

Unit 8

Angles, 2D and 3D shapes, perimeter and area

Five daily lessons

National
Numeracy Strategy

Year 6

Spring term

Unit Objectives

Year 6

- Recognise and estimate angles.
- **Use a protractor to measure** and draw **acute and obtuse angles to the nearest degree.**
- Check that the sum of the angles in a triangle is 180 degrees.
- Calculate angles in a triangle or around a point.
- Describe and visualise properties of solid shapes such as parallel or perpendicular faces or edges.
- Visualise 3D shapes from 2D drawings and identify different nets for a closed cube.
- **Calculate the perimeter and area of simple compound shapes that can be split into rectangles.**

Page 111

Pages 103, 109

Page 105

Page 97

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
- Activity sheet 8.1
- Activity sheet 8.2
- Activity sheet 8.3
- Activity sheet 8.4
- OHT 8.1
- OHT 8.2
- OHT 8.3
- OHT 8.4
- OHT 8.5
- CD from Using ICT to Support Numeracy pack
- Protractors
- OHP protractor
- Arrow cards
- Whiteboards
- Centimetre squared paper
- Interlocking cubes
- Cardboard box
- Models of prisms and pyramids
- Related Key Stage 2 national test questions

Year 5

Link Objectives

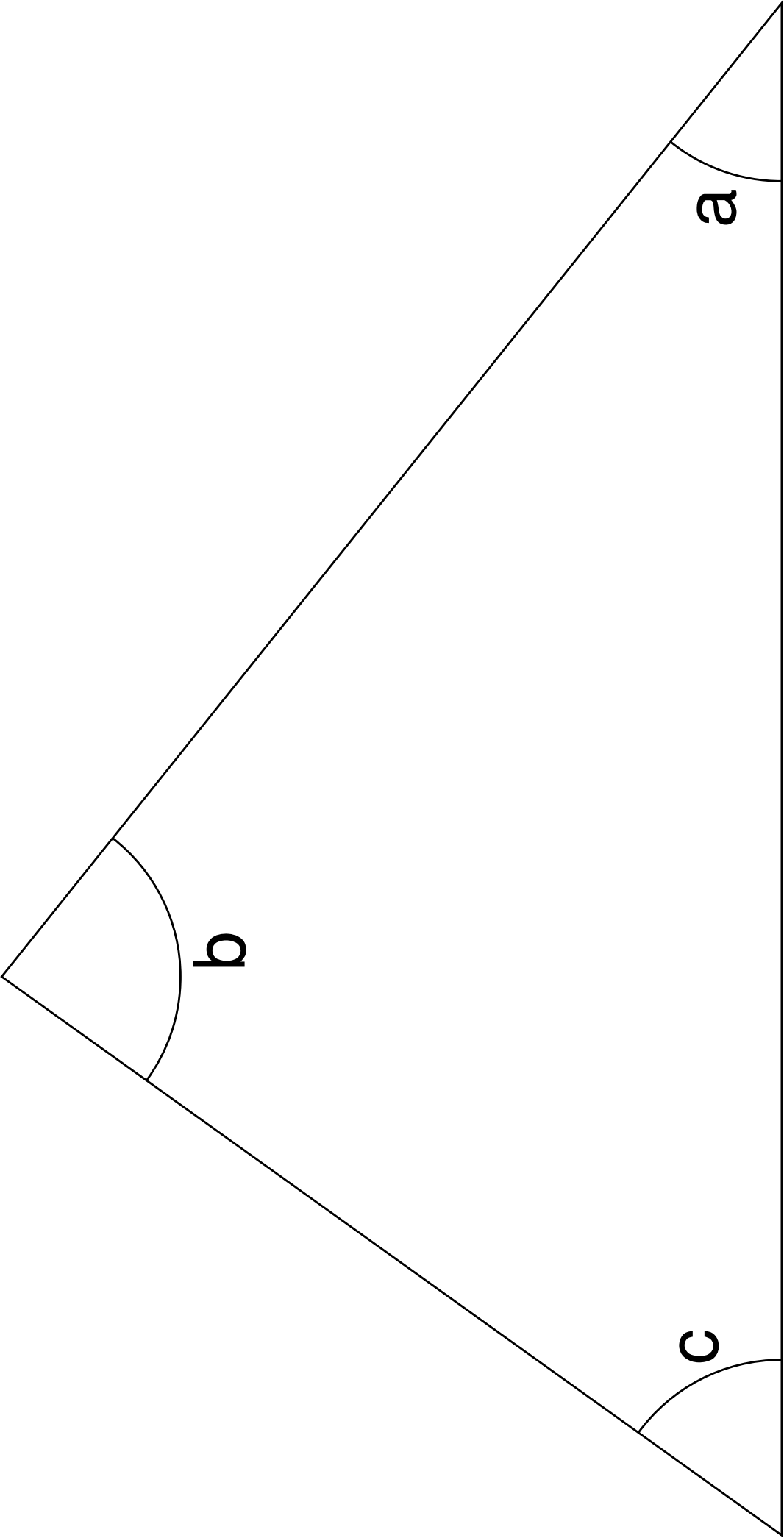
Year 7

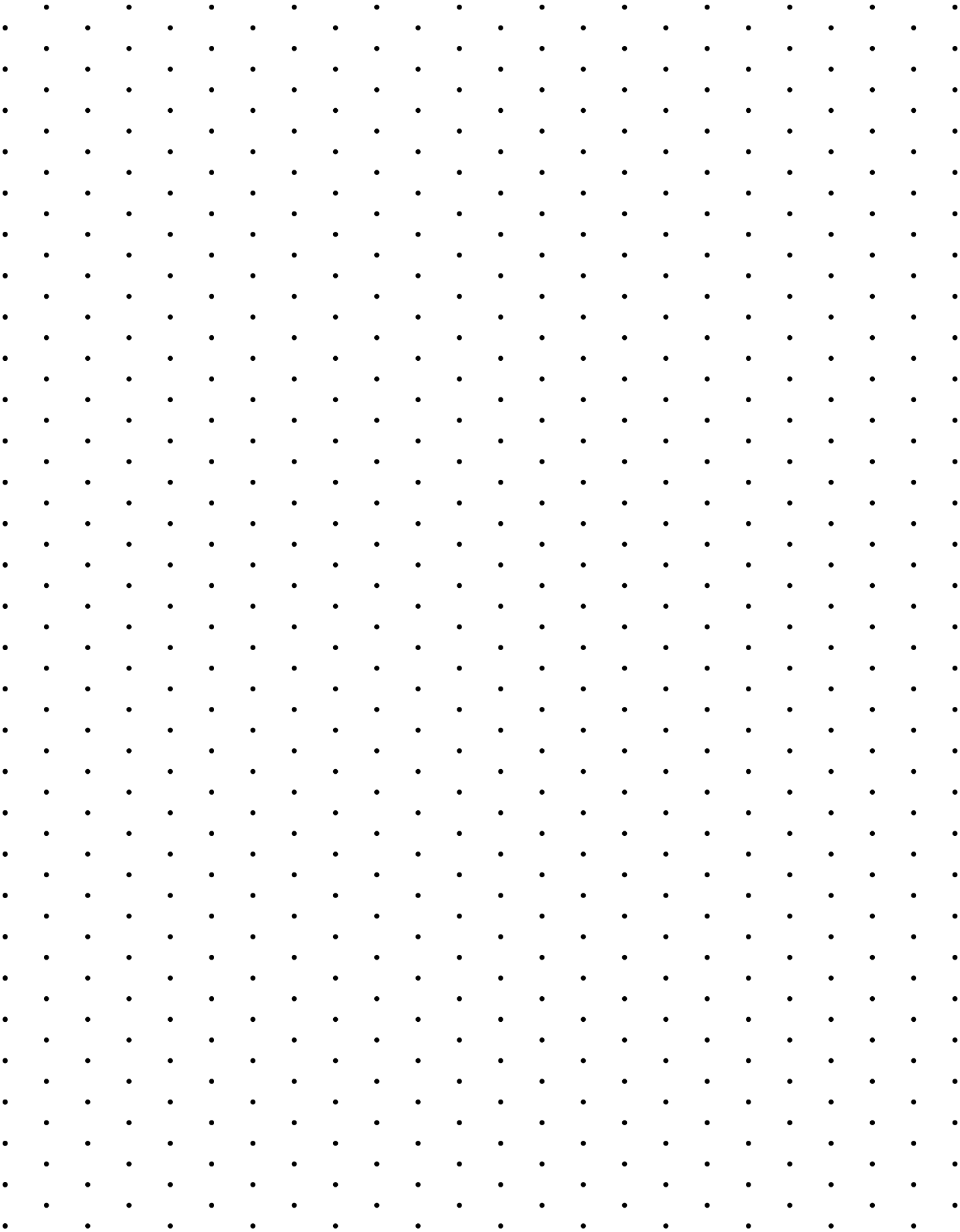
- Use a protractor to measure and draw acute and obtuse angles to the nearest 5 degrees.
- Identify, estimate and order acute and obtuse angles.
