The National Strategies
Secondary

Assessing pupils' progress in mathematics at Key Stage 3

Year 7 assessment package
Number

Teacher pack

department for
children, schools and families

QCA Qualifications and Curriculum Authority

Year 7 Number task: *Shape expectations* and *Polygon perimeters*

Levels 3/4/5

The lesson plans in this pack are set out in two columns. The left-hand column has indicative times for activities, highlights the resource sheets required and also has some examples of questions which teachers may wish to use with pupils during the activities. The right-hand column describes each activity in detail.

APP ASSESSMENT CRITERIA
These lessons may generate evidence to help inform judgements against a number of assessment criteria, including the following:

Calculating

- level 4: solve problems with or without a calculator
- level 4: use efficient written methods of addition and subtraction and of short multiplication and division
- level 5: use known facts, place value, knowledge of operations and brackets to calculate including using all four operations with decimals to two places

Using and applying mathematics

- level 4: search for a solution by trying out ideas of their own
- level 5: solve word problems and investigations from a range of contexts.

LESSON 1: *SHAPE EXPECTATIONS*
Resources

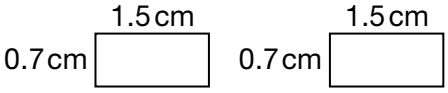
- Teacher OHT/whiteboard slides:
  Four shapes **(T4L1teacher1)**
  Two hexagons **(T4L1teacher2)**
- Each pupil or group of pupils needs the following worksheet:
  Three hexagons **(T4L1pupil1)**
- Each pupil needs one of the following assessment sheets:
  Level 3 pupils: *Perimeter sheet 1* **(T4L1assess1)**
  Level 4 pupils: *Perimeter sheet 2* **(T4L1assess2)**
  Level 5 pupils: *Perimeter sheet 3* **(T4L1assess3)**
- Cardboard shapes, e.g. regular hexagons, or other practical equipment to demonstrate tessellating shapes (optional)
- Paper, squared, plain or lined, for the assessment activity and for any rough working
- Note that calculators should not be used, since the activity is assessing understanding of decimals

Starter about 5 minutes **T4L1teacher1** *Is 'splitting' 2.6 into 2.5 + 0.1 helpful? Why?* *Is 'splitting' 2.6 into 3 – 0.4 helpful? Why?*	Show the OHT/whiteboard slide: *Four shapes* **(T4L1teacher1)** Ask for the mathematical names of these shapes, emphasising the equal side lengths within each shape [equilateral triangle, square, regular pentagon and regular hexagon]. Explain that each shape has the same side length and, to start with, say that this side length is **2.6 cm**. What is the perimeter of the square? [10.4 cm] What is the perimeter of each of the other shapes? Consider some alternative methods, e.g. triangle 3 × 2.6 or 10.4 – 2.6 = 7.8 cm pentagon 5 × 2.6 is half of 10 × 2.6, i.e. 26 ÷ 2, or 10.4 + 2.6 = 13 cm hexagon 2 × 7.8 or 13 + 2.6 = 15.6 cm
Group activity about 5 minutes	Tell the pupils that the side length of the shapes has changed, but emphasise that the shapes still have the same side length. The **perimeter** of the pentagon is now **7 cm**. Ask the pupils to work in groups to find the perimeters of the three other shapes. [Side length = 1.4 cm, so perimeters are 4.2 cm for the triangle, 5.6cm for the square and 8.4 cm for the hexagon.]
Mini-plenary about 5 minutes **T4L1teacher2** *What efficient method could be used to work out the answer to 13 ÷ 5? Or 13 ÷ 2.5?* *Why is 12 × 3.5 the same as 6 × 7?*	Discuss methods, focusing especially on the calculation 7 ÷ 5. For example, how could the calculation 7 ÷ 10 help to work out the answer to 7 ÷ 5? What about 14 ÷ 10? Now show only the top part (two hexagons that are not joined) of the OHT/whiteboard slide: *Two hexagons* **(T4L1teacher2)** Say that the side length of each hexagon is **3.5 cm**. What calculation will work out the total perimeter of the two hexagons? [12 × 3.5] Ask for efficient methods to do this calculation, focusing especially on 6 × 7, i.e. halving and doubling, and 10 × 3.5 + 2 × 3.5. Now show the lower part (two hexagons that are joined at one side) of the OHT/whiteboard slide: *Two hexagons* **(T4L1teacher2)** Ask for the total perimeter (around the outside edges only) of this joined shape. [10 × 3.5 = 35 cm]

Group activity about 10 minutes **T4L1pupil1** *If you know the answer to 18 × a number, is there a quick way to find the answer to 12 × the same number?* [÷ 3, × 2] *What might a picture for 16 × side length look like?* [Example shown below] *The greatest total perimeter for three hexagons is 18 × side length. For four hexagons it is 24 × side length. What would it be for ten hexagons?* [60 × side length] *What would it be for n hexagons?* [6*n* × side length] *Hexagons can join in a single row (i.e. only ever join a side with one other hexagon). Three hexagons in this arrangement have a total perimeter of 14 × side length, four hexagons have a total perimeter of 18 × side length. What would it be for ten hexagons?* [42 × side length] *What would it be for* n *hexagons?* [(4*n* + 2) × side length] *What do you notice about the calculations for the perimeters of shapes with four hexagons?* [Side lengths are always multiplied by even numbers. Note that this idea is used within the assessment activity so it is not recommended that the justification for this is discussed in depth at this stage.]	Give each pupil or group of pupils the following worksheet: *Three hexagons* **(T4L1pupil1)** Note that the side length of the hexagon has been left blank to enable teachers to differentiate according to ability. Suggestions are: Level 3 pupils: side length 1.5 cm Level 4 pupils: side length 1.2 cm Level 5 pupils: side length 1.9 cm [The calculations required are: 18 × side length, 14 × side length and 12 ××× side length.] Pupils who complete the activity can be asked to investigate perimeters of arrangements of four hexagons, e.g. 24 × side length 18 × side length 16 × side length 14 × side length
Assessment activity about 20 minutes **T4L1assess1** **T4L1assess2** **T4L1assess3**	Give out the assessment sheets, i.e. Level 3 pupils: *Perimeter sheet 1* **(T4L1assess1)** Level 4 pupils: *Perimeter sheet 2* **(T4L1assess2)** Level 5 pupils: *Perimeter sheet 3* **(T4L1assess3)** Note that spare paper, probably squared, may be required by level 4 and level 5 pupils. Also note that teachers may need to clarify what is meant by shapes that are joined and shapes that are not joined.

Plenary
about 5 minutes

Tell the class that you will now be working with two 1.5 cm by 0.7cm rectangles. Sketch them on the board/OHT, i.e.

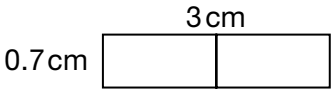


What is the perimeter of one of these rectangles? [4.4 cm]
How can it be worked out?

Ask pupils to visualise the two rectangles with the shorter sides joined. Ask what shape is formed. [A rectangle]

Explain why both the following calculations give the perimeter of one of the rectangles.
(a) 2 × 0.7 + 2 × 1.5
(b) 2 × (0.7 + 1.5)

Ask for a calculation to work out the perimeter of this shape. [E.g. 2 × 0.7 + 4 × 1.5] What is its perimeter? [7.4 cm] Draw the shape at this stage if it helps any pupils who were struggling to visualise it, i.e.

