

Unit 8

Shape and space: reasoning about shapes: measures

Five daily lessons

*National
Numeracy Strategy*

Year 6
Autumn term

Unit Objectives

Year 6

- Classify quadrilaterals using criteria such as parallel sides, equal angles, equal sides
- Solve mathematical problems or puzzles, recognise and explain patterns and relationships (orally and in writing).
- **Calculate perimeter of rectangles and area of simple compound shapes that can be split into rectangles.**

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Link Objectives

Year 5

Year 7

- Classify triangles using criteria such as equal sides, equal angles, lines of symmetry.
- Solve mathematical problems or puzzles, recognise and explain patterns and relationships (orally and in writing).
- Understand, measure and calculate perimeters of rectangles and regular polygons.
- Make and investigate a general statement about familiar shapes by finding examples that satisfy it.

- **Solve word problems and investigate in a variety of contexts: shape, space and measures.**
- Calculate the perimeter of shapes made from rectangles.
- Begin to identify and use angle, side and symmetry properties of triangles and quadrilaterals.

(Key objectives in bold)

This Unit Plan is designed to guide your teaching.

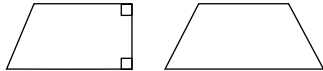
You will need to adapt it to meet the needs of your class.

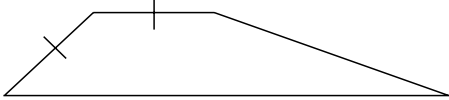
Resources needed to teach this unit:

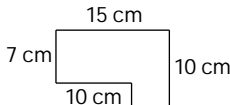
- Resource sheet 8.1
- Resource sheet 8.2
- Resource sheet 8.3
- Resource sheet 8.4
- Resource sheet 8.5
- Resource sheet 8.6
- Resource sheet 8.7
- Resource sheet 8.8
- Resource sheet 8.9
- Resource sheet 8.10
- Resource sheet 8.11
- OHT 8.1 (Activity sheet 8.2)
- Activity sheet 8.1
- Activity sheet 8.2 (OHT 8.1)
- Large card quadrilaterals
- Large squared paper/squared section of board or OHT
- Centimetre squared paper
- Small whiteboards
- 'ICT to support mathematics' pack, 'sort the shapes' program
- Related Key Stage 2 national test questions

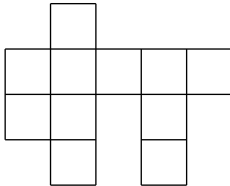
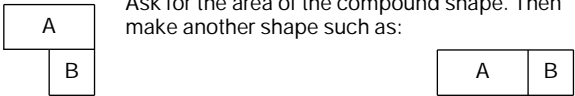

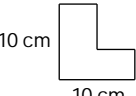
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education and skills

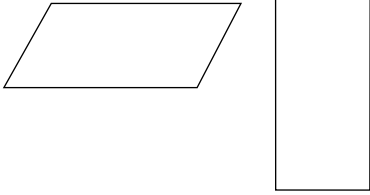
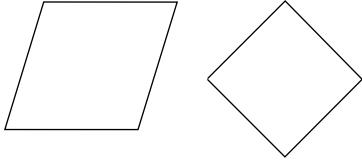
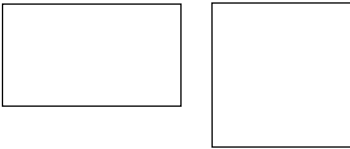
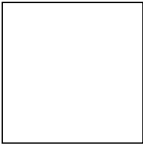

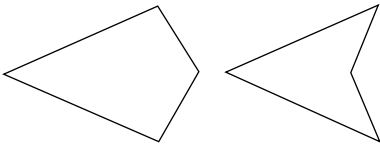
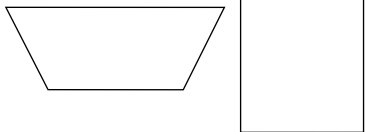
Planning sheet	Day One	Unit 8 <i>Shape and space: reasoning about shapes: measures</i>	Term: <i>Autumn</i>	Year Group: 6	
Oral and Mental		Main Teaching			Plenary
Objectives and Vocabulary	Teaching Activities	Objectives and Vocabulary	Teaching Activities	Teaching Activities / Focus Questions	
<p>Classify quadrilaterals using side/angle properties.</p> <p>VOCABULARY quadrilateral parallelogram parallel right angle</p>	<ul style="list-style-type: none"> Say to the children that you are thinking of a 2-D shape and want them to ask questions to help them to guess what it is. Say that you can only answer 'yes' or 'no'. <p>As the children ask questions, write the properties they find on the board e.g. four sides, two pairs of parallel sides, four right angles, opposite sides are the same length, all sides are the same length.</p> <p>Play this game twice, once thinking of a parallelogram and then thinking of a rectangle. Ensure that the children know that both these are quadrilaterals. Also ensure that they are familiar with vocabulary such as parallel. Point out this vocabulary on the board.</p> <div>Q How can we distinguish between a parallelogram and a rectangle?</div> <div>Q How do their properties differ?</div>	<p>Classify quadrilaterals using side/angle properties.</p> <p>VOCABULARY parallelogram rhombus trapezium kite adjacent irregular lines of symmetry</p> <p>RESOURCES Whiteboards ICT to support mathematics pack 'sort the shapes' program Resource sheet 8.1</p>	<ul style="list-style-type: none"> Draw on the board a parallelogram, rhombus, trapezium, kite, rectangle and a square together with their names. Ask the children to describe each in turn and as they do so write the properties by each shape. Draw out the vocabulary. Point out that squares are regular quadrilaterals and special/particular rectangles. <p>Use Resource sheet 8.1 as a reference.</p> <ul style="list-style-type: none"> Ask the children to draw quadrilaterals on whiteboards according to certain properties e.g. <ul style="list-style-type: none"> has opposite sides equal; one pair of parallel sides; one right angle; equal adjacent angles. <p>In each case ask children to write the name of their quadrilateral underneath it.</p> <p>Repeat using the following vocabulary – adjacent sides, irregular, lines of symmetry.</p> <div>Q Have you drawn the same shape as your neighbour?</div> <div>Q What other four-sided shapes could you have drawn?</div> <ul style="list-style-type: none"> Use ICT Pack Program 'sort the shapes' to demonstrate to children how to sort shapes into categories. 	<ul style="list-style-type: none"> In turn hold up a parallelogram, a rhombus, a rectangle, a square, a trapezium, a kite, an irregular quadrilateral (Resource sheets 8.2 – 8.8). Complete the grid (Resource sheet 8.9), putting ticks and crosses in the appropriate boxes. Hide a quadrilateral. Ask the children to guess what it is as you slowly reveal it. Repeat with another quadrilateral if appropriate. <div>Q What shape do I have here?</div> <div>Q How do you know?</div> <div>Q What shapes can't it be?</div> <p>Encourage the correct use of names and properties in all responses.</p> <div> <p>By the end of the lesson children should know that:</p> <ul style="list-style-type: none"> A parallelogram has its opposite sides equal and parallel; A rhombus is a parallelogram with 4 equal sides; A rectangle has 4 right angles and its opposite sides are equal; A square is a rectangle with 4 equal sides; A trapezium has one pair of opposite parallel sides; A kite has 2 pairs of adjacent sides equal. <p>(Refer to supplement of examples, section 6, page 103.)</p> </div> <p>RESOURCES Resource sheets 8.2-8.9 Large card quadrilaterals</p>	