- Calculate angles in a straight line.
- Make shapes with increasing accuracy.
- Visualise 3D shapes from 2D drawings and identify different nets for an open cube.
- **Understand area measured in square centimetres(cm^2). Understand and use the formula in words 'length times breadth' for the area of a rectangle.**

- **Know the sum of angles at a point, on a straight line and in a triangle** and recognise vertically opposite angles.
- Use angle measure; distinguish between and estimate the size of acute, obtuse and reflex angles.
- Use a ruler and protractor to measure and draw lines to the nearest millimetre and angles to the nearest degree.
- Use 2D representations to visualise 3D shapes.
- Begin to identify and use angle, side and symmetry properties of triangles and quadrilaterals; solve geometrical problems involving these properties, using step by step deduction and explaining reasoning with diagrams and text.
- Know and use the formula for the area of a rectangle; calculate the perimeter and area of shapes made from rectangles.

(Key objectives in bold)

department for
education and skills

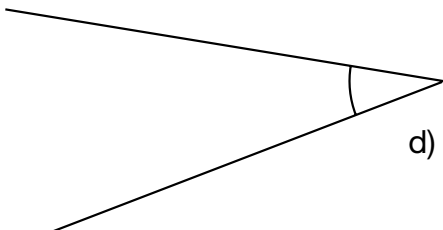
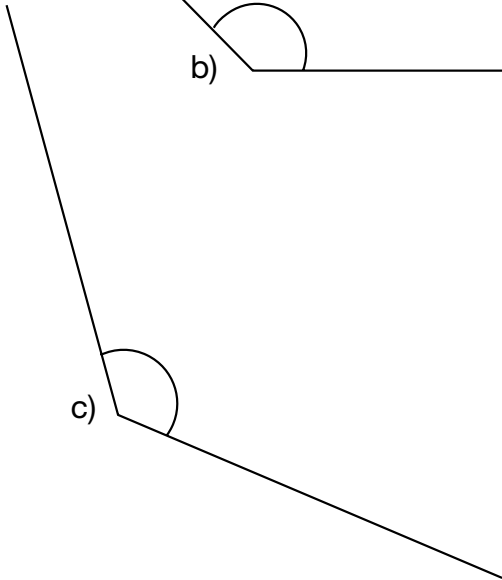
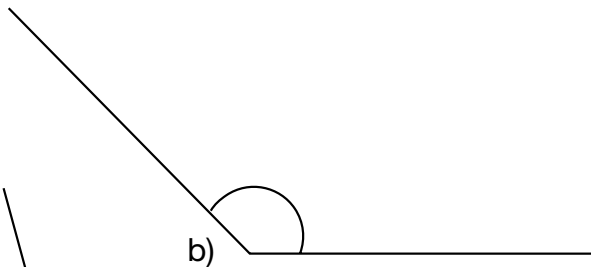
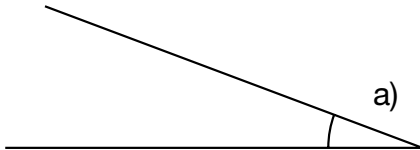
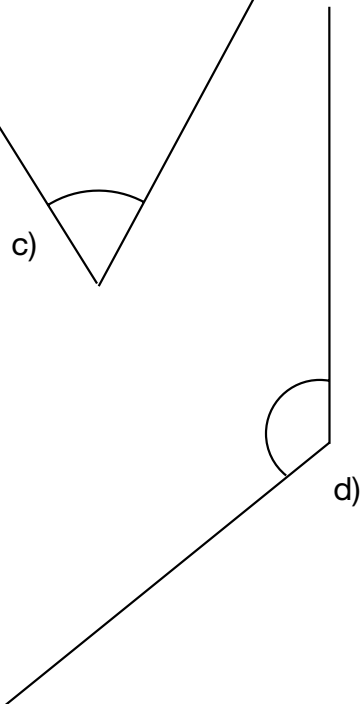
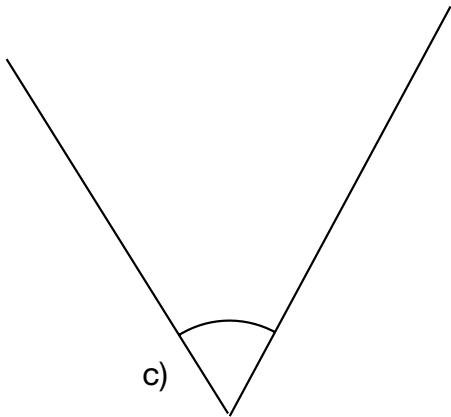
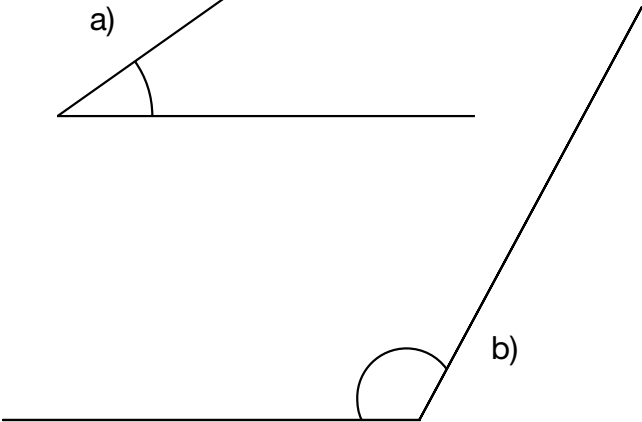
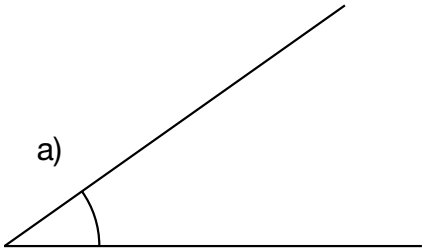