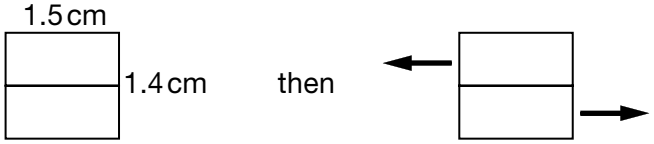


If another of the rectangles is joined on by its shorter side, what would the perimeter of the new shape be? Does it matter which part of the shape it is joined onto?

What is the perimeter of a rectangle made by joining 100 of these small rectangles end to end by their shorter sides? What about a rectangle made in this way with n small rectangles?

Now ask the pupils to visualise the rectangle formed by joining the longer sides of the original shapes. Again, ask for its perimeter and discuss different methods and mental calculations. [Perimeter = 5.8 cm]

Draw the rectangle and now ask pupils to visualise the two rectangles sliding horizontally in opposite directions (i.e. parallel to the longer sides), i.e.



As before, what happens if the 1.5 by 1.4 rectangle is extended by adding another rectangle joined by its longer side? Does it matter this time which part of the shape it is joined to?

Again, what is the perimeter of a rectangle made with longer sides joined using 100 small rectangles? Or n *small rectangles?*

What happens to the perimeter as the two rectangles slide further? [The perimeter increases.]

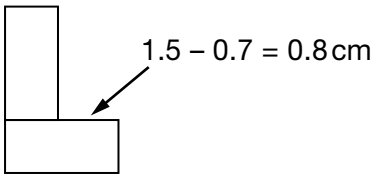
Now ask the class to visualise the two rectangles joined in an 'L-shape', i.e. one shorter side joined to one longer side. What is the mathematical name of the 'L-shape'? [A hexagon]

Think about a 10cm by 10cm square made of card. What is its perimeter?

What happens to the perimeter of the card if a smaller square or rectangle is cut out of the corner? E.g.

What happens when steps like this are cut out? (NB: adjacent sides are all at right angles.)

What is the perimeter of the hexagon? [7.4 cm] Again, discuss methods and mental calculations. Draw the diagram if it helps the discussion about how to work out the lengths of sides where subtraction is needed, e.g.



What happens to the perimeter if the rectangle joined by its shorter side slides along to form a 'T-shape'? [It stays the same.] How can we be sure? What is the mathematical name of the 'T-shape'? [An octagon]

LESSON 2: *POLYGON PERIMETERS*

Resources

- A piece of wire or string, or similar, that is exactly 12cm long
- Each pupil, or group of pupils, needs a copy of the worksheet:
  Regular 12s **(T4L2pupil1)**
- Teacher OHT/whiteboard slides:
  Regular 12s, table of results **(T4L2teacher1)**
  Growing pentagons **(T4L2teacher2)**
- Each pupil needs one or more of the following worksheets, depending on ability:
  Level 3/4 pupils: *Polygon perimeters sheet 1* **(T4L2assess1)**
  Level 4/5 pupils: *Polygon perimeters sheet 2* **(T4L2assess2)**
- Pupils who complete the assessment with confidence may wish to attempt the next in the series of worksheets. For level 5 pupils, the following worksheet is available:
  Extension activity: *Polygon perimeters sheet 3* **(T4L2assess3)**
- Paper for group work, and for the assessment activity, and for any rough working
- Note that calculators should not be used, since the activity is assessing understanding of decimals. However, some of the calculations are difficult and teachers should use their judgement as to whether lower-ability pupils would benefit from the use of a calculator and/or spreadsheet: this should be taken into account when assessing the work

Starter 5 minutes *What is a regular polygon? What do we usually call a regular triangle* [equilateral] *or a regular quadrilateral* [square]*? Is a rhombus a regular quadrilateral?* [No. Its sides are equal but its angles can differ.] *How might you complete this statement about the shape made with wire/string? The more sides the polygon has, …* [e.g. the shorter each side will be].	Show the pupils a piece of wire or string, or similar, that is exactly 12cm long. Ask: If you could use the wire or string to make an equilateral triangle with a perimeter of exactly 12cm, what would its side length be? What other shapes could you make with the wire or string? For now, state that the shapes should be regular, ensuring that pupils understand the meaning of the term.
Group activity 10 minutes **T4L2pupil1** *For which polygons is it hardest to work out the side lengths? Why?* *How could we use the side lengths of the square to find the side lengths of the 8-sided polygon or the 12-sided polygon?*	Give each pupil, or group of pupils, the following worksheet: *Regular 12s* **(T4L2pupil1)** Ask the pupils to work together in small groups to find the side lengths. The shapes are drawn accurately, so do not allow rulers. Also, for most pupils, do not allow calculators. Warn the pupils that some shapes will be easier than others, so they will need to think about the order they work in. (Note that the 7-, 9- and 11-sided polygons are difficult and may be better discussed in the mini-plenary that follows.) After ten minutes or so, bring the group back together to discuss their findings, even if the work is incomplete.

Mini-plenary
15 minutes

T4L2teacher1

What are the names of these polygons?

Which language gives us the names of the polygons? [Greek – e.g. *deka* for 10, as in decagon, *dodeka* for 12 as in dodecagon. In modern Greek, *theka* (th pronounced as in 'there', not 'thin') means 10, *thotheka* means 12.]

What does 'poly' mean? [Many]
What does 'polygon' mean? [Many-sided]

From the fact that the 3-sided shape has a side length of 4, can you find a quick way of working out the side length of the 6-sided shape? What other connections are there in the table?

Look at the pictures of the shapes. What do you notice? If regular polygons of perimeter 12 cm with increasing numbers of sides continued to be drawn, what would the shapes start to look like? [Circles]

Is there an exact way of writing down the side length of a 9-sided polygon? [e.g. $1\frac{1}{3}$]

What happens if you type in 1.333333333 (as many times as possible) on the calculator display and then multiply by 9? What does the calculator show?

How do we write recurring decimals efficiently?
[$1.\dot{3}$, $1.\dot{7}1\dot{4}285\dot{}$, $1.0\dot{9}$ – discuss dot convention]

[Note that the questions below lead to an interesting investigation in its own right.]
What is 1 ÷ 7? [$0.\dot{1}42857\dot{}$]
What is 2 ÷ 7? [$0.\dot{2}85714\dot{}$]

What about 3 ÷ 7, 4 ÷ 7, etc? Look carefully at the recurring cycle of digits. What do you notice?

Show the OHT/whiteboard slide:
Regular 12s, table of results **(T4L2teacher1)**
Ask which side lengths were easy to work out, and why.

Record the side lengths that are integers or 'easy' decimals, i.e. that are exact to one decimal place:

Number of sides	Calculation	Side length (cm)
3	12 ÷ 3	4
4	12 ÷ 4	3
5	12 ÷ 5	2.4
6	12 ÷ 6	2
7		
8	12 ÷ 8	1.5
9		
10	12 ÷ 10	1.2
11		
12	12 ÷ 12	1

What do they notice? [The side lengths are decreasing.]

Which of the regular polygons have side lengths that are whole numbers (integers)? [Polygons with 3, 4, 6 and 12 sides.]
How does this link with the factors of 12?
Why can't you have polygons with 1 or 2 sides?

Choose one of the polygons with a side length that is a terminating decimal, e.g. an 8-sided polygon, side length 1.5 cm.
How could you check that the side length is correct?
[Work out 1.5 × 8 = 12.]

The remainder of this part of the lesson will depend on the ability level of the group. Weaker pupils will benefit from the use of calculators and/or spreadsheets. More able pupils can be challenged to explore the nature of recurring decimals.