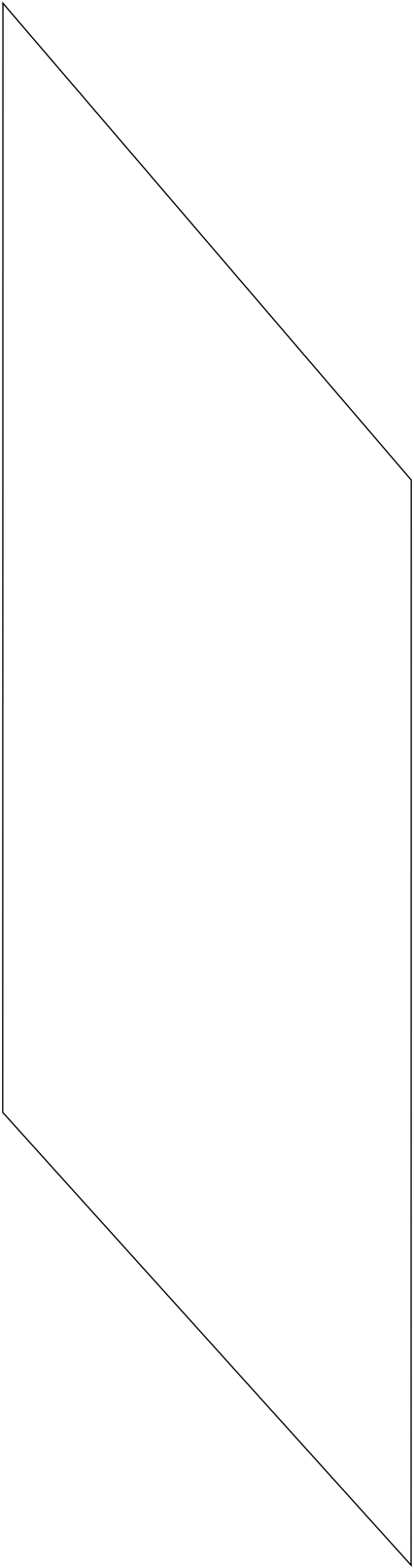
Planning sheet	Day Two	Unit 8 <i>Shape and space: reasoning about shapes: measures</i>	Term: <i>Autumn</i>	Year Group: 6
Oral and Mental		Main Teaching		Plenary
Objectives and Vocabulary	Teaching Activities	Objectives and Vocabulary	Teaching Activities	Teaching Activities / Focus Questions
<p>Classify quadrilaterals using side/angle properties.</p> <p>RESOURCES Whiteboards</p>	<ul style="list-style-type: none"> Describe a quadrilateral using specific vocabulary (with shape hidden from children). For example, say 'my quadrilateral has two pairs of parallel sides and four right angles'. <p>Ask the children to draw on their whiteboards what the quadrilateral might be.</p> <p>Repeat for several quadrilaterals.</p> <p>Q Are there any other quadrilaterals that it could be?</p> <p>Q What else would we need to say about this quadrilateral, so that it can only be a parallelogram and not a rectangle?</p>	<p>Classify quadrilaterals using side/angle properties.</p> <p>VOCABULARY intersect bisect acute adjacent diagonal</p> <p>RESOURCES Whiteboards Activity sheets 8.1 and 8.2 OHT 8.1</p>	<ul style="list-style-type: none"> Recap the meaning of terms: diagonal, intersect, bisect. Ask children to draw on their whiteboard two straight lines that bisect each other at right angles. <p>Q If these are diagonals of a quadrilateral what is the shape?</p> <p>Q Did everyone draw 2 lines of different lengths?</p> <p>Q What differences does it make?</p> <p>Ask children to draw on their whiteboards two equal lines which bisect each other but not at right angles.</p> <p>Q What quadrilateral would these be the diagonals of?</p> <ul style="list-style-type: none"> Give out sheet with drawings of quadrilaterals (Activity sheet 8.1). Ask for the names of each shape. Get children to draw in the diagonals. Ask the children what they can say about the diagonals. Remind them that their drawings may not be accurate and they have not proved anything is true by their drawings but that they are making inferences and hypothesising at this stage. Draw out that diagonals of any: <ul style="list-style-type: none"> square, rhombus, kite intersect at right angles; square, rectangle, rhombus, parallelogram bisect one another; square, rectangle, isosceles trapezium are equal. Introduce the binary tree using a single case for sorting square, parallelogram, triangle, pentagon. <pre> graph TD A[Has 4 sides] -- No --> B["(triangle, pentagon)"] A -- Yes --> C["(square, parallelogram)"] </pre> <p>Ask children to work in pairs to complete the 'sorting quadrilaterals' (Activity sheet 8.2) tree diagram for quadrilaterals A to G. Collect responses and correct any misinterpretations or errors.</p>	<ul style="list-style-type: none"> Discuss and challenge children by working through the tree diagram for the rhombus and the trapezium (OHT 8.1). <p>Ask questions around the defining properties of the shapes e.g.</p> <ul style="list-style-type: none"> How many pairs of parallel sides does the shape have? How many pairs of equal sides? <p>On the board draw the quadrilaterals.</p>  <p>Q What are they called? Why is each a trapezium?</p> <p>Q Will each end up in the same place on the tree diagram as the other trapezium? Why?</p> <ul style="list-style-type: none"> Define a trapezium as a shape with one pair of parallel sides; the other sides may be equal, may be parallel, may be neither. Remind them that when the sides are equal the trapezium is called isosceles. <p>HOMEWORK – Draw as many different looking kites and trapeziums as possible. Then try to label them with something that is special, for example, this one is symmetrical, or has a right angle.</p> <p>By the end of the lesson children should know that:</p> <ul style="list-style-type: none"> The diagonals of any square, rhombus or kite intersect at right angles; The diagonals of any square, rectangle, rhombus or parallelogram bisect one another. <p>(Refer to supplement of examples, section 6, page 103.)</p>