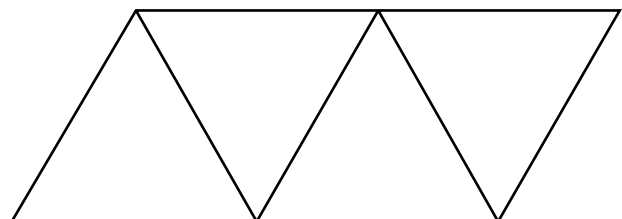
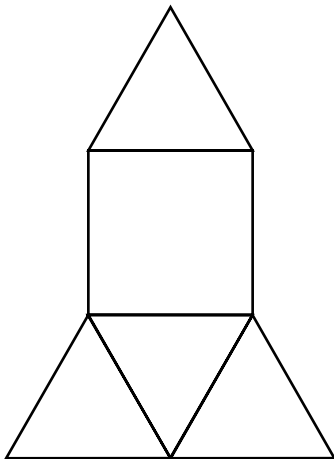
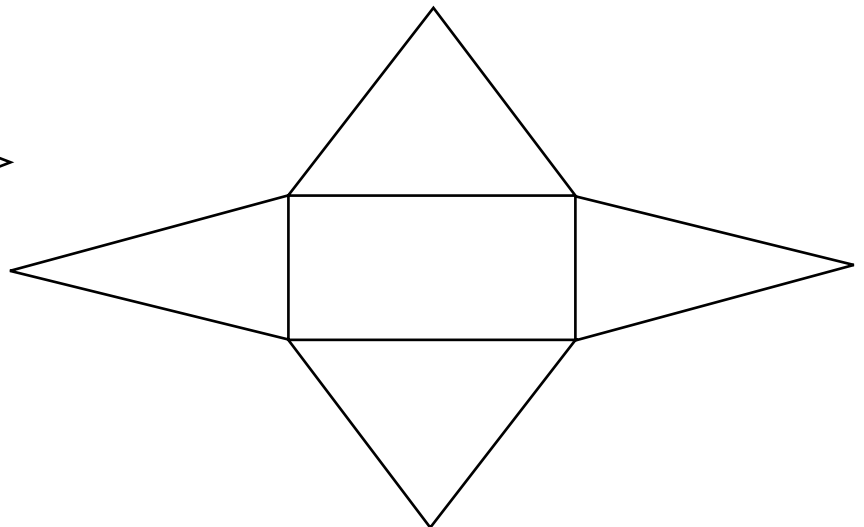
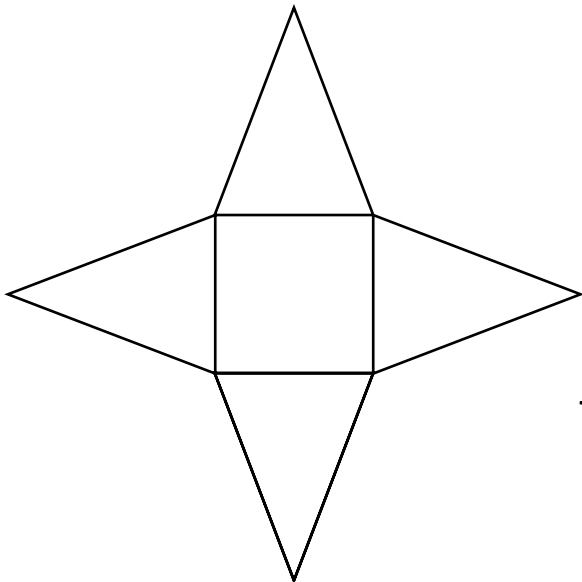
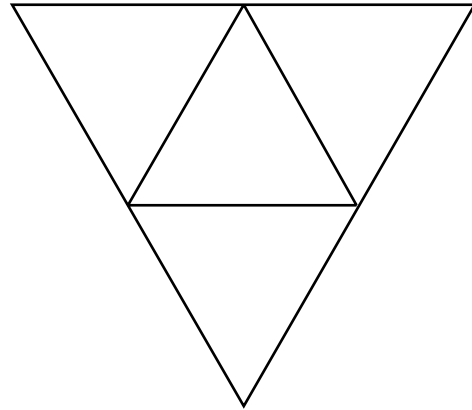
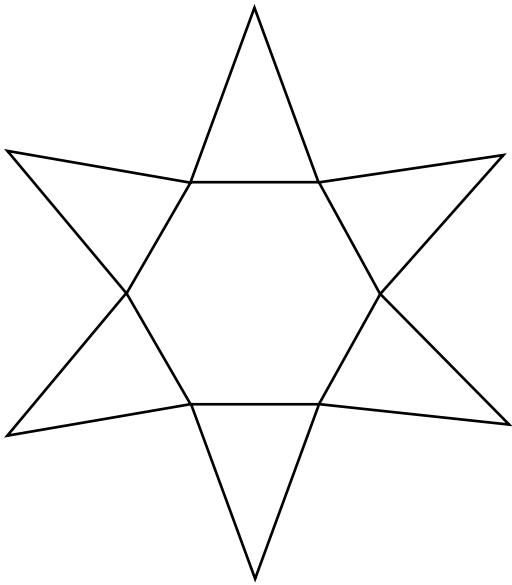