Focus on the 9-sided polygon. Is the answer 1.3 correct?
Does 1.3 × 9 = 12? What about 1.33 × 9? Or 1.333 × 9?
Discuss the recurring nature of the decimal.

Now focus on the 11-sided polygon. Is the answer 1.1 correct?
Does 1.1 × 11 = 12? What about 1.09 × 11?
Show how the decimal continues, i.e. 1.090909…
Discuss the answer given on a calculator (e.g. 1.090909091).
Does that mean that the pattern of repeating 09 stops?

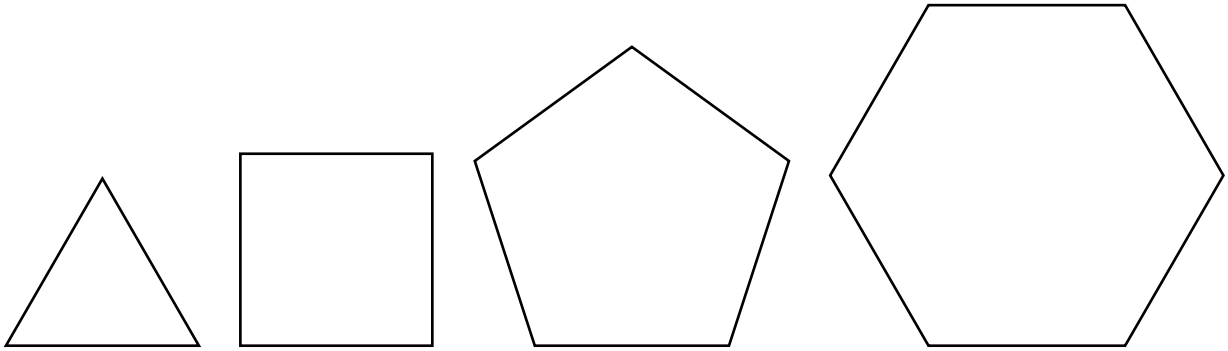
Finally, focus on the 7-sided polygon. Either show how the pattern in the digits after the decimal point continues by dividing by hand, or by using a calculator or spreadsheet.
[12 ÷ 7 = 1.7142857142857…]

Assessment activity 15 minutes **T4L2assess1** **T4L2assess2** **T4L2assess3**	Give out the following assessment sheets: Level 3/4 pupils: *Polygon perimeters sheet 1* **(T4L2assess1)** If appropriate, pupils can then continue with: *Polygon perimeters sheet 2* **(T4L2assess2)** Level 4/5 pupils: *Polygon perimeters sheet 2* **(T4L2assess2)** If appropriate, pupils can then do the extension activity: *Polygon perimeters sheet 3* **(T4L2assess3)** Encourage the pupils to show their working either in the white spaces on the sheet or on a separate sheet which they should attach. This is useful when making assessment decisions. Note that, for sheet 2, some pupils may benefit from being prompted about the order in which they attempt the polygons. One suggested order is given below, but such prompts should be taken into account when assessing. 3 sides [5.2] 6 sides [2.6] 4 sides [3.9] 8 sides [1.95] 10 sides [1.56] 5 sides [3.12] 12 sides [1.3] 13 sides [1.2] The final question on sheet 3 is challenging and may not be attempted by all pupils, though provides ideas for interesting future investigative work.
Plenary 5 minutes **T4L2teacher2** *Suppose different shapes were used instead of pentagons, e.g. octagons. Can you find rules for these different shapes?* *What about a rule for shapes with m sides?*	Show the OHT/whiteboard slide: *Growing pentagons* **(T4L2teacher2)** Ask how many side lengths there are around the perimeter of each of the shapes. [5, 8, 11, 14] Can they predict how many side lengths there would be around the perimeter of five pentagons joined in a row? [17] What about ten pentagons joined in a row? [32] How do they know? (Note that some pupils may give the answer 34, assuming it will be double the value for five pentagons. This is a common misconception, which is worth probing.) More able pupils should be encouraged to find a rule for the number of sides given the number of pentagons joined in a row, e.g. 'multiply the number of pentagons by 3 and add 2' or '$3n + 2$, where n is the number of pentagons in the row'. They should also be encouraged to justify the rule. [Each pentagon has three sides showing, hence × 3, except for the two on the outside which have a further one each, hence + 2.]

Teacher resource sheets

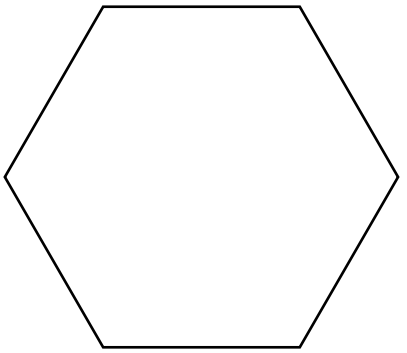
T4L1teacher1

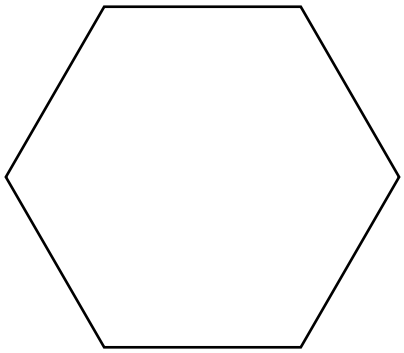
Four shapes



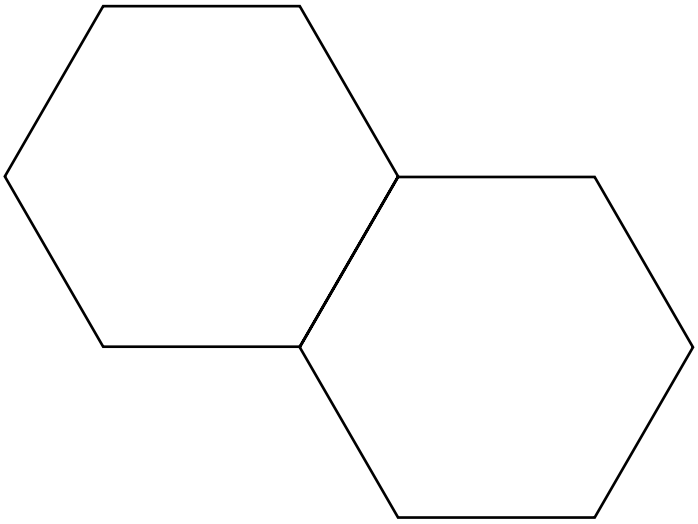
T4L1teacher2

Two hexagons





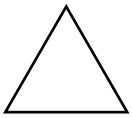
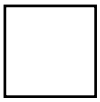
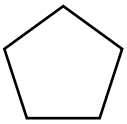
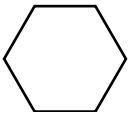
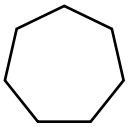
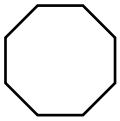
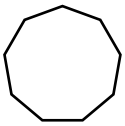
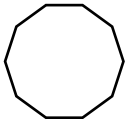
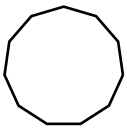
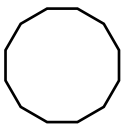
Total perimeter?



Total perimeter?

