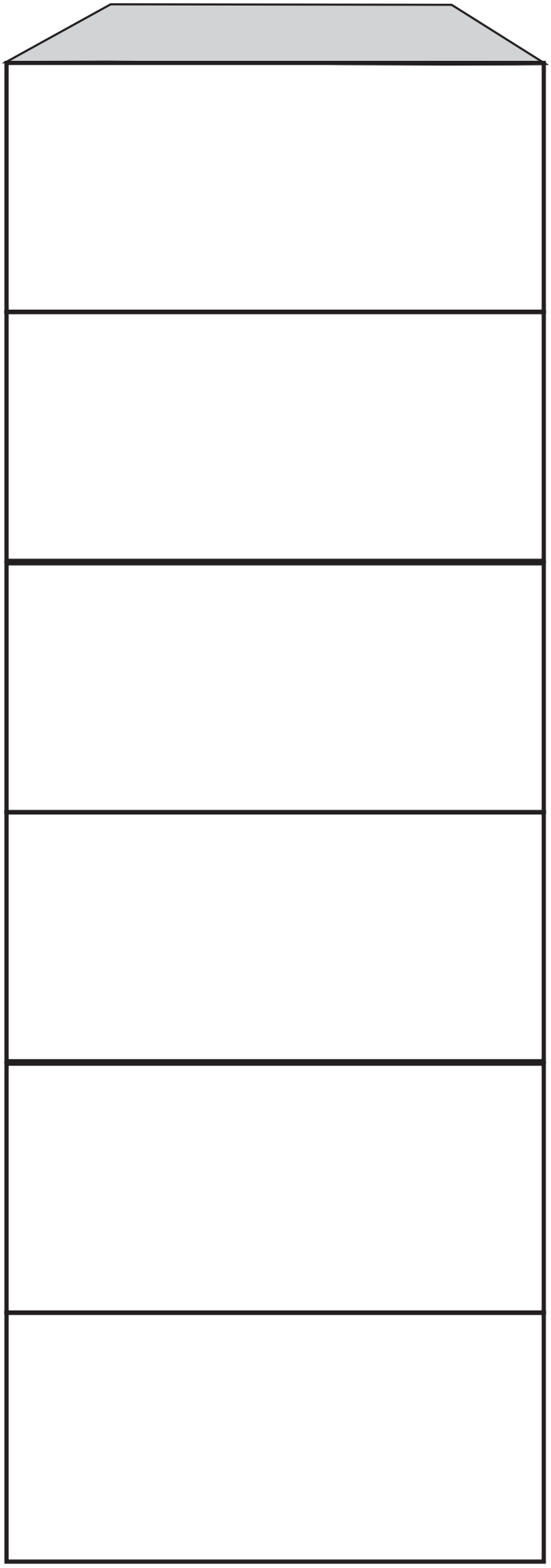

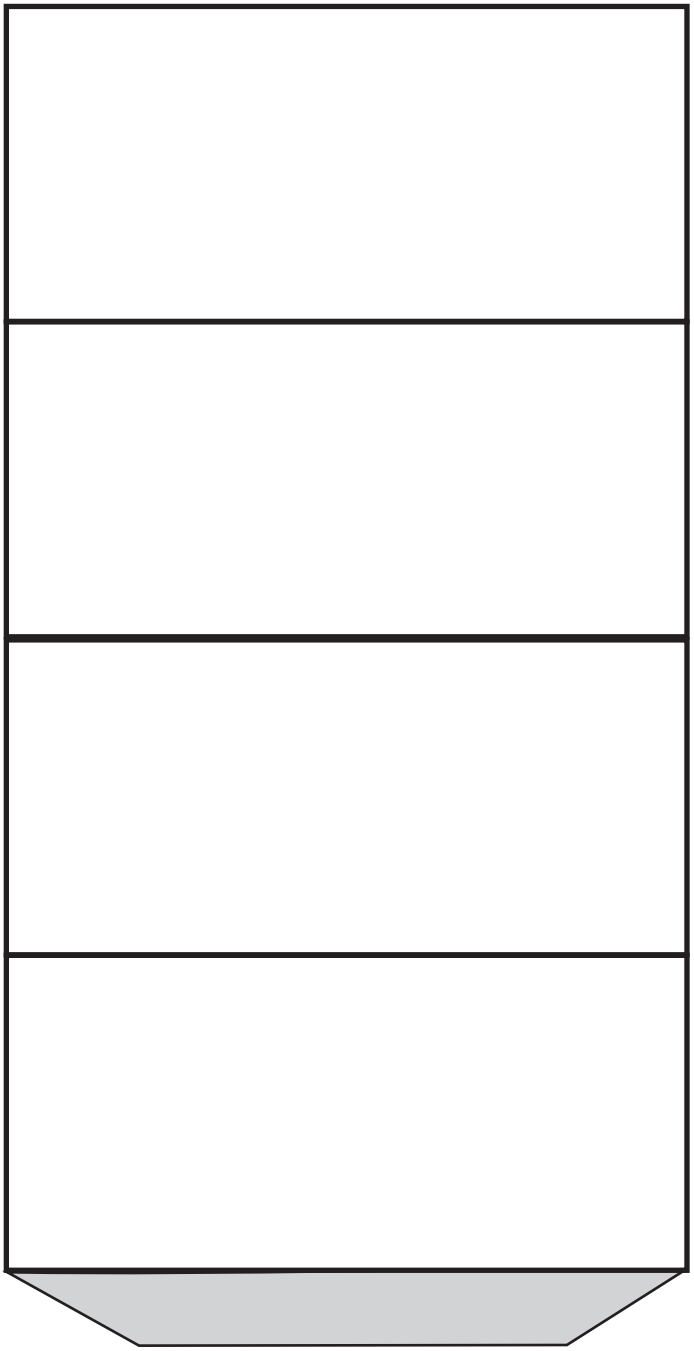

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