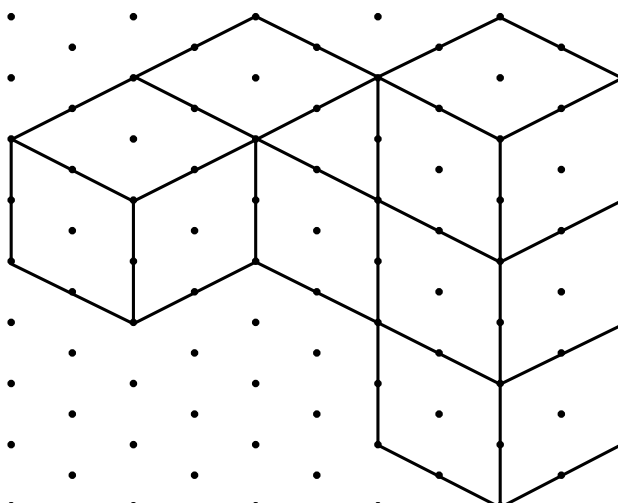
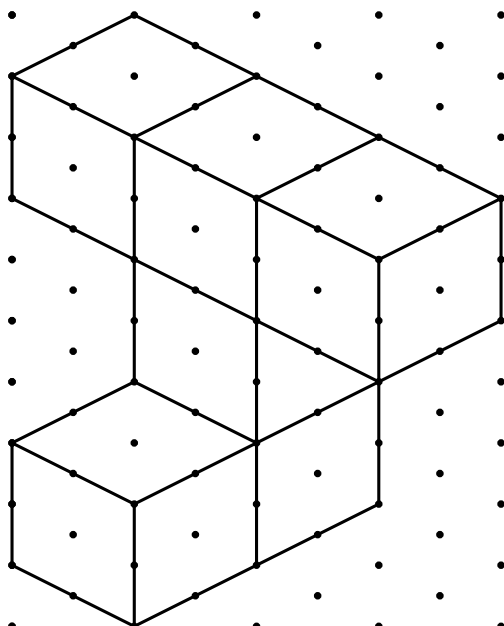
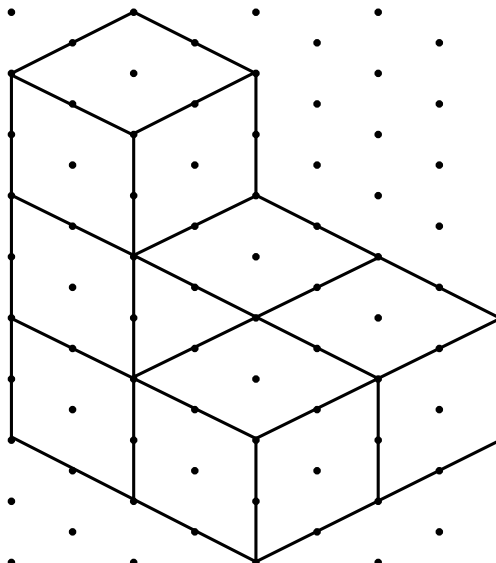
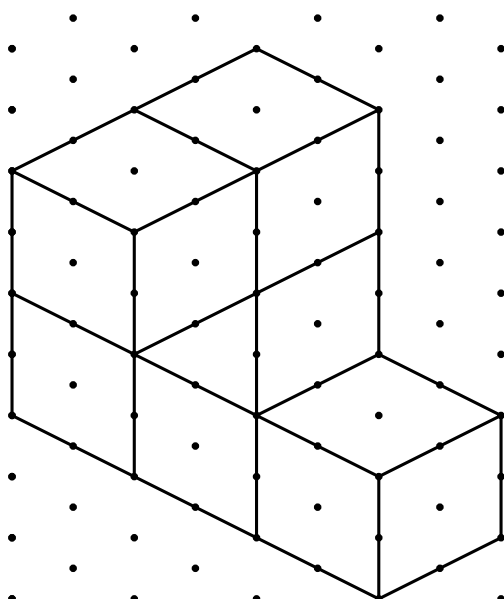
A

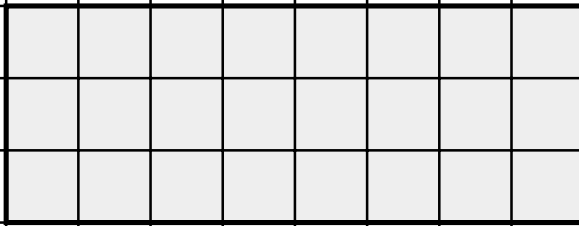
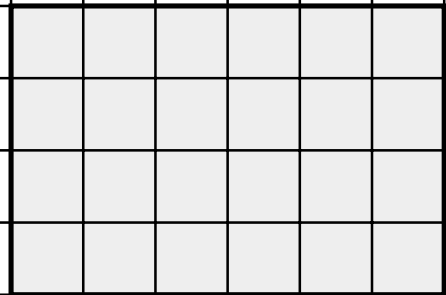
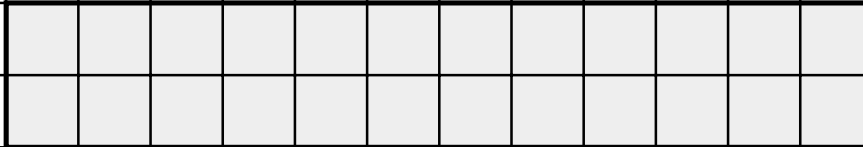
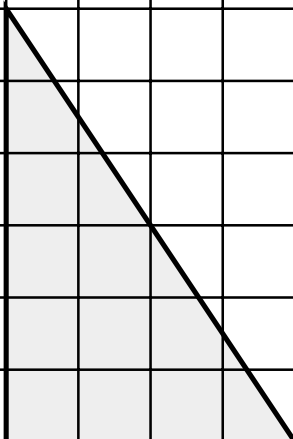
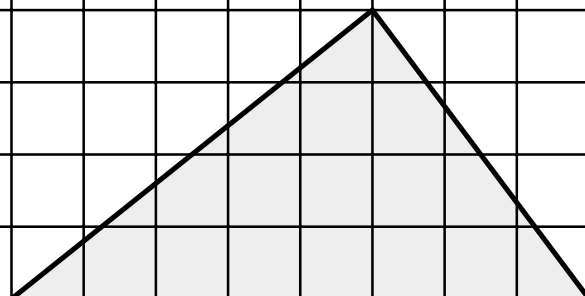
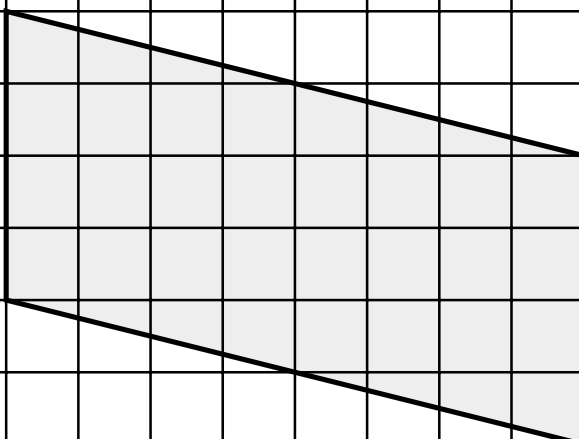
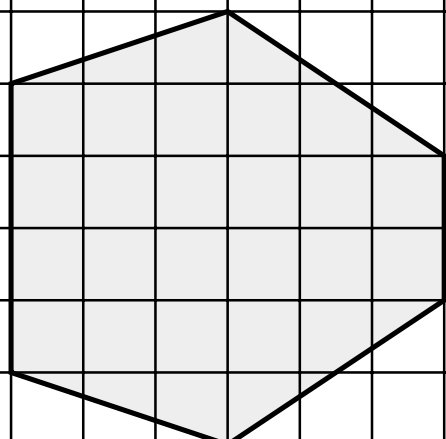
B