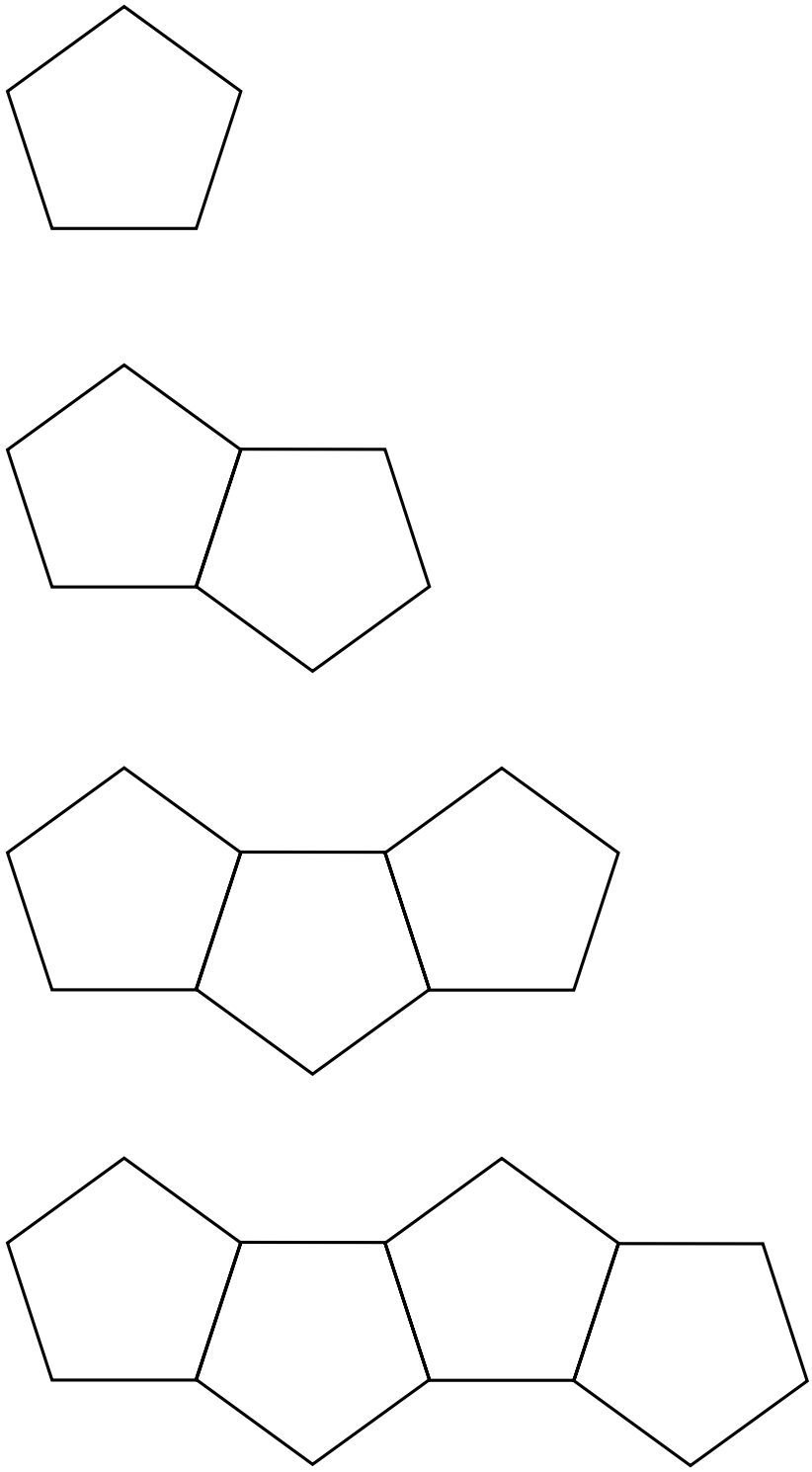
T4L2teacher1

Regular 12s, table of results

Shape	Number of sides	Calculation	Side length (cm)
	**3**		
	**4**		
	**5**		
	**6**		
	**7**		
	**8**		
	**9**		
	**10**		
	**11**		
	**12**		

T4L2teacher2

Growing pentagons



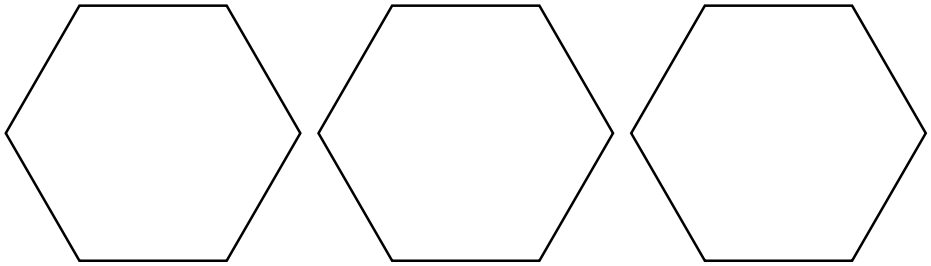
Pupil sheets

T4L1pupil1

Three hexagons Name(s): _____

What is the **total perimeter** of each group of three regular hexagons?

Side length = _____ cm



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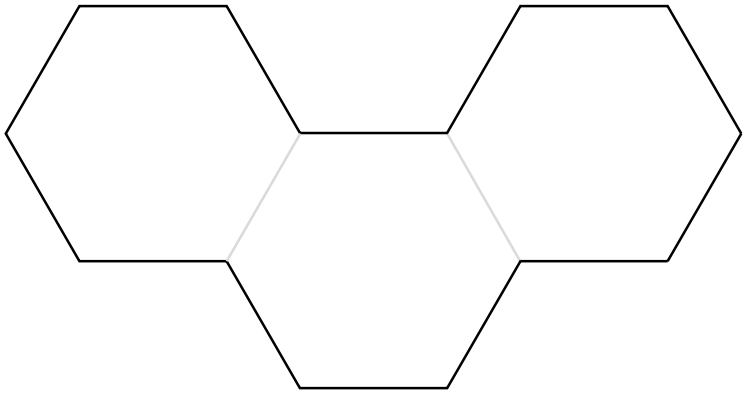

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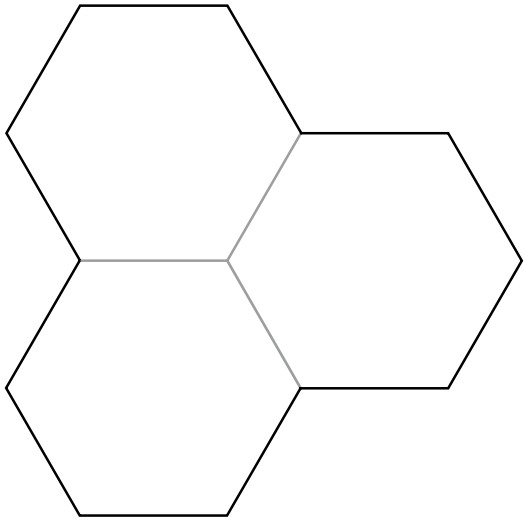
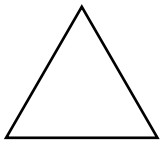


_____

T4L1assess1

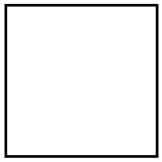
Perimeter sheet 1 Name: _____

The perimeter of the equilateral **triangle** is **3.6 cm**.
The side length for all four shapes is the same.
What is the perimeter of each of the other regular shapes?
Show how you work out the answers.