Hexagrammic Prism

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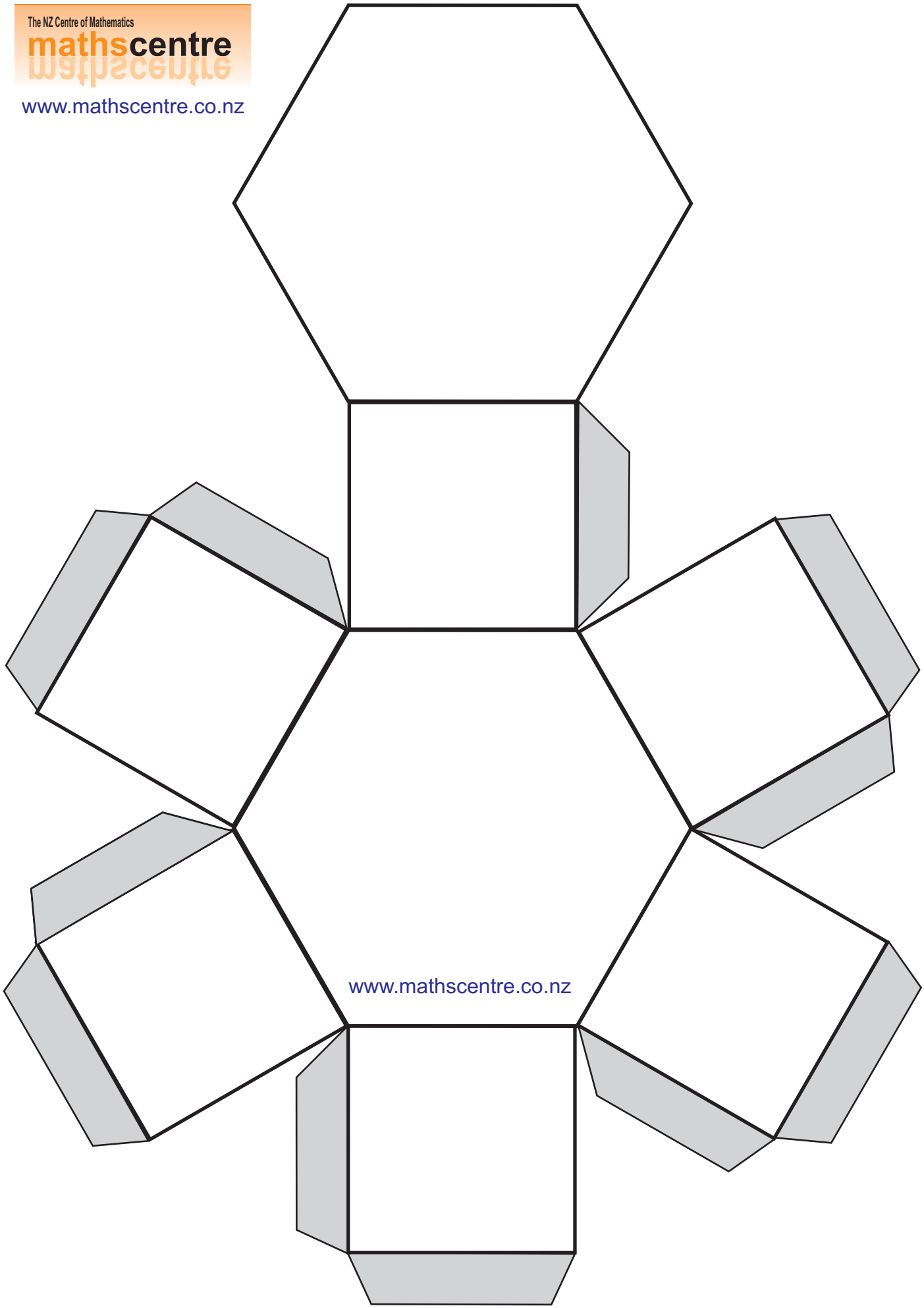