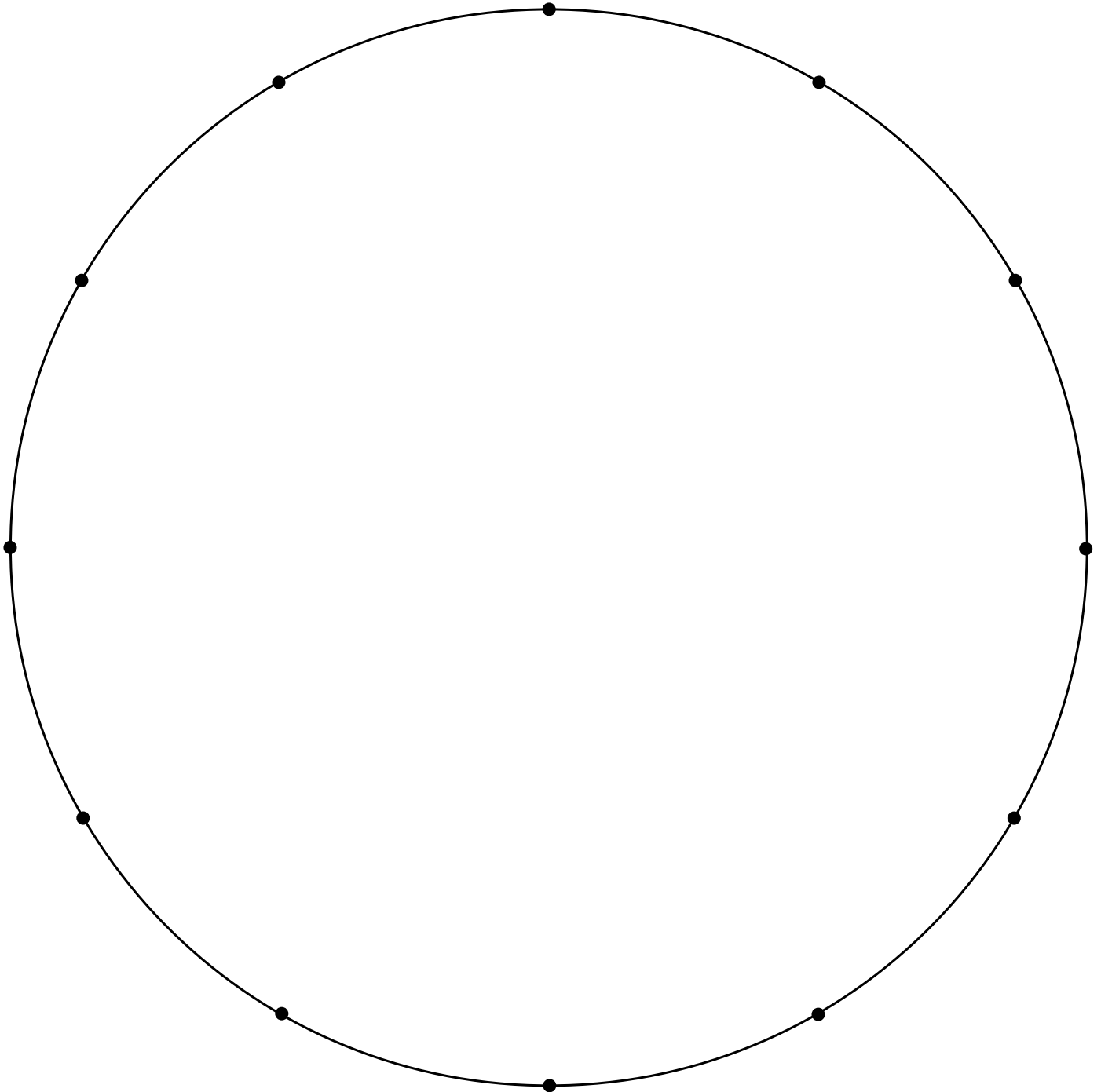
1. Draw these angles: 35°, 66°, 47°, 161°, 120°, 52°	1. Draw these angles: 24°, 150°, 55°, 128°, 133°, 19°
2. Measure these angles to the nearest degree.	2. Measure these angles to the nearest degree.