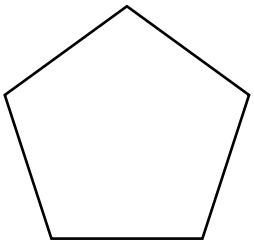


Perimeter

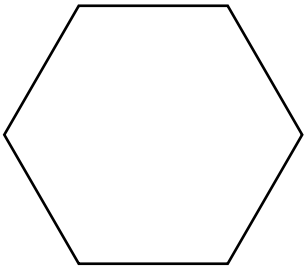
3.6 cm



Perimeter



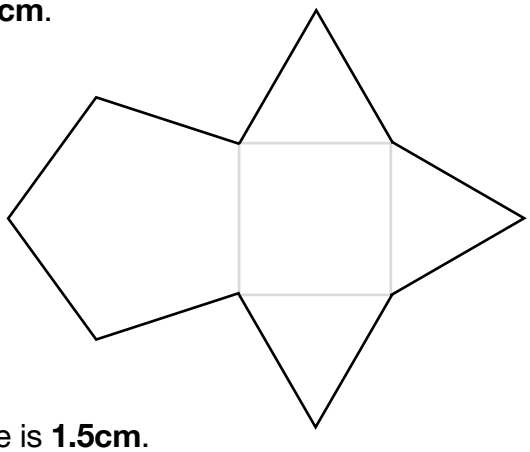
Perimeter



Perimeter

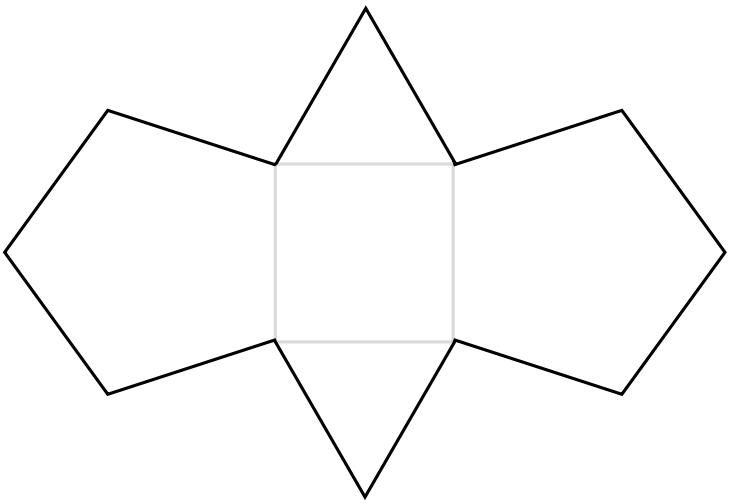
Each side length in this joined shape is **0.9cm**.
What is the total perimeter?

Perimeter



Each side length in this bigger joined shape is **1.5cm**.
What is the total perimeter?
Show how you work out the answer.

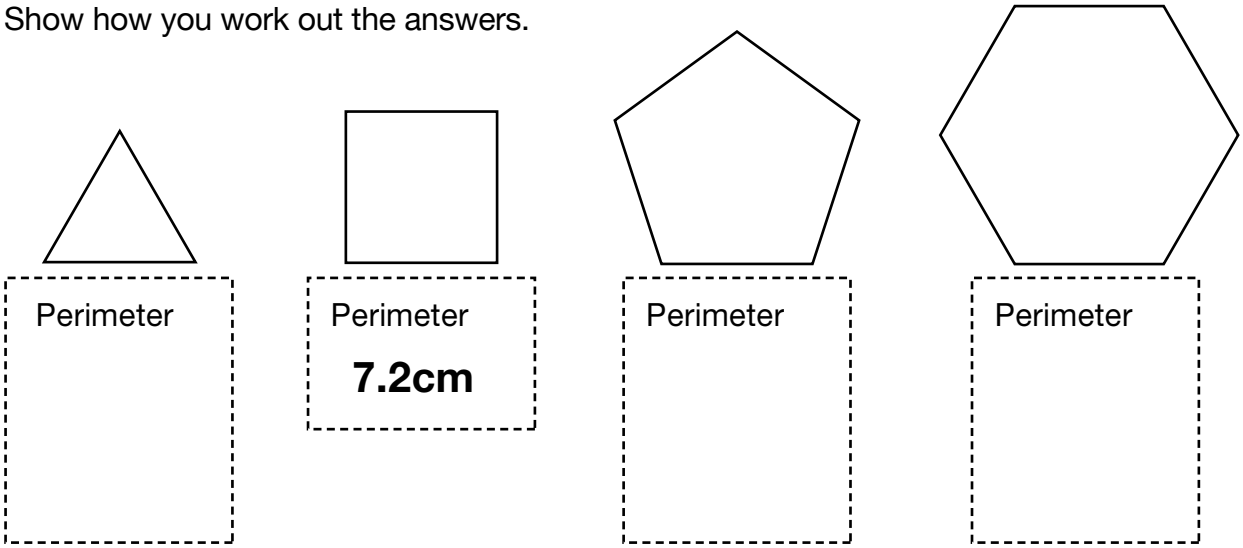
Perimeter



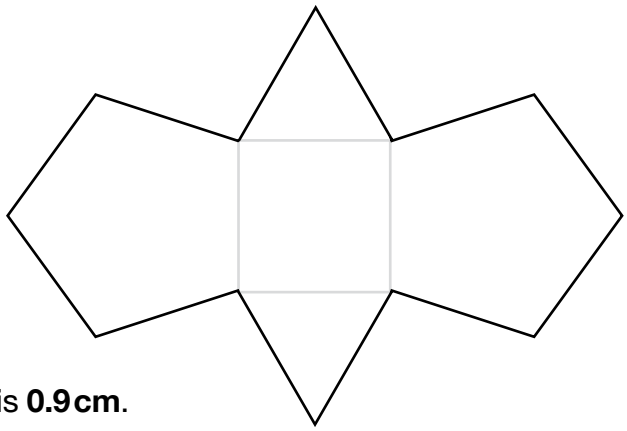
T4L1assess2

Perimeter sheet 2 Name: _____

The perimeter of the **square** is **7.2cm**.
The side length for all four shapes is the same.
What is the perimeter of each of the other regular shapes?
Show how you work out the answers.



Each side length in this joined shape is **1.5cm**.
What is the total perimeter?
Show how you work out the answer.



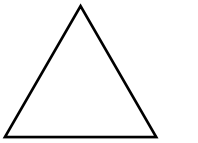
Each side length in a different group of shapes is **0.9cm**.
The total perimeter of the shapes is **13.5cm**.
How many sides does the group of shapes have? Show how you work out the answer.

No shapes in the group are joined.
Could the shapes **all** be **squares**? Explain your answer.

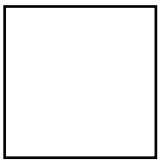
T4L1assess3

Perimeter sheet 3 Name: _____

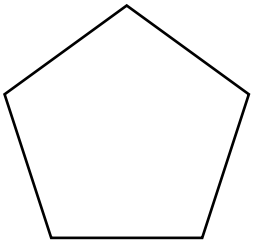
The perimeter of the regular **hexagon** is **14.1 cm**.
The side length for all four shapes is the same.
What is the perimeter of each of the other regular shapes?
Show how you work out the answers.



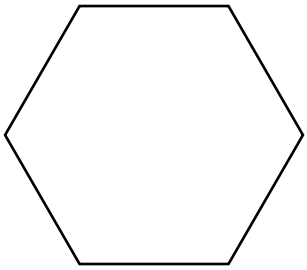
Perimeter



Perimeter



Perimeter



Perimeter

14.1cm

Each side length in a different group of shapes is **0.9 cm**.
The total perimeter of the group of shapes is **11.7 cm**.
How many sides does the group of shapes have? Show how you work out the answer.