Hexagonal Prism

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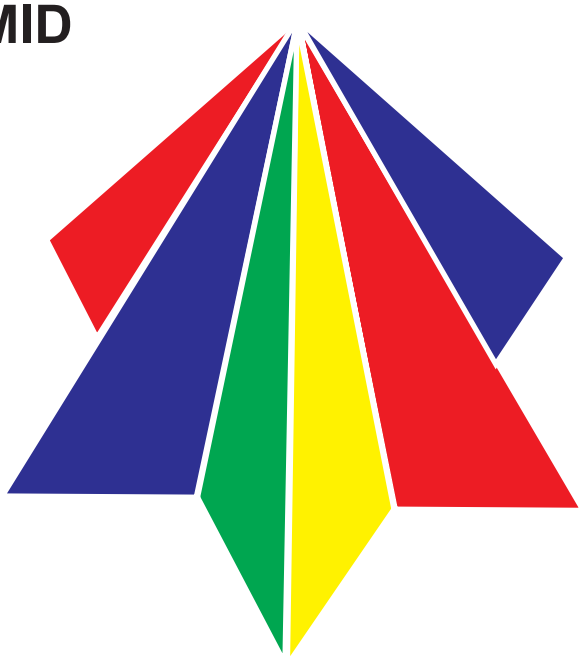
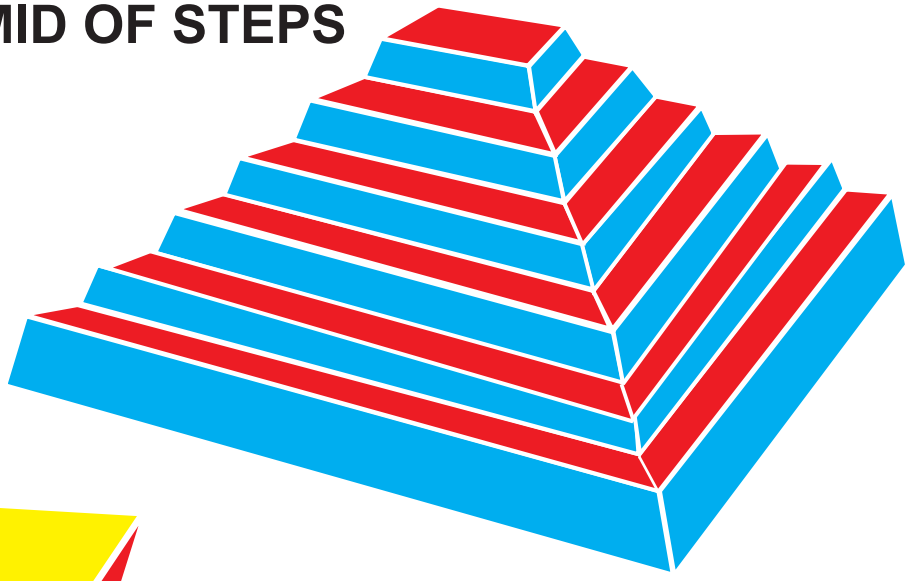
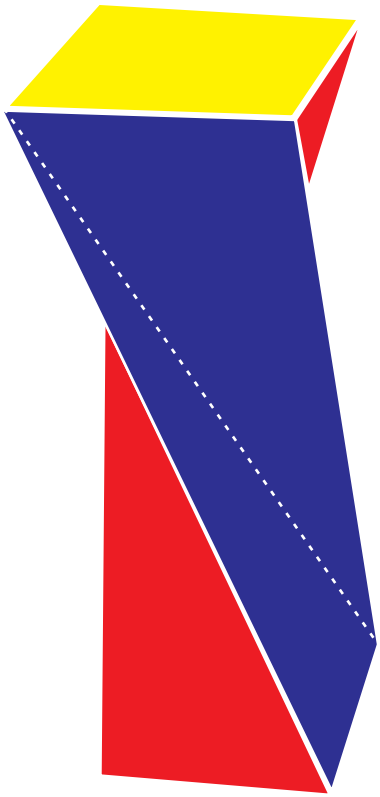
HEXAGRAMMIC PYRAMID