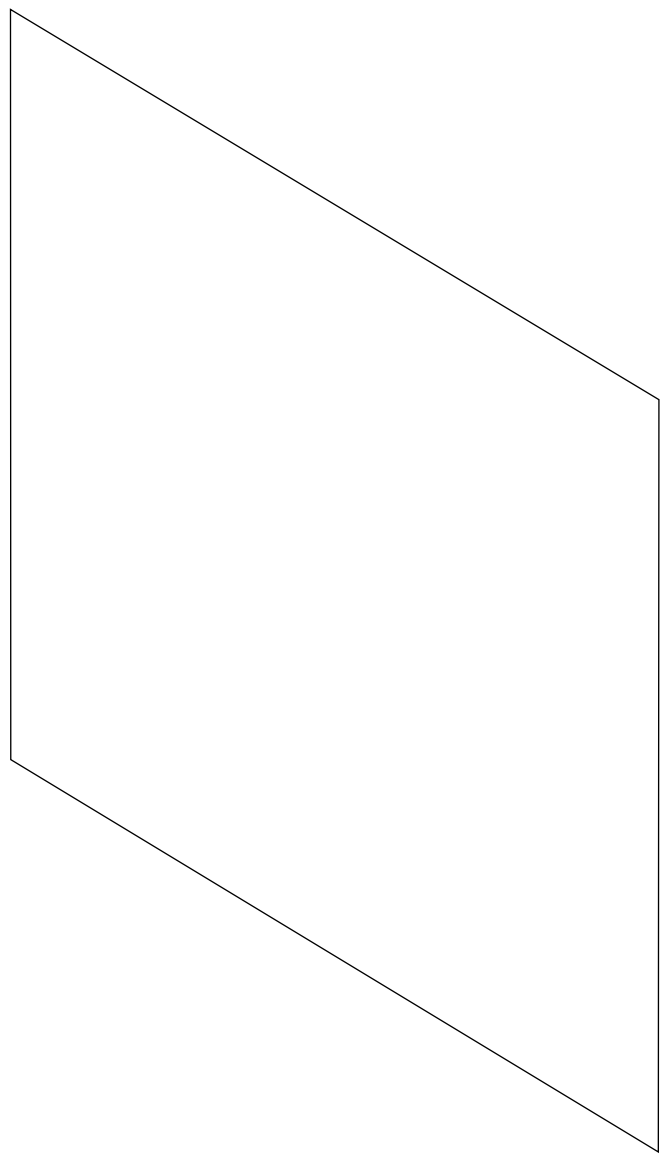
Planning sheet	Day Three	Unit 8 <i>Shape and space: reasoning about shapes: measures</i>	Term: <i>Autumn</i>	Year Group: 6
Oral and Mental		Main Teaching		Plenary
Objectives and Vocabulary	Teaching Activities	Objectives and Vocabulary	Teaching Activities	Teaching Activities / Focus Questions
<p>Classify quadrilaterals using side/angle properties.</p> <p>RESOURCES Whiteboards</p> <p>VOCABULARY adjacent sides irregular lines of symmetry</p>	<ul style="list-style-type: none"> Briefly follow up the homework. Ask children to draw a quadrilateral on their whiteboards with a particular property, e.g. opposite sides equal, one pair of parallel lines, one right angle. <p>Ask them to look at each other's and see the 'family' that all have this particular property. If necessary take part yourself and draw shapes that the children may not think of, e.g. a trapezium with three equal sides.</p> <p>Extend examples by using more of the following vocabulary list e.g. adjacent sides, irregular, lines of symmetry.</p> <div>Q Are there any other shapes that it could be?</div> <div>Q What else would we need to say about this shape so that it can only be a rectangle and not any other sort of parallelogram?</div> <p>Responses may include:</p> <ul style="list-style-type: none"> 2 lines of symmetry 	<p>Classify quadrilaterals using side/angle properties.</p> <p>VOCABULARY intersect bisect acute adjacent irregular regular</p> <p>RESOURCES Whiteboard Resource sheets 8.1, 8.9, 8.10</p>	<ul style="list-style-type: none"> Play 'guess my shape' as a whole class. Draw a quadrilateral on a mini-whiteboard and hide it from the children. Ask them to ask questions about it to which you can only answer yes or no. Encourage the children to use all the vocabulary they have been learning over the last few days. <p>Repeat but this time choose an 'awkward' shape such as a trapezium with a pair of adjacent sides equal.</p>  <div>Q What are helpful questions? What questions would narrow the choice?</div> <p>Responses may include</p> <ul style="list-style-type: none"> has it got one pair of parallel sides? <ul style="list-style-type: none"> Write a series of properties on the board. Ask children to record these in their books and draw as many four-sided shapes as they can that meet each of these properties. Collect responses and correct any misconceptions or errors. <i>Note:</i> refer to Resource sheet 8.1 for properties. 	<ul style="list-style-type: none"> Say you have 8 properties cards (Resource sheet 8.10). You will hold one up and the class write on their whiteboards the name of a quadrilateral that has this property. Use this to correct mistakes. Share unusual responses with the class. <p>Repeat but hold up 2 cards. Identify cases where one property implies the other e.g. 4 lines of symmetry and opposite angles equal. Hold up extra card e.g. opposite sides equal and ask:</p> <div>Q Does the property on this card mean that the shape has other properties listed on the cards?</div> <div> <p>By the end of the lesson children should be able to:</p> <ul style="list-style-type: none"> Make a general statement about quadrilaterals by finding examples that satisfy it. <p>(Refer to supplement of examples, section 6, page 81 and page 103.)</p> </div>

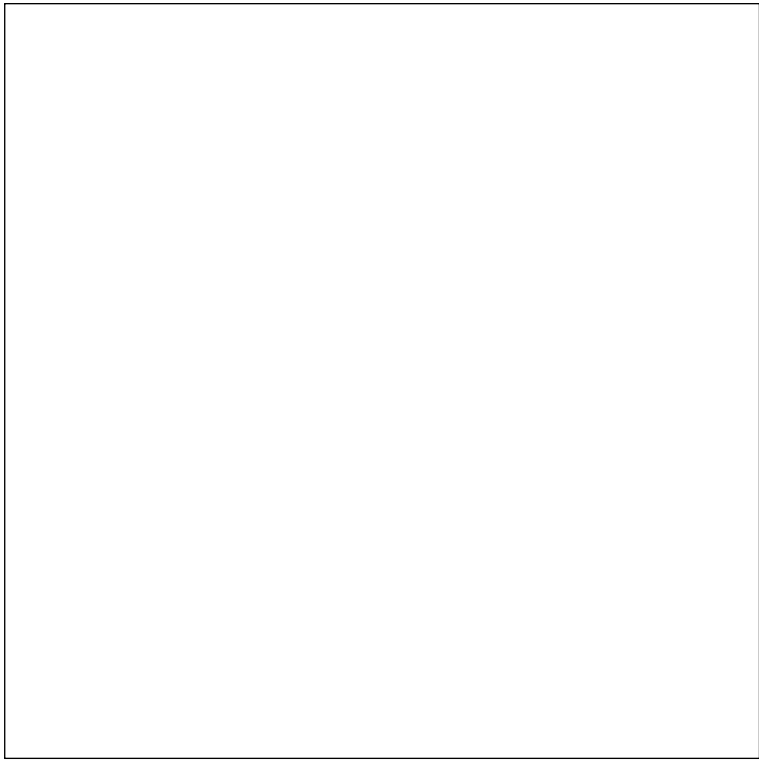
Planning sheet	Day Four	Unit 8 <i>Shape and space: reasoning about shapes: measures</i>	Term: <i>Autumn</i>	Year Group: 6
Oral and Mental		Main Teaching		Plenary
Objectives and Vocabulary	Teaching Activities	Objectives and Vocabulary	Teaching Activities	Teaching Activities / Focus Questions
<p>Add/subtract any pair of two-digit numbers, including crossing 100.</p> <p>VOCABULARY add increase more than plus total subtract difference between minus decrease how many more to make ...?</p>	<ul style="list-style-type: none"> Ask the children quickly to sketch a 4×4 grid and write in 16 numbers between 90 and 110 inclusive. Tell them to use 16 different numbers and arrange them in random order. Ask addition and subtraction questions with answers within this range. Use a range of vocabulary. Ask the children to cross out the answers as they occur. Repeat each question twice. Keep track of the questions and answers. Allow between 5 and 10 seconds for each question. <p>The first child to get four answers in a row (horizontal, vertical or diagonal) wins. Correct and check results.</p> <p>Repeat if time.</p> <p>Choose a few questions and ask how children worked out the answers.</p>	<p>Calculate the perimeter of rectangles and simple compound shapes that can be split into rectangles.</p> <p>VOCABULARY perimeter distance edge</p> <p>RESOURCES Large squared paper</p>	<ul style="list-style-type: none"> Draw a rectangle on the board and ask what we mean by finding the perimeter of a shape. <p>Ask the children what strategies they might use for calculating the perimeter of a rectangle. They might include:</p> <ul style="list-style-type: none"> adding together the lengths of the sides; doubling the length, doubling the breadth and then adding these two answers together; adding together one length and one breadth and then doubling this answer. <ul style="list-style-type: none"> Draw several rectangles on the board (with only two sides labelled) and ask the children to calculate their perimeters and after each explain to a partner how they calculated the answer. Quickly take feedback to make sure that they are familiar with finding perimeters of rectangles. <p>Q Do you have to measure all the sides of a rectangle?</p> <p>Q What units of measurement might you use?</p> <ul style="list-style-type: none"> Now draw a compound shape on the board. Explain that it is called compound because it is made up of different rectangles.  <p>Q How do you go about calculating the dimensions of this compound shape?</p> <p>Discuss their methods. Demonstrate how to find the length of all the sides and then ask the children for efficient ways to find the total of these, i.e. the perimeter.</p> <ul style="list-style-type: none"> Show children how to record the solution in their books. Provide children with differentiated exercises to practise finding perimeters. Collect their responses and correct any mistakes. 	<ul style="list-style-type: none"> Draw a compound shape on large squared paper and count all the squares around the shape. <p>Q Is this the perimeter?</p> <p>Lead them towards saying that we need the distance along the edge of the shape and this will be a linear measurement such as centimetres, not the number of squares, e.g. square centimetres. (This is a common error.)</p> <p>Q What units could you use for the perimeter of this shape?</p> <p>By the end of the lesson children should be able to:</p> <ul style="list-style-type: none"> Calculate the perimeter of simple compound shapes that can be split into rectangles. <p>(Refer to supplement of examples, section 6, page 97.)</p> <p>RESOURCES Large squared paper</p>