If **no shapes** in the group are **joined**, could the shapes all be regular hexagons?
Explain your answer.

If the shapes in the group **are** joined, could the shapes all be equilateral triangles?
Explain your answer.

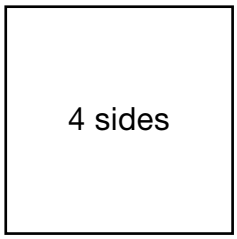
If the shapes in the group **are** joined, could the shapes all be squares?
Explain your answer. (You may need extra paper.)

T4L2pupil1

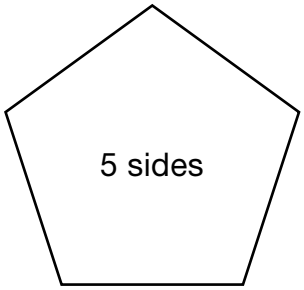
Regular 12s Name(s): _____

Each of these regular shapes has **perimeter 12 cm**.

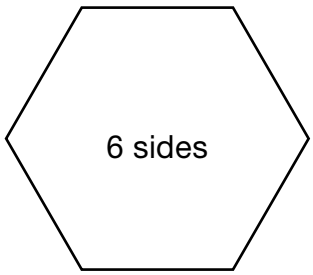
For each shape, work out the side length.



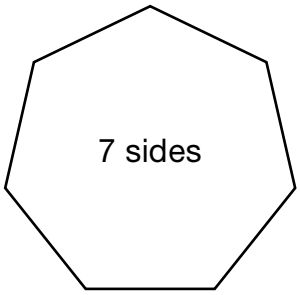
_____ cm



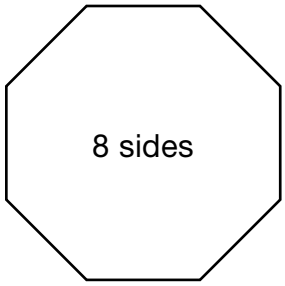
_____ cm



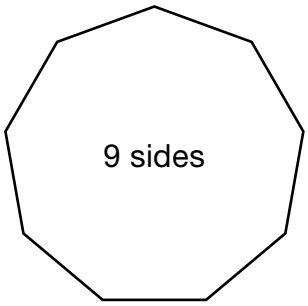
_____ cm



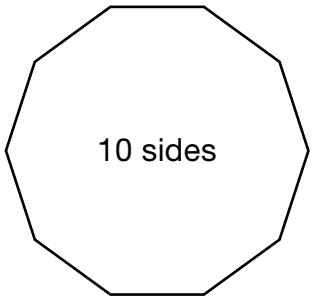
_____ cm



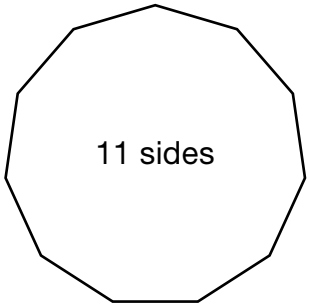
_____ cm



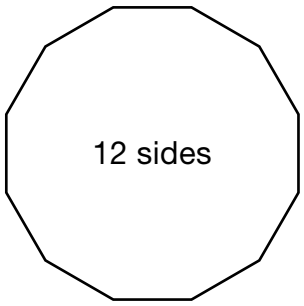
_____ cm



_____ cm



_____ cm



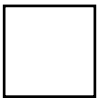
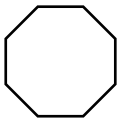
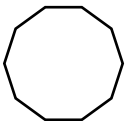
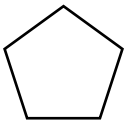
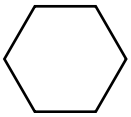
_____ cm

T4L2assess1

Polygon perimeters sheet 1 Name: _____

Fill in the table to show the side lengths of regular polygons with perimeter **16cm**.

The first one is done for you.

Perimeter is 16 cm			
Shape	Number of sides	Calculation	Side length (cm)
	4	16 ÷ 4	4
	8		
	10		
	5		
	6		

If you have finished, you can add more rows to the table and complete them for different shapes.

T4L2assess2

Polygon perimeters sheet 2 Name: _____

Fill in the table to show the side lengths of regular polygons with perimeter **15.6 cm**.

You will need to choose the number of sides in each shape.

If you wish, you can continue on a separate sheet of paper.

Perimeter is 15.6 cm		
Number of sides	Calculation	Side length (cm)

T4L2assess3

Polygon perimeters sheet 3 Name: _____

The perimeter of a **rectangle** is 15.6 cm.

If its length is 6.2 cm, explain why its width must be 1.6 cm.

What else could the length and width of this rectangle be?

Give two different examples.

Perimeter is 15.6 cm	
Length (cm)	Width (cm)

The perimeter of a regular nonagon (a **9-sided** shape) is **16 cm**.

Alice said:

'The side length of this shape is exactly **1.7 cm**.'

Show that Alice is wrong.

What is the exact side length of the regular nonagon?

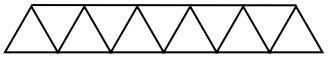
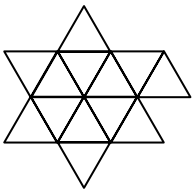
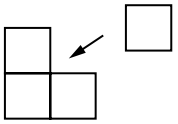
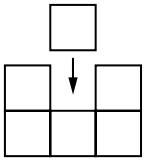
Solutions and performance indicators

LESSON 1: *SHAPE EXPECTATIONS* Solutions

Perimeter sheet 1 (target level 3)	**T4L1assess1**
Solutions	Notes
Perimeter of the square given as 4.8(cm) or equivalent A correct method, e.g. • 3.6 ÷ 3 = 1.2, 1.2 × 4 • 3.6 + 1.2 • 1.2 + 1.2 + 1.2 + 1.2	**Good** responses show some correct working for finding a perimeter. **Better** responses show an efficient method and give the correct value with a correct unit.
Perimeter of the pentagon given as 6(cm) or equivalent A correct method, e.g. • 3.6 ÷ 3 = 1.2, 1.2 × 5 • 1.2 × 10 = 12, 12 ÷ 2 • 1.2 ÷ 2 × 10 • Their perimeter for the square + 1.2 • 1.2 + 1.2 + 1.2 + 1.2 + 1.2	
Perimeter of the hexagon given as 7.2(cm) or equivalent A correct method, e.g. • 3.6 ÷ 3 = 1.2, 1.2 × 6 • 3.6 × 2 • Their perimeter for the pentagon + 1.2 • 1.2 + 1.2 + 1.2 + 1.2 + 1.2 + 1.2	
Total perimeter of the shape given as 9(cm) or equivalent, with or without a correct method	
Total perimeter of the shape given as 18(cm) or equivalent A correct method, e.g. • 1.5 × 12 • 1 × 12 = 12, 0.5 × 12 = 6, 12 + 6 • 1.5 × 10 = 15, 1.5 × 2 = 3, 15 + 3 • 1.5 × 2 = 3, 3 × 6 • 6 + 6 + 3 + 3	