PYRAMID OF STEPS





RECTANGULAR PRISM WITH A TWIST

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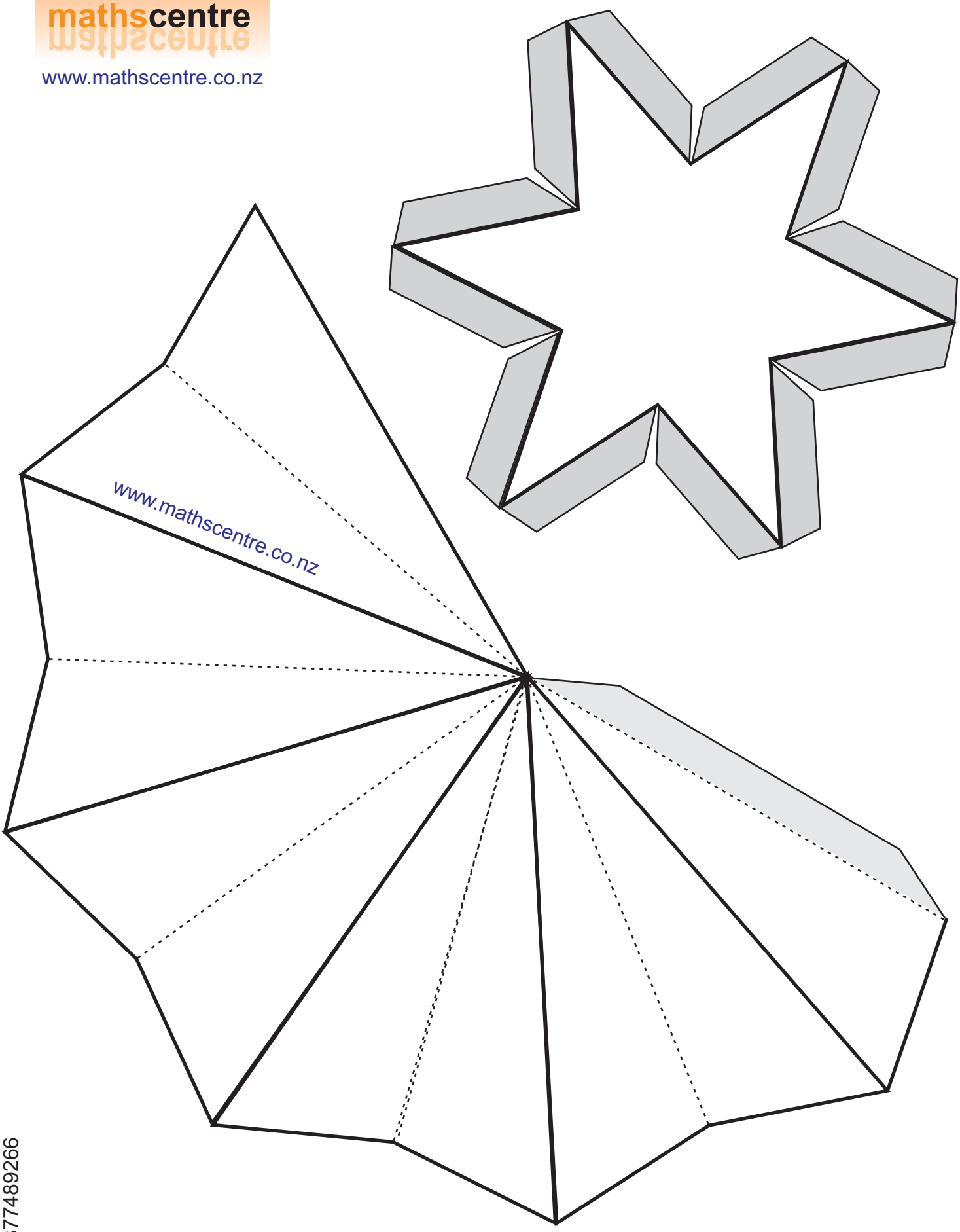

Hexagrammic Pyramid

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Pyramid Of Steps

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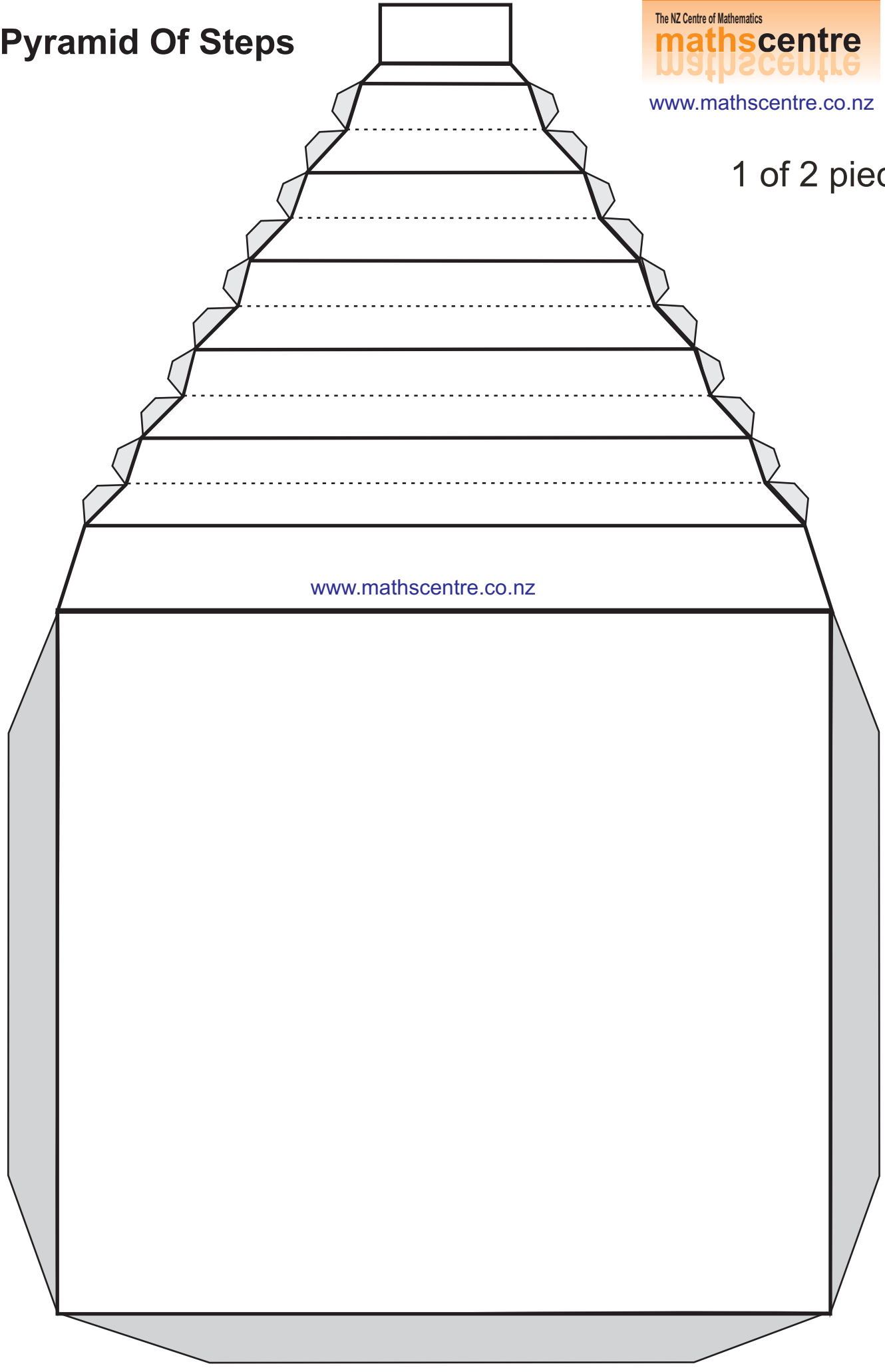
1 of 2 pieces