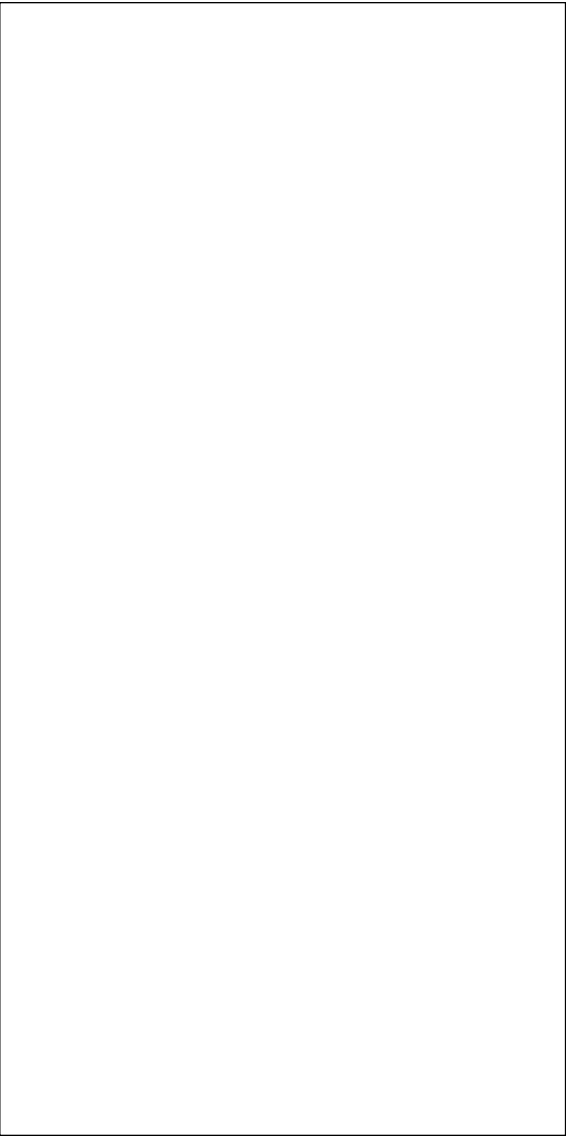
Planning sheet	Day Five	Unit 8 <i>Shape and space: reasoning about shapes: measures</i>	Term: <i>Autumn</i>	Year Group: 6
Oral and Mental		Main Teaching		Plenary
Objectives and Vocabulary	Teaching Activities	Objectives and Vocabulary	Teaching Activities	Teaching Activities / Focus Questions
<p>Consolidate knowing by heart multiplication facts up to 10×10.</p>	<ul style="list-style-type: none"> Ask the children quickly to sketch a 4×4 grid and write in 16 numbers between 40 and 65 inclusive. Ask children to find the areas or perimeters of rectangles with answers within this range, e.g. 'What is the area of a rectangle measuring 7cm by 8cm?' 'What is the perimeter of a rectangle measuring 11cm by 13cm?' Ask the children to cross out the answers as they occur. <p>The first child to get four answers in a row (horizontal, vertical or diagonal) wins. Collect and check results.</p> <div>Q Which numbers did not occur? Why might this be?</div> <div>Q Would you be able to cross 53 off? Why?</div> <p>This will only occur for the area of a rectangle measuring 53 by 1. Establish that some numbers have more pairs of factors.</p> <p>Repeat if time saying that they can alter their grid in the light of the knowledge that some numbers won't occur.</p>	<p>Calculate the perimeter of simple compound shapes that can be split into rectangles.</p> <p>Solve shape puzzles. Explain methods and reasoning orally.</p>	<ul style="list-style-type: none"> Draw this shape on the board.  <p>Ask the class what the area of the shape is. Ask two volunteers to draw 2 other shapes with the same area. Get the class to find the perimeters of the 3 shapes.</p> <p>Ask the children to try and draw a shape of the same area with the maximum perimeter and a shape with the minimum perimeter.</p> <p>Ask the children how they tried to maximise or minimise the perimeter.</p> <div>Q What can you say about the areas of these shapes?</div> <div>Q Do shapes with the same area have the same perimeter?</div> <ul style="list-style-type: none"> Show the class three rectangles (as on Resource sheet 8.11): A (10 cm by 16 cm), B (8 cm by 10 cm), C (5 cm by 8 cm). Ask children to find the area of each rectangle. Use A and B to blu-tack to the board to form a compound shape such as:  <div>Q What has changed? Why?</div> <p>Emphasise that while the areas are the same the perimeter is different. With the class find the perimeters of each shape. Show the class how to record this in their books. Using rectangles A, B and C get the children to make compound shapes of their own, record the areas and find the perimeters.</p> <ul style="list-style-type: none"> Collect responses and correct any misunderstandings and mistakes. 	<ul style="list-style-type: none"> Draw 3 L-shaped polygons on the board.  <div>Q How many sides does each L-shape have?</div> <div>Q What is the name of this polygon?</div> <div>Q Is it regular or irregular?</div> <p>Explain that each of the hexagons represents a garden fenced all the way round. The total length of fencing is 40 m. The longest two sides are 10 m and 8 m. Get children to discuss what possible lengths the other sides might be for each case. Record these on the board. In pairs get the children to find the area of each garden. Collect their responses and correct any misinterpretations and errors.</p> <ul style="list-style-type: none"> Draw another L-shaped hexagon.  <p>Say this time the area is 70 m^2. What might the perimeter be?</p> <p>Collect responses. Emphasise that shapes with the same area can have different perimeters.</p> <div>By the end of the lesson children should be able to:</div> <ul style="list-style-type: none"> Find the perimeters of simple compound shapes that can be split into rectangles. <p>(Refer to supplement of examples, section 6, pages 91 and 97.)</p>
<p>VOCABULARY</p> <p>area</p> <p>square centimetres, cm^2</p> <p>prime</p>		<p>VOCABULARY</p> <p>perimeter</p> <p>distance</p> <p>edge</p> <p>polygon</p> <p>hexagon</p> <p>revision of vocabulary related to length and their abbreviations</p> <p>centimetres, cm</p> <p>square centimetres, cm^2</p> <p>metres, m</p> <p>RESOURCES</p> <p>Whiteboards</p> <p>Centimetre squared paper</p> <p>Resource sheet 8.11</p>		<p>RESOURCES</p> <p>Whiteboards</p>