Perimeter sheet 2 (target level 4)	**T4L1assess2**
Solutions	Notes
Perimeter of the triangle given as 5.4(cm) or equivalent A correct method, e.g. • 7.2 ÷ 4 = 1.8, 1.8 × 3 • 7.2 – 1.8 • 1.8 + 1.8 + 1.8	**Good** responses show some correct working for finding a perimeter. **Better** responses show an efficient method and give the correct value with a correct unit.
Perimeter of the pentagon given as 9(cm) or equivalent A correct method, e.g. • 7.2 ÷ 4 = 1.8, 1.8 × 5 • 1.8 × 10 = 18, 18 ÷ 2 • 1.8 ÷ 2 × 10 • 7.2 + 1.8 • 1.8 + 1.8 + 1.8 + 1.8 + 1.8	
Perimeter of the hexagon given as 10.8(cm) or equivalent A correct method, e.g. • 7.2 ÷ 4 = 1.8, 1.8 × 6 • Their perimeter for the triangle × 2 • Their perimeter for the pentagon + 1.8 • 1.8 + 1.8 + 1.8 + 1.8 + 1.8 + 1.8	
Total perimeter of the shape given as 18(cm) or equivalent A correct method, e.g. • 1.5 × 12 • 1 × 12 = 12, 0.5 × 12 = 6, 12 + 6 • 1.5 × 10 = 15, 1.5 × 2 = 3, 15 + 3 • 1.5 × 2 = 3, 3 × 6 • 6 + 6 + 3 + 3	
Number of sides given as 15 A correct method, e.g. • 13.5 ÷ 0.9 = 135 ÷ 9 • 0.9 × 10 = 9, 0.9 × 5 = 4.5, 9 + 4.5 = 13.5 • 13.5 – 9 = 4.5, 4.5 – 0.9 – 0.9 – 0.9 – 0.9 – 0.9 = 0	**Good** responses show some correct working for finding the number of sides. **Better** responses show an efficient method and give the correct value.
Indicates ‘no’ A correct explanation, e.g. • ‘With squares that are not joined you can have 12 sides or 16 sides but not 15 sides’ • ‘You would need 1 more side’ • ‘15 sides is 3 squares with 3 sides left over’ • ‘Each square has 4 sides but 15 is not a multiple of 4’ • ‘15 is not in the 4 times table’	**Good** responses indicate whether it is possible to use squares to obtain their total number of sides, using examples to begin to justify their answer. **Better** responses understand the relevance of multiples of 4.

Perimeter sheet 3 (target level 5)	**T4L1assess3**
Solutions	Notes
Perimeter of the triangle given as 7.05(cm) or equivalent A correct method, e.g. • 14.1 ÷ 6 = 2.35, 2.35 × 3 • 14.1 ÷ 2 • 2.35 + 2.35 + 2.35	**Good** responses show some correct working for finding a perimeter. **Better** responses show an efficient method and give the correct value with a correct unit.
Perimeter of the square given as 9.4(cm) or equivalent A correct method, e.g. • 14.1 ÷ 6 = 2.35, 2.35 × 4 • Their perimeter for the triangle + 2.35 • 14.1 – 4.7 • 2.35 + 2.35 + 2.35 + 2.35	
Perimeter of the pentagon given as 11.75(cm) or equivalent A correct method, e.g. • 14.1 ÷ 6 = 2.35, 2.35 × 5 • 2.35 × 10 = 23.5, 23.5 ÷ 2 • 2.35 ÷ 2 × 10 • Their perimeter for the square + 2.35 • 14.1 – 2.35 • 2.35 + 2.35 + 2.35 + 2.35 + 2.35	
Number of sides given as 13 A correct method, e.g. • 11.7 ÷ 0.9 = 117 ÷ 9 • 0.9 × 10 = 9, 0.9 × 3 = 2.7, 9 + 2.7 = 11.7 • 11.7 – 9 = 2.7, 2.7 – 0.9 – 0.9 – 0.9 = 0	**Good** responses show some correct working for finding the number of sides. **Better** responses show an efficient method and give the correct value.
Indicates ‘no’ A correct explanation, e.g. • ‘With hexagons that are not joined you can have 12 sides or 18 sides but not 13 sides’ • ‘You would need 1 more side’ • ‘13 sides is 2 hexagons with 1 side left over’ • ‘Each hexagon has 6 sides but 13 is not a multiple of 6’ • ‘13 is not in the 6 times table’	**Good** responses justify whether it is possible to use hexagons to obtain their total number of sides. **Better** responses understand the relevance of multiples of 6.

Perimeter sheet 3 (target level 5)	**T4L1assess3**
Solutions	Notes
Indicates 'yes' A correct explanation, e.g. •  • 'You need 11 triangles in a row' •  • 'You can have any number of sides from 3 upwards using triangles' • 'If you join n triangles in a line, you get $n + 2$ sides, so 13 is possible'	**Good** responses give an example to show it is possible to use triangles to obtain their total number of sides. **Better** responses reason more generally about possible numbers of sides using triangles.
Indicates 'no' A correct explanation, e.g. • 'Groups of squares always have an even number of sides' • 'The first square has 4 sides then when you add another, you cover 1 side but add 3 more, so you add 2 overall. So it must stay an even number' •  – 1 side then + 3 sides = + 2 sides  – 2 sides then + 2 sides = + 0 sides  – 3 sides then + 1 sides = – 2 sides	**Good** responses indicate whether it is possible to use squares to obtain their total number of sides, using examples to begin to justify their answer. **Better** responses understand the relevance of even numbers, and reason more generally about possible numbers of sides using squares.

LESSON 1: *SHAPE EXPECTATIONS* Performance indicators

Note that performance indicators involving an element of 'Using and applying mathematics' are given in **bold**.

Worksheet	Performance indicators
Perimeter sheet 1 (target level 3) **T4L1assess1**	**Level 3:** At this level, pupils are generally able to: • work out the side length, given the perimeter of a simple shape; • use repeated addition to work out simple decimal perimeters, given a side length; • use the result of a previous calculation to avoid repeating working. However, they are less likely to be able to: • avoid computational or place value errors when calculating using simple decimals; • **recognise consistently that the result of a previous calculation can be used to avoid repeating working**; • **use more efficient methods, such as grouping numbers of sides, to calculate decimal perimeters**.
Perimeter sheet 2 (target level 4) **T4L1assess2**	**Level 4:** At this level, pupils are generally able to: • avoid computational or place value errors when calculating using simple decimals; • **recognise consistently that the result of a previous calculation can be used to avoid repeating working**; • **use more efficient methods, such as grouping numbers of sides, to calculate decimal perimeters**. However, they are less likely to be able to: • use conventional written methods of multiplication and division with decimals; • calculate accurately using values with two decimal places; • use an equivalent division in order to make a division calculation more straightforward, e.g. evaluating 117 ÷ 9 for 11.7 ÷ 0.9; • **reason about total numbers of sides within groups of shapes, understanding the effect of the shapes being joined or not joined**.
Perimeter sheet 3 (target level 5) **T4L1assess3**	**Level 5:** At this level, pupils are generally able to: • use conventional written methods of multiplication and division with decimals; • calculate accurately using values with two decimal places; • use an equivalent division in order to make a division calculation more straightforward, e.g. evaluating 117 ÷ 9 for 11.7 ÷ 0.9; • **understand the importance of multiples of the number of sides of a shape when these shapes are not joined**; • **give an example to show a certain arrangement of joined shapes is possible**. However, they are less likely to be able to: • **reason generally about total numbers of sides within of groups of shapes, when these shapes are joined**. **Above level 5:** At these levels, pupils are generally able to: • give evidence for the performance indicators listed previously for pupils working at level 5, plus; • **reason generally about total numbers of sides within groups of shapes, when these shapes are joined**.

Polygon perimeters sheet 1 (target level 3/4) **T4L2assess1**

Solutions

Table completed correctly, e.g.