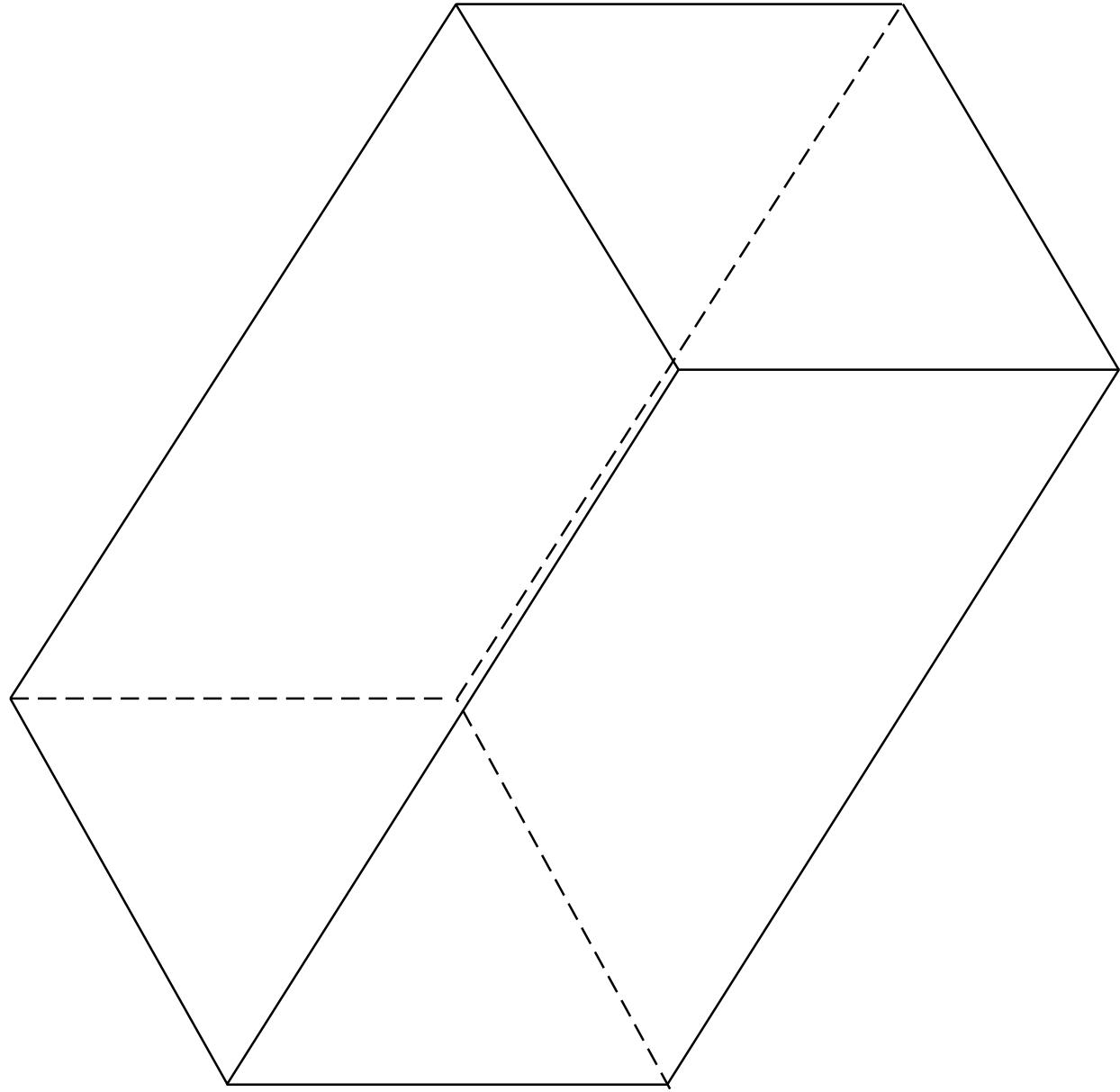


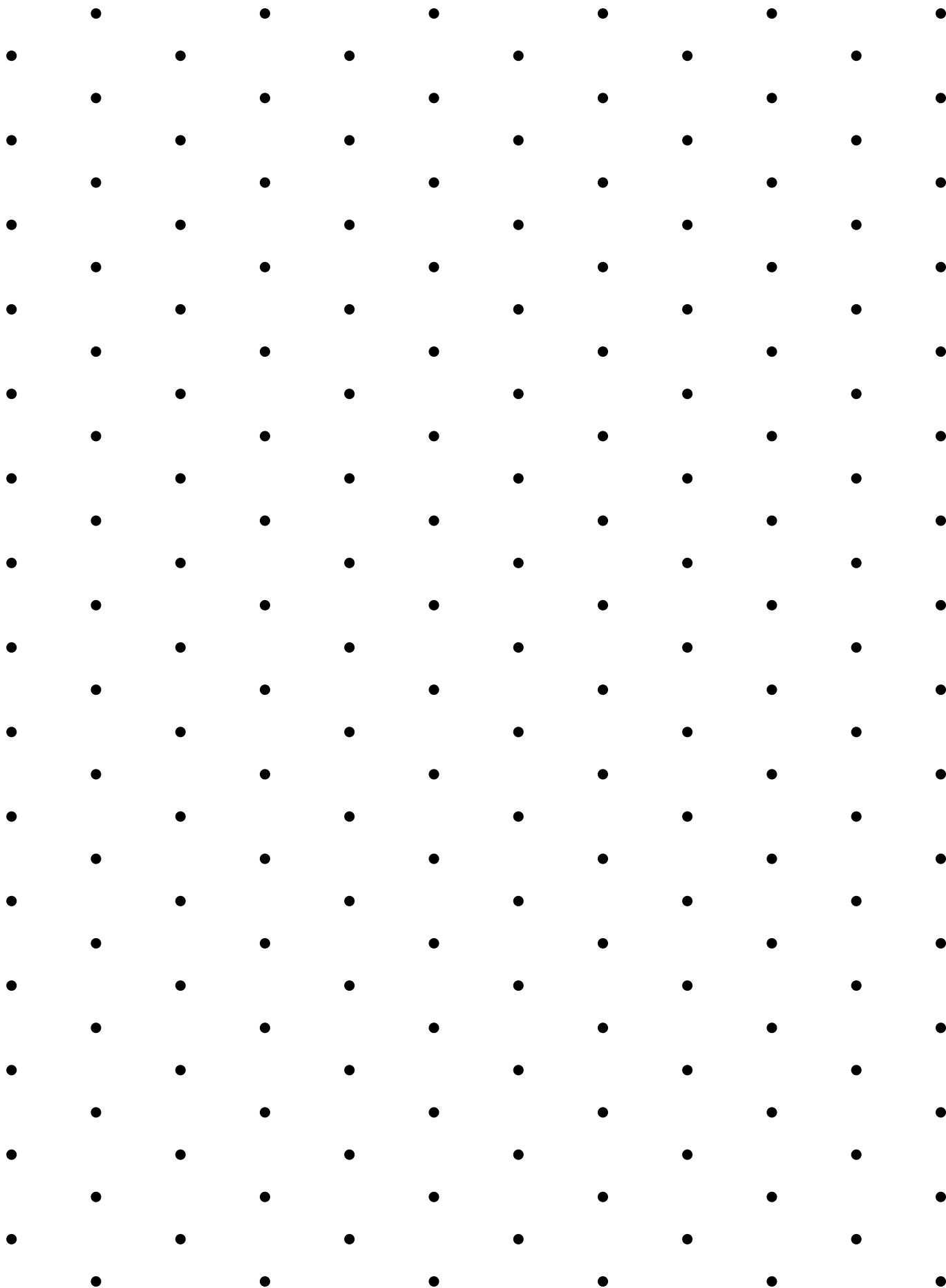


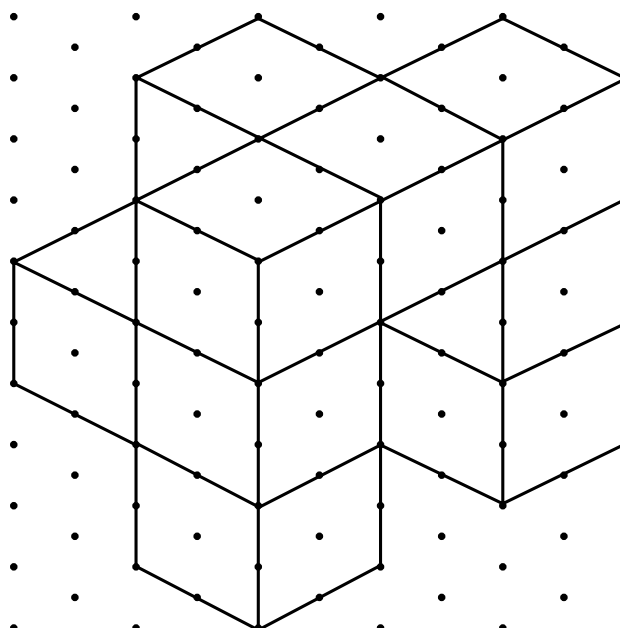
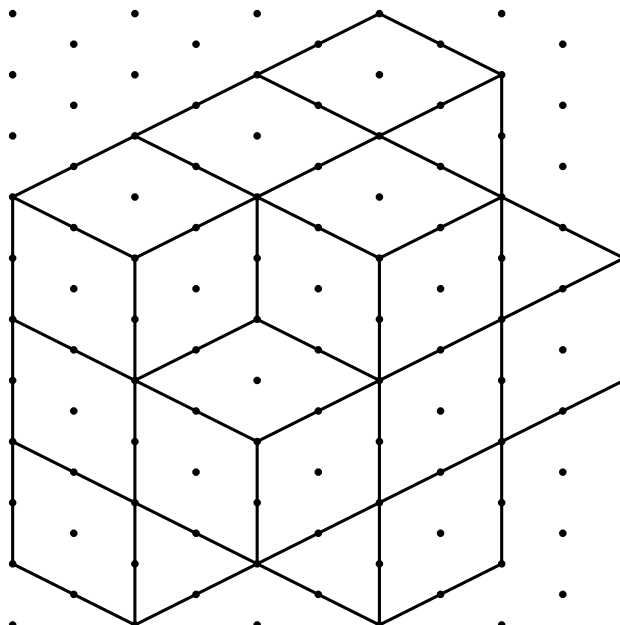


Shape A**Shape B****Shape C****Shape D****Shape E****Shape F****Shape G**





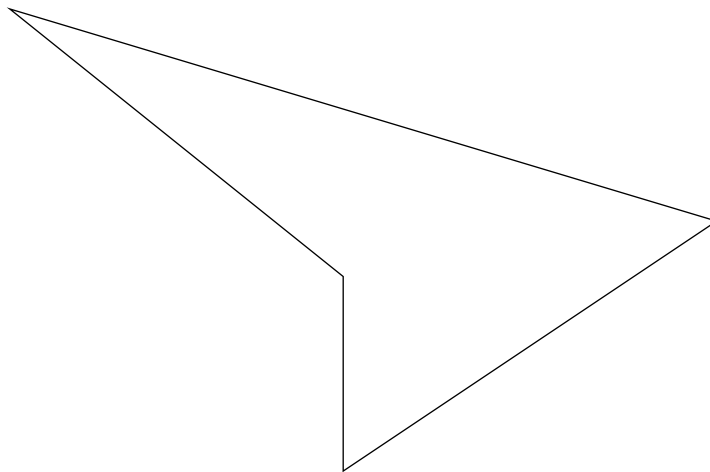




Related Key Stage 2 National test questions:

2001 Test A

17



Measure accurately the **longest side** of this shape.

Give your answer in millimetres.



	mm
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17a

1 mark

Measure accurately the **smallest angle** in the shape.

Use a protractor (angle measurer).



	°
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17b

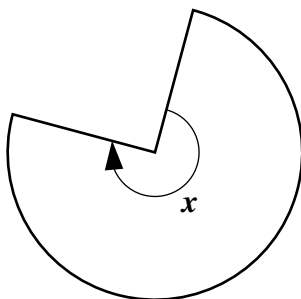
1 mark

Total

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13

This shape is **three-quarters** of a circle.



How many degrees is **angle** x ?



13

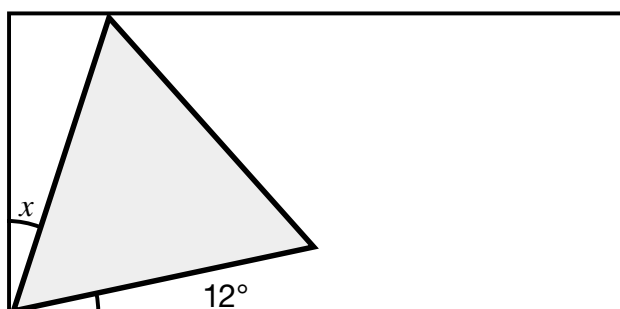
1 mark