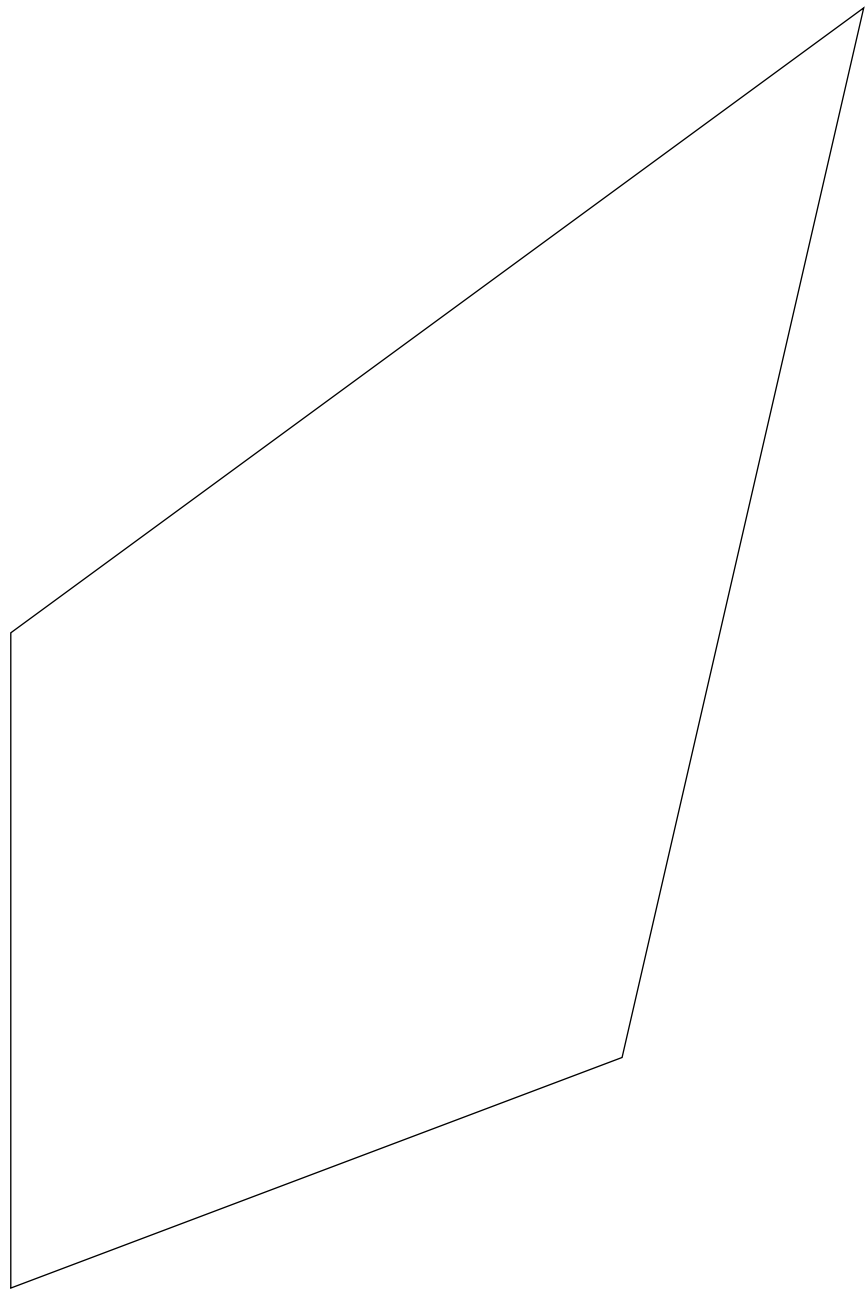
			Definition	Properties
SPECIAL QUADRILATERALS	Parallelogram		2 pairs of opposite parallel sides	Opposite sides equal, opposite angles equal
	Rhombus		4 equal sides – a special parallelogram	Opposite sides equal and parallel, opposite angles equal, 2 lines of symmetry
	Rectangle		4 right angles – a special parallelogram	Opposite sides equal and parallel, opposite angles equal, 2 lines of symmetry
	Square		4 equal sides and 4 right angles – a special rhombus, special rectangle	Opposite sides equal and parallel, 4 lines of symmetry
	Oblong		4 right angles, but length and breadth different – a rectangle which is not square	As rectangle, 2 lines of symmetry
	Kite and inverted kite (delta)		2 pairs of adjacent sides equal	1 pair of opposite angles equal, 1 line of symmetry
	Trapezium		One pair of parallel sides – if the other pair of sides is equal the trapezium is isosceles	None