-

Number of sides	Calculation	Side length (cm)
4	16 ÷ 4	4
8	16 ÷ 8	2
10	16 ÷ 10	1.6
5	16 ÷ 5	3.2
6	16 ÷ 6	$2.\dot{6}$ or 2.66(…) or 2.7

Notes

Good responses show understanding of correct calculations for finding the side lengths.

Better responses also calculate the side lengths correctly and show understanding of correct rounding or recurring decimals.

Polygon perimeters sheet 2 (target level 4/5) **T4L2assess2**

Solutions

Table completed using a range of different numbers of sides, in any order, e.g.

-

Number of sides	Calculation	Side length (cm)
3	15.6 ÷ 3	5.2
6	5.2 ÷ 2	2.6
12	2.6 ÷ 2	1.3
4	1.3 × 3	3.9
8	3.9 ÷ 2	1.95
10	15.6 ÷ 10	1.56
5	1.56 × 2	3.12

-

Number of sides	Calculation	Side length (cm)
3	15.6 ÷ 3	5.2
4	15.6 ÷ 4	3.9
5	15.6 ÷ 5	3.12
6	15.6 ÷ 6	2.6
7	15.6 ÷ 7	$2.2\dot{2}85714\dot{4}$ or 2.2(…)
8	15.6 ÷ 8	1.95
9	15.6 ÷ 9	$1.7\dot{3}$ or 1.7(…)
10	15.6 ÷ 10	1.56
11	15.6 ÷ 11	$1.4\dot{1}\dot{8}$ or 1.4(…)
12	15.6 ÷ 12	1.3
13	15.6 ÷ 13	1.2
14	15.6 ÷ 14	$1.1\dot{1}42857\dot{}$ or 1.1(…)
15	15.6 ÷ 15	1.04
16	15.6 ÷ 16	0.975
20	15.6 ÷ 20	0.78
39	15.6 ÷ 39	0.4
78	15.6 ÷ 78	0.2
156	15.6 ÷ 156	0.1

Notes

Good responses show understanding of correct calculations for finding the side lengths and calculate simple short divisions correctly.

Better responses calculate a range of different side lengths and show understanding of correct rounding and/or recurring decimals.

Polygon perimeters sheet 3 (extension activity)	**T4L2assess3**
Solutions	Notes
A correct explanation, e.g. • $2 \times 6.2 = 12.4$, $15.6 - 12.4 = 3.2$, $3.2 \div 2 = 1.6$ • $15.6 \div 2 = 7.8$, $7.8 - 6.2 = 1.6$ • $2 \times 6.2 = 12.4$, $2 \times 1.6 = 3.2$, $12.4 + 3.2 = 15.6$ • $6.2 + 1.6 + 6.2 + 1.6 = 15.6$ • 'When you add two sides of 6.2 cm and two sides of 1.6 cm, you get 15.6 cm altogether'	**Good** responses show understanding that pairs of each dimension add to make the perimeter. **Better** responses also show correct and efficient calculations.
Table completed using two different pairs of numbers that sum to 7.8 (but not 1.6 and 6.2), e.g. •	**Good** responses show one pair of correct dimensions. **Better** responses show different pairs of correct dimensions.

Length (cm)	Width (cm)
6	1.8
1.5	6.3

•

Length (cm)	Width (cm)
7	0.8
0.1	7.7

A correct explanation that shows Alice is wrong, e.g. • $1.7 \times 9 = 15.3$, not 16 • $1.7 \times 10 = 17$, $17 - 1.7 = 15.3$ • '$9 \times 7 = 63$, so it would end in .3 not .0' • '1.777… rounds to 1.8, not 1.7' • $16 \div 9 = 1.\dot{7}$ (or 1.77(…) or 1.8)	**Good** responses show some understanding of why the side length cannot be 1.7. **Better** responses also show correct and efficient calculations.
$1\frac{7}{9}$ or $1.\dot{7}$ or 1.77(…) or 1.8	**Good** responses show a correct value for the side length. **Better** responses show understanding of recurring decimals and/or correct rounding.

LESSON 2: *POLYGON PERIMETERS* Performance indicators

Note that performance indicators involving an element of 'Using and applying mathematics' are given in **bold**.

<table>
<tr><th>Worksheet</th><th>Performance indicators</th></tr>
<tr><td>Polygon perimeters sheet 1
(target level 3/4)
T4L2assess1</td><td rowspan="2">Level 3:
At this level, pupils are generally able to:
• write correct calculations involving division in the context of perimeter and side length;
• evaluate a simple division by a single digit, e.g. 16 ÷ 8;
• divide a two-digit number by 10, e.g. 16 ÷ 10;
• evaluate the correct units digit for a more complex division, e.g. 16 ÷ 5 or 16 ÷ 6.
However, they are less likely to be able to:
• evaluate the correct tenths digit for a division by a single digit that gives a terminating decimal answer, e.g. 16 ÷ 5;
• evaluate several correct digits for a division by a single digit that gives a recurring decimal answer, e.g. 16 ÷ 6.

Level 4:
At this level, pupils are generally able to:
• evaluate a division by a single digit that gives a terminating decimal answer, e.g. 16 ÷ 5 or 15.6 ÷ 4;
• evaluate several correct digits for a division by a single digit that gives a recurring decimal answer, e.g. 16 ÷ 6 or 15.6 ÷ 7;
• divide a decimal number by 10, e.g. 15.6 ÷ 10;
• evaluate a division that involves increasing the number of decimal places, e.g. 15.6 ÷ 5 or 15.6 ÷ 8.
However, they are less likely to be able to:
• select a sensible order of calculations to attempt or complete all divisions with confidence regardless of difficulty;
• use only calculations appropriate to the context, i.e. dividing by integers greater than 2;
• evaluate sufficient correct digits to establish the pattern for a division that gives a recurring decimal answer, e.g. 15.6 ÷ 7;
• appreciate the need for the correct rounding of a recurring decimal or use conventional notation for the recurrence correctly;
• use connections between calculations to develop more efficient methods.

(See next page for level 5 indicators)</td></tr>
<tr><td>Polygon perimeters sheet 2
(target level 4/5)
T4L2assess2</td></tr>
</table>

Worksheet	Performance indicators
Polygon perimeters sheet 2 (target level 4/5) **T4L2assess2**	**Level 5:** At this level, pupils are generally able to: • **select a sensible order of calculations to attempt**, or attempt all divisions with confidence regardless of difficulty; • use only calculations appropriate to the context, i.e. dividing by integers greater than 2; • **evaluate sufficient correct digits to establish the pattern** for a division that gives a recurring decimal answer, e.g. 15.6 ÷ 7; • appreciate the need for the correct rounding of a recurring decimal or show some understanding of conventional notation for the recurrence; • **see some connections between calculations to enable some more efficient working to be used**. However, they are less likely to be able to: • show consistently correct use of the conventional notation for recurring decimals; • **consistently use one of the more efficient methods available**; • extend the context to solve problems involving perimeters of shapes other than regular polygons, using decimal calculations; • reason about a misconception involving rounding a recurring decimal. **Above level 5:** At these levels, pupils are generally able to: • give evidence for the performance indicators listed previously for pupils working at level 5; plus • show consistently correct use of the conventional notation for recurring decimals; • **consistently use more efficient methods**; • extend the context to solve problems involving perimeters of shapes other than regular polygons, using decimal calculations; • reason about a misconception involving rounding a recurring decimal.
Polygon perimeters sheet 3 (extension activity) **T4L2assess3**	

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