Total

2001 Test B

26

Here is an **equilateral triangle** inside a **rectangle**.



Not to scale

Calculate the value of angle x .

Do **not** use a protractor (angle measurer).



○

Show
your **method**.
You may get
a mark.

26

2 marks

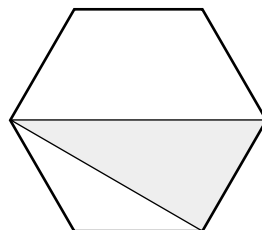
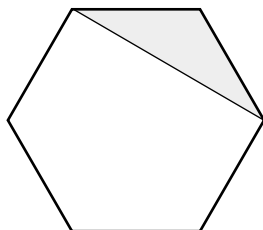
Total

2001 Test B

18

These two shaded triangles are each inside a regular hexagon.

Under each hexagon, put a ring around the correct name of the shaded triangle.



equilateral

equilateral

isosceles

isosceles

scalene

scalene



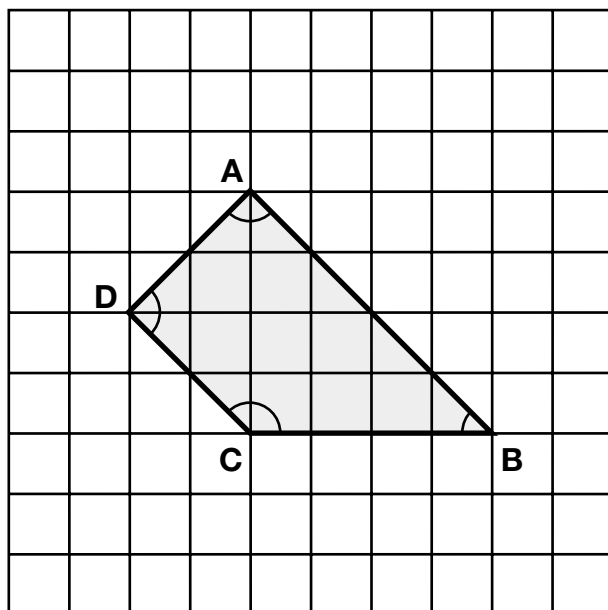
18

1 mark

Total

20

Here is a shape on a square grid.



For each sentence, put a tick (✓) if it is true.
Put a cross (✗) if it is not true.



Angle **C** is an **obtuse** angle.

☐

Angle **D** is an **acute** angle.

☐

Line **AD** is **parallel** to line **BC**.

☐

Line **AB** is **perpendicular** to line **AD**.