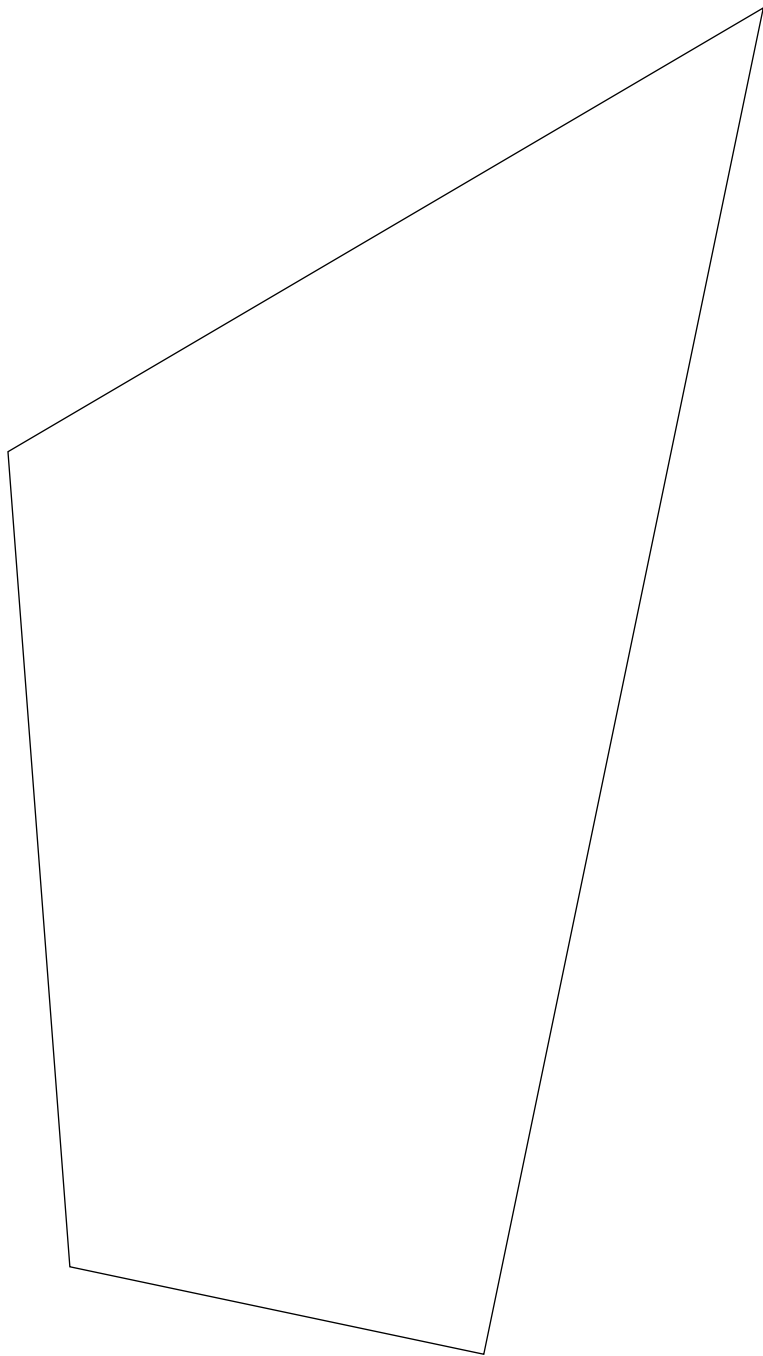


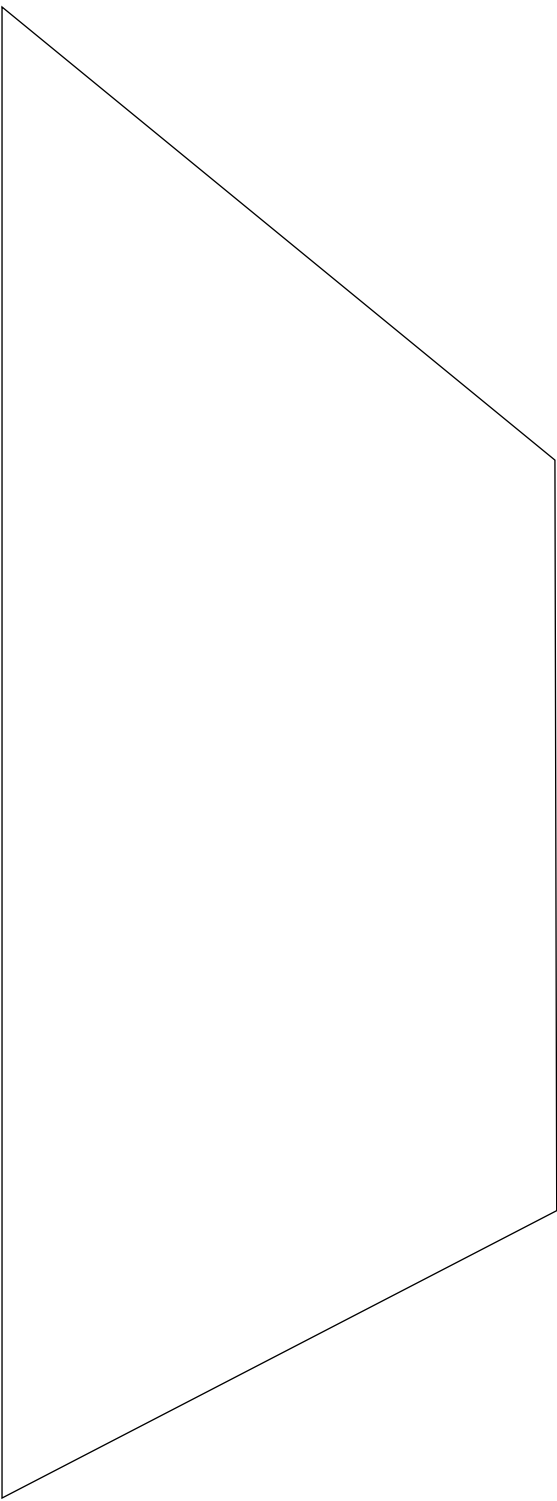












	4 equal sides	Opposite sides equal	4 right angles	Opposite sides parallel	Adjacent sides equal
Quadrilateral					
Parallelogram					
Rhombus					
Rectangle					
Square					
Trapezium					
Kite					

Properties of quadrilaterals cards

Opposite sides
equal

Adjacent sides
equal

One line of symmetry

Opposite angles
equal

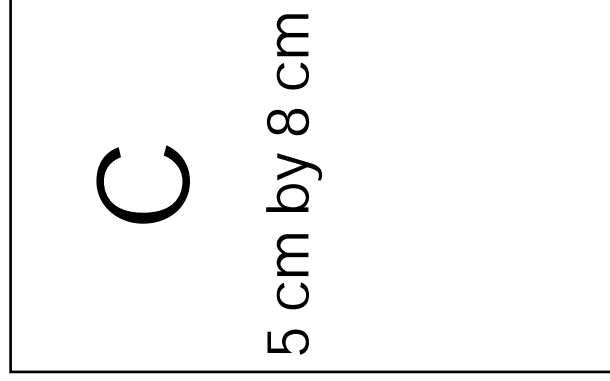
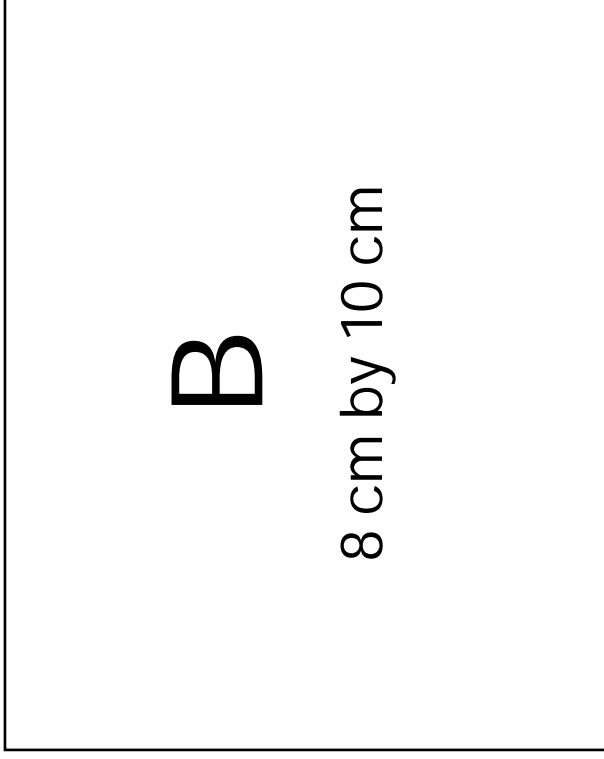
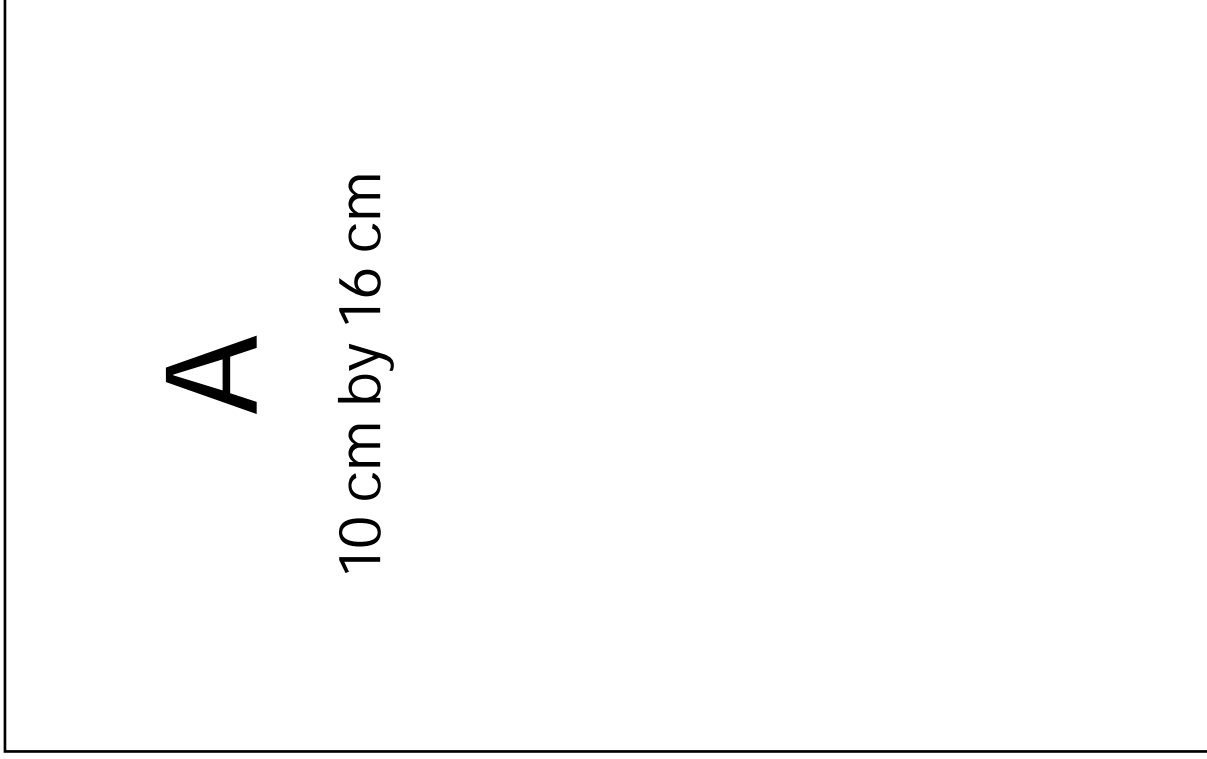
Adjacent angles
equal