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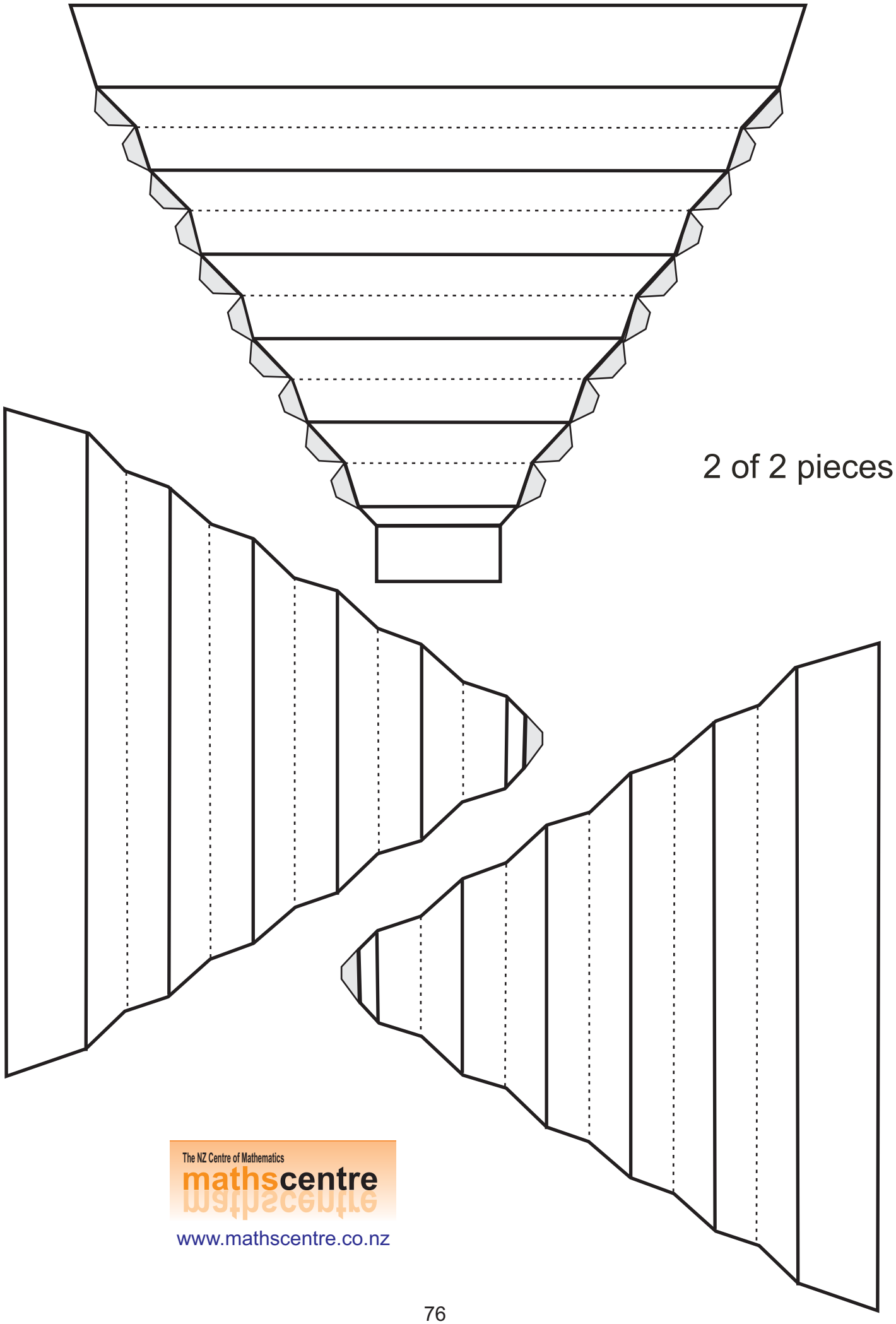