Two lines of symmetry

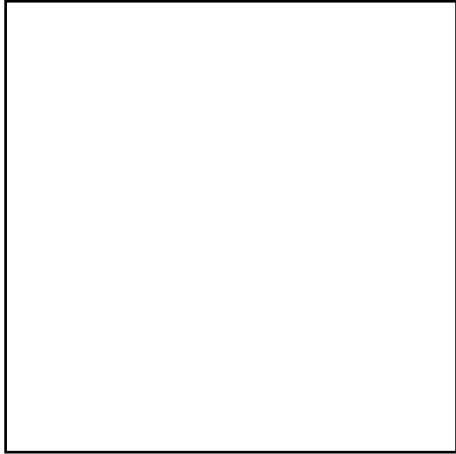
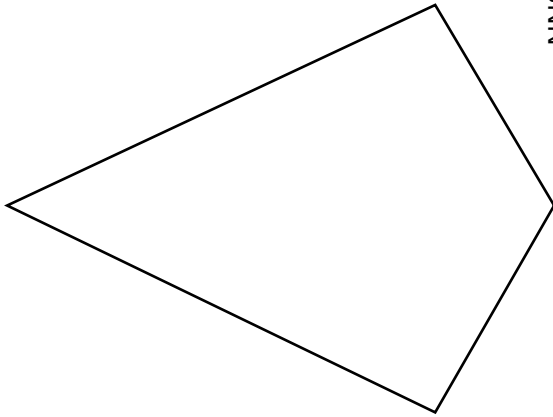
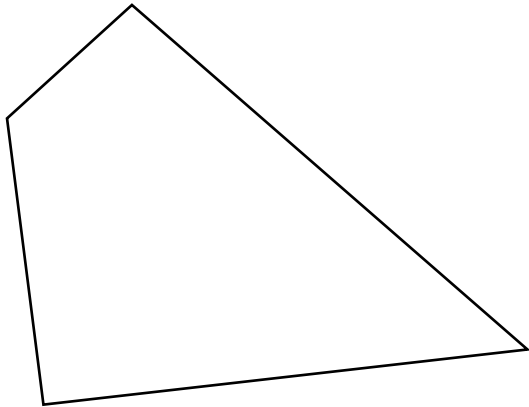
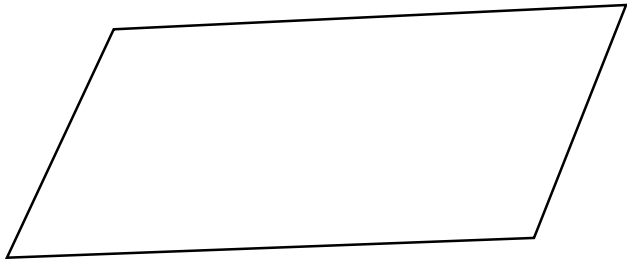
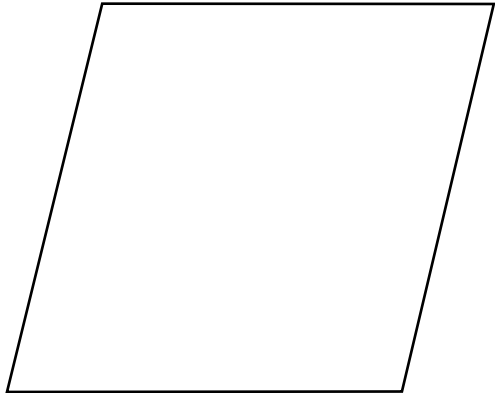
Opposite sides
parallel

Four lines of symmetry

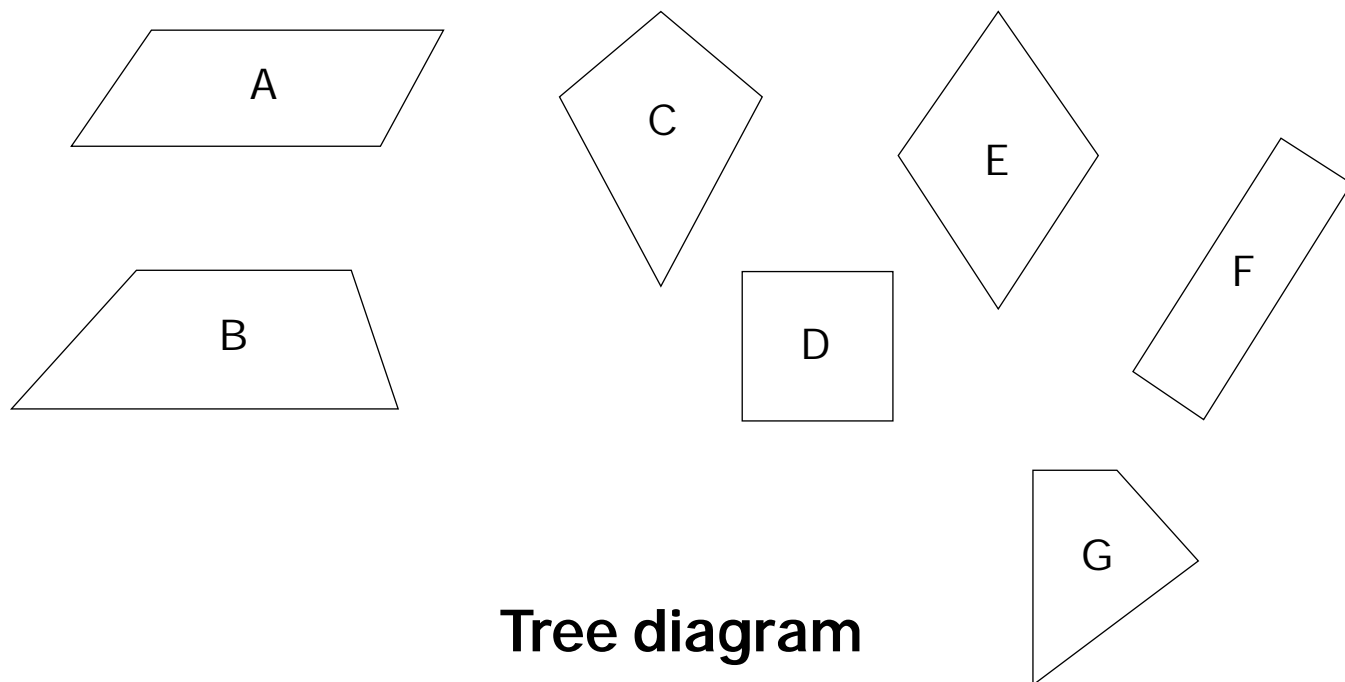
Three rectangles



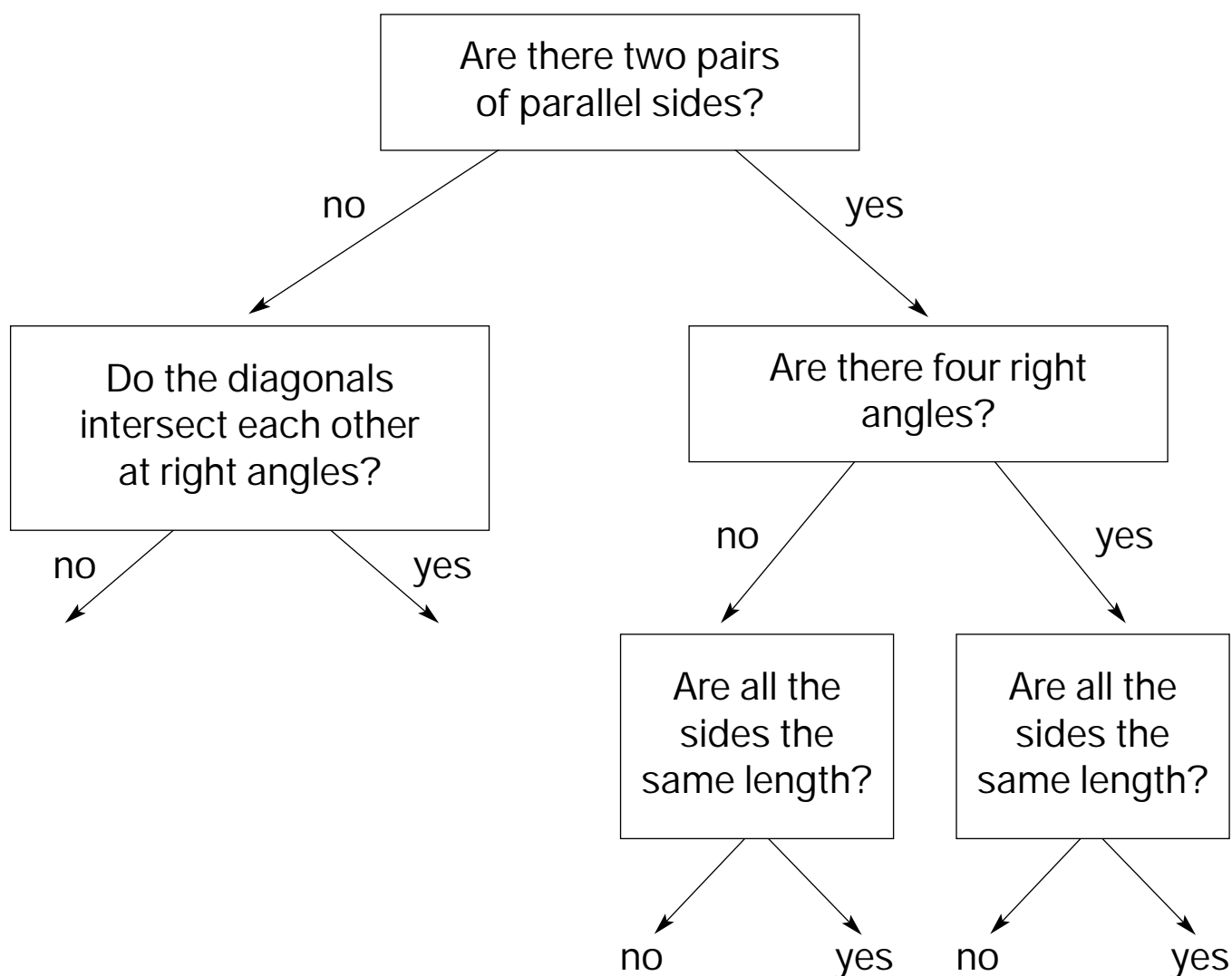
Draw diagonals



Sorting quadrilaterals



Tree diagram

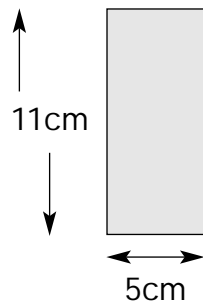


Related Key Stage 2 national test questions:

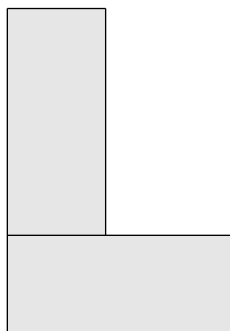
2000 Test A

19

Liam has two rectangular tiles like this.



He makes this L shape.



What is the **perimeter** of Liam's L shape?



cm

19

1 mark

Total

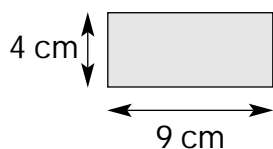
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2000 Test A

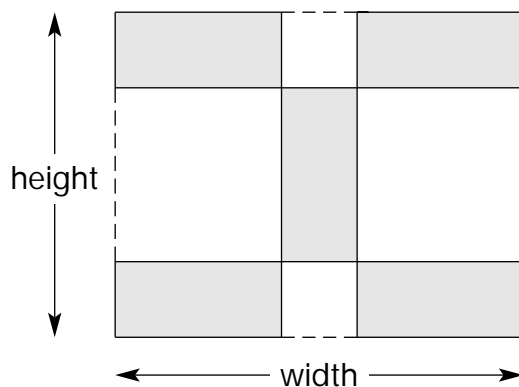
16

Kim has some rectangular tiles.

Each one is **4 centimetres** by **9 centimetres**.



She makes a design with them.



Calculate the **width** and **height** of her design.



width =

 cm

height =

 cm

16a

1 mark

16b

1 mark

Total