2 of 2 pieces

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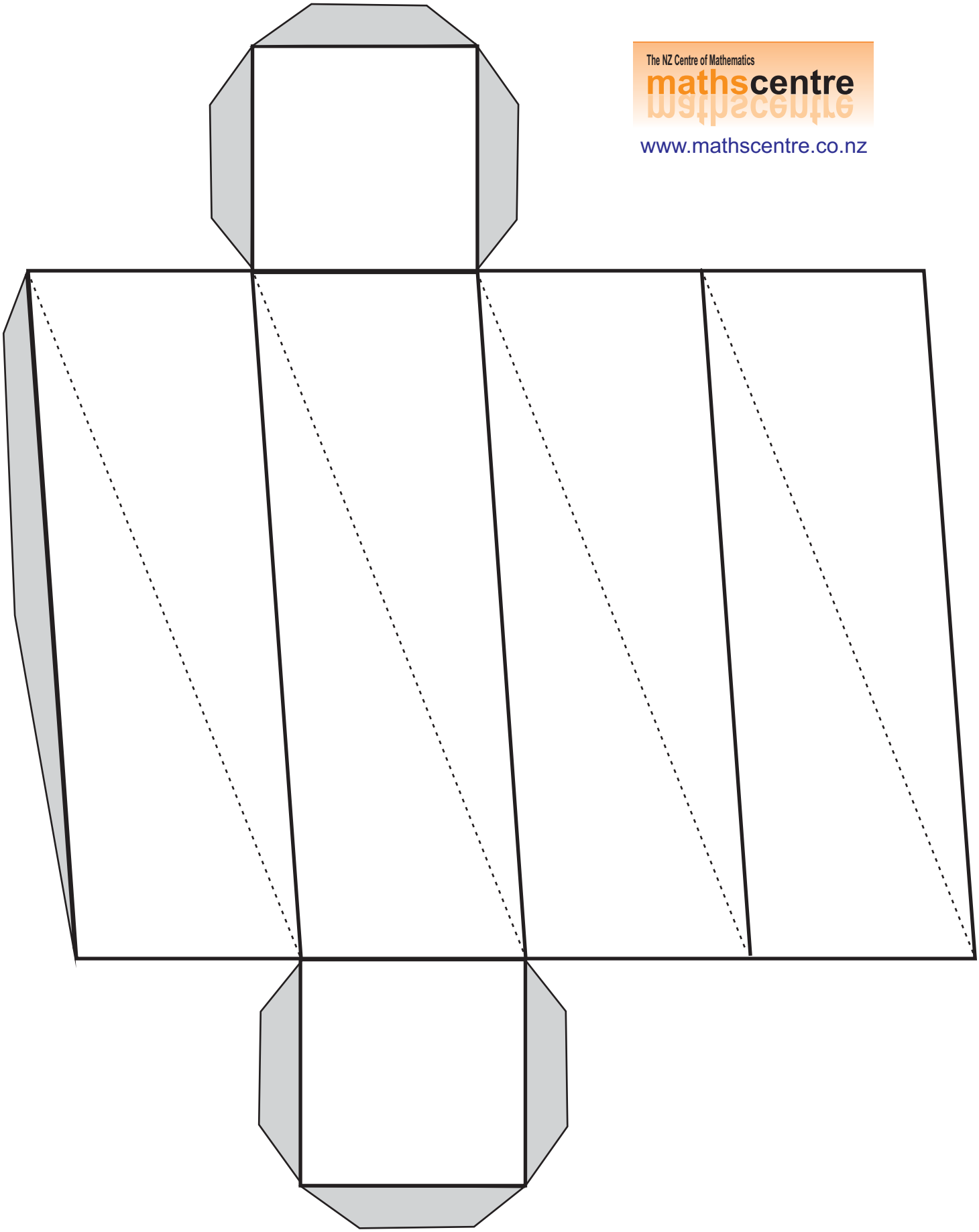
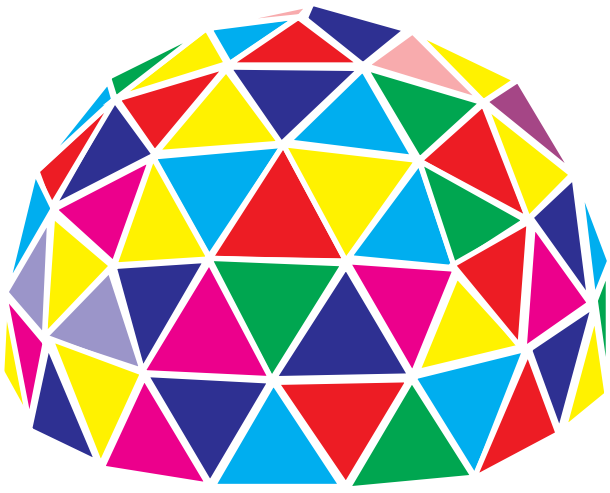


Rectangular Prism With A Twist

NINTH STELLATION OF THE ICOSAHEDRON

Stellating is the process extending the faces of a geometrical figure until they reintersect. This process can be applied to any solid however regular tetrahedrons and hexahedrons have no stellations other than themselves. Extended forever, their planes would never reintersect:

THE DOME



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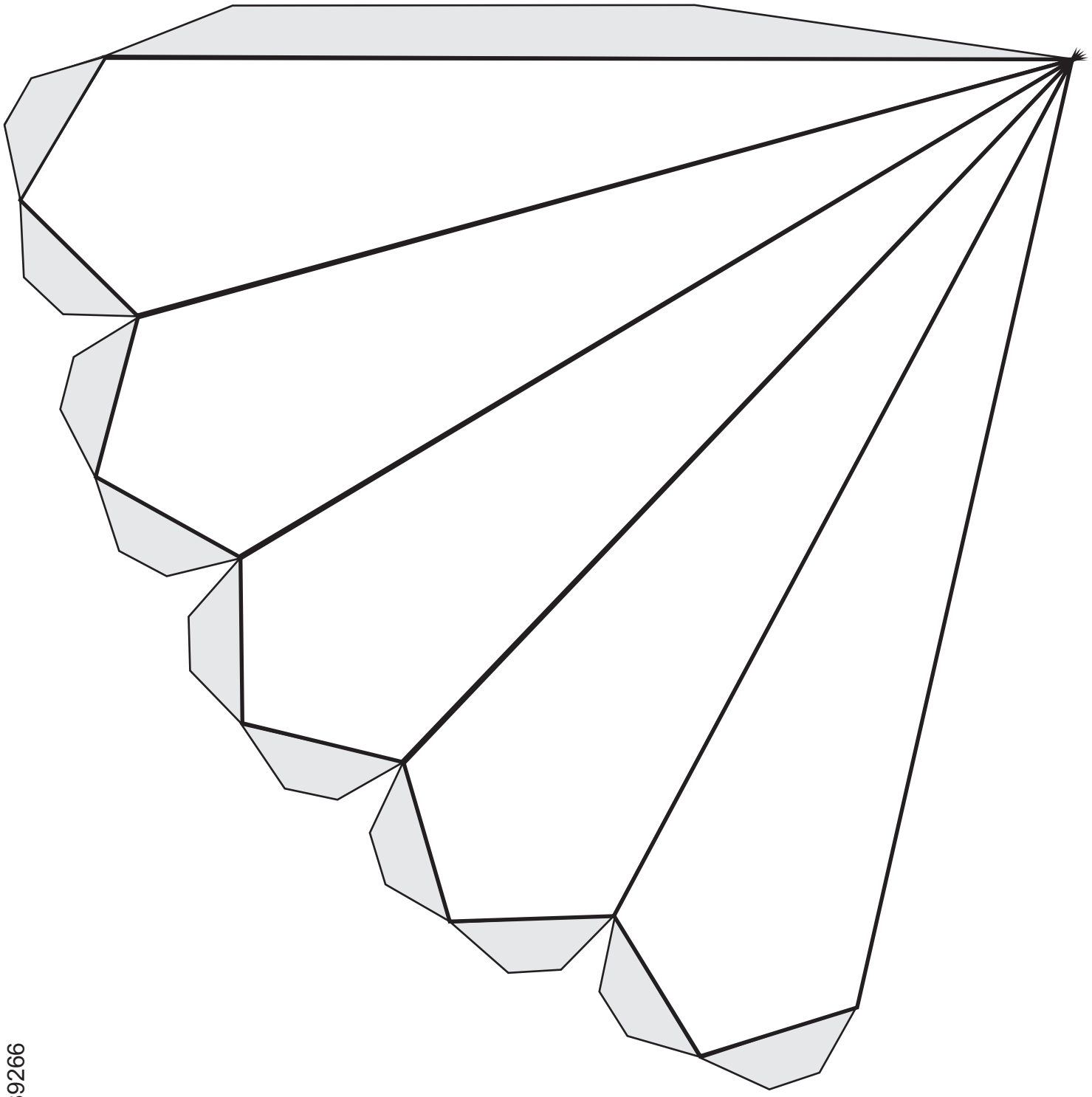
You need 12 of these shapes



Ninth Stellation Of The Icosahedron

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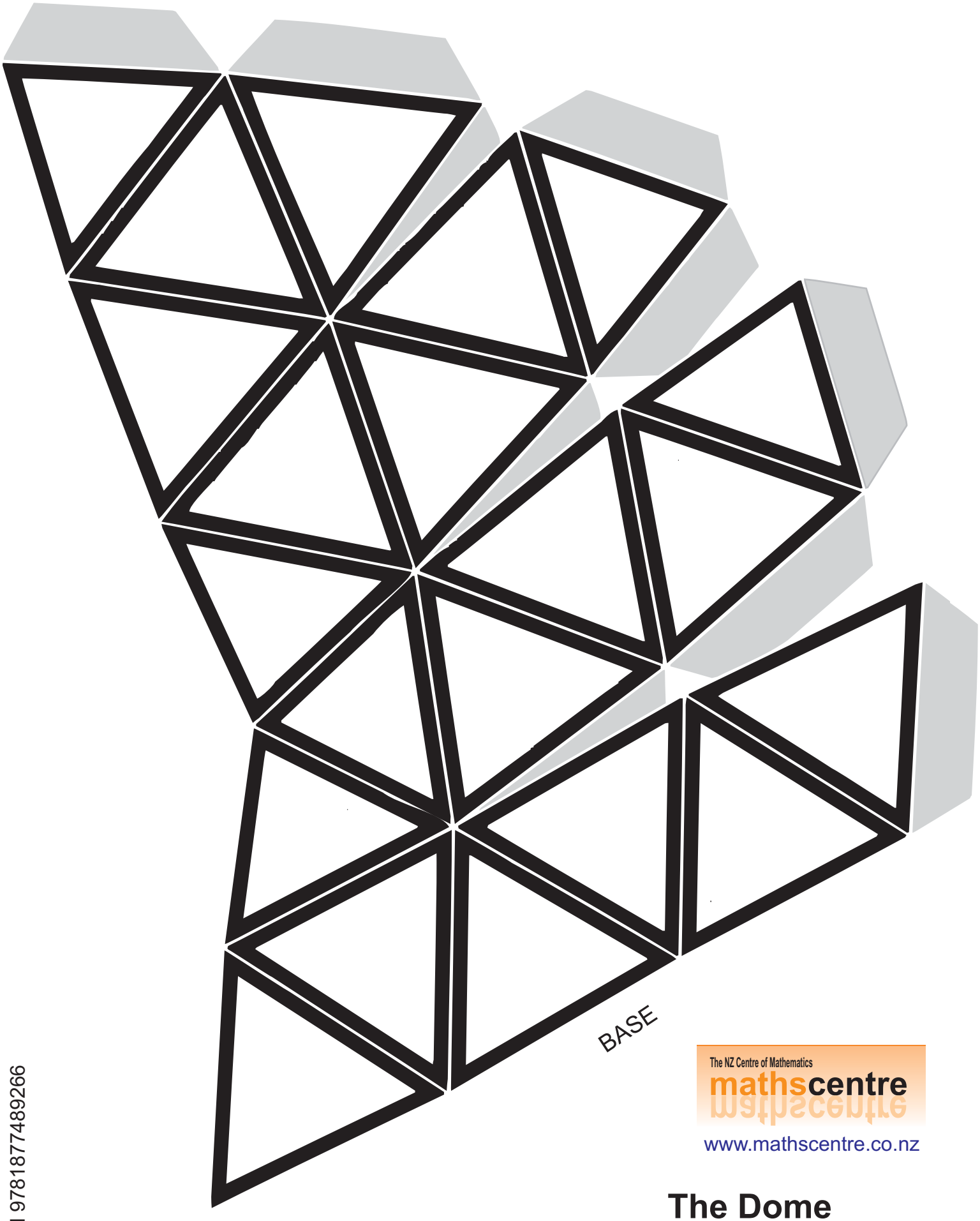
You need 5 of these shapes



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The Dome

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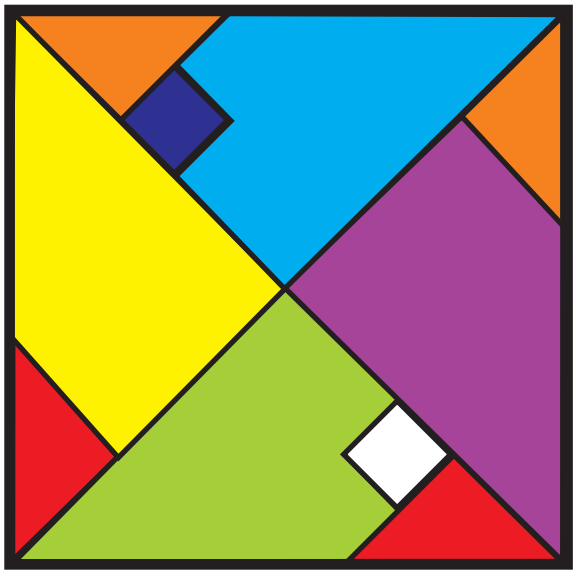
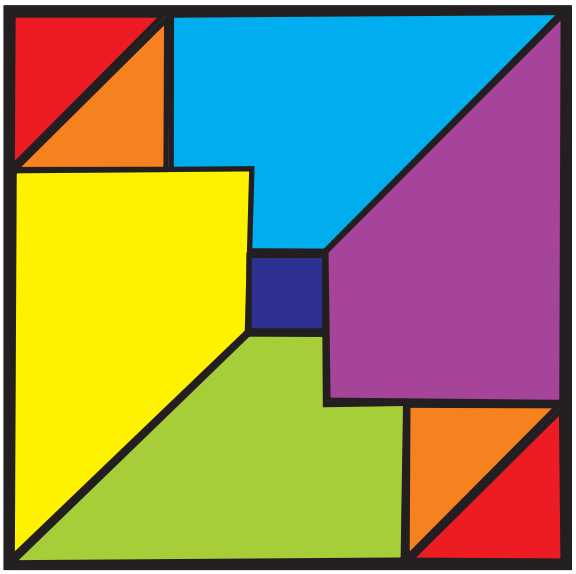
Is there a piece missing in your Mathematics?





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Kim Freeman

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