☐

2 marks

20

Total

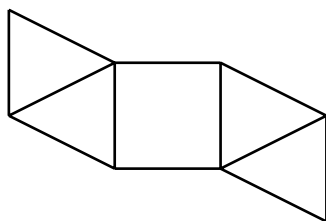
2000 Test B

13

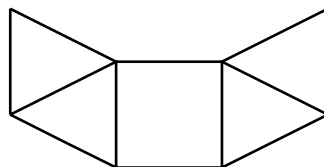
Look at each of these diagrams.

Put a tick (✓) if it is the **net of a square based pyramid**.

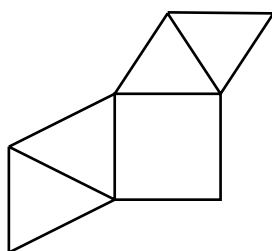
Put a cross (✗) if it is **not**.



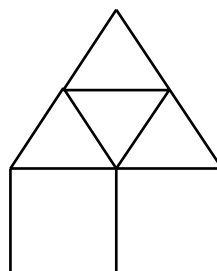
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13

2 marks

Total

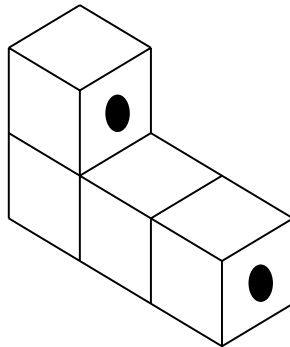


2001 Test B

8

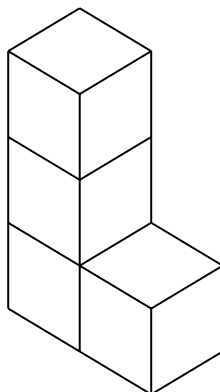
Tom makes this shape from four cubes stuck together.

Two circles are drawn on the shape.



Tom moves the shape.

Draw the **circles** on the shape in its new position.



8

1 mark

Total

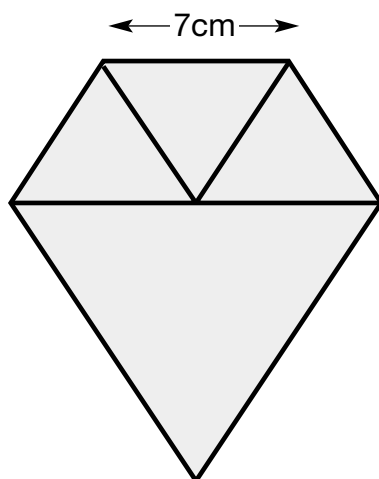
2001 Test B

20

Lauren has **three small equilateral triangles** and **one large equilateral triangle**.

The small triangles have sides of **7 centimetres**.

Lauren makes this shape.



Not actual size

Calculate the **perimeter** of the shape.

Do **not** use a ruler.



	cm
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20

1 mark

Total

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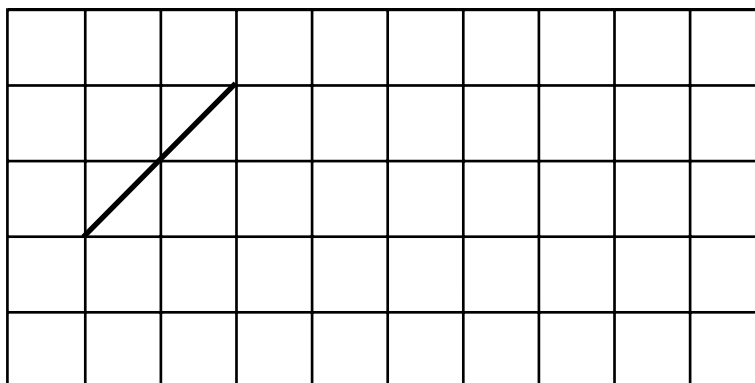
2001 Test A

25

This is a centimetre grid.

Draw **3 more lines** to make a **parallelogram** with an **area of 10cm^2** .

Use a ruler.



25

1 mark

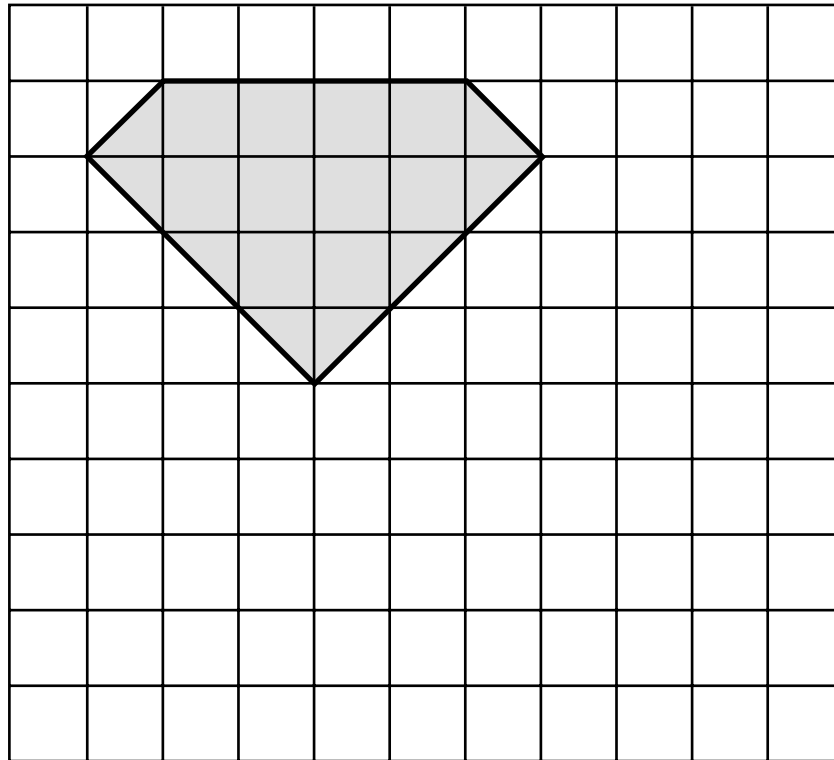
Total

2000 Test B

11

On the grid, draw a **rectangle** which has the **same area** as this shaded pentagon.

Use a ruler.



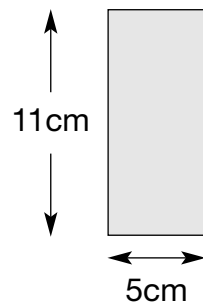
11

1 mark

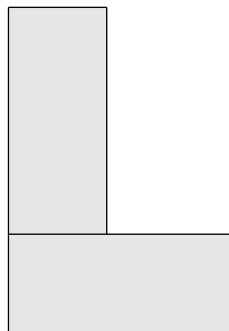
Total

19

Liam has two rectangular tiles like this.



He makes this L shape.



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



cm

1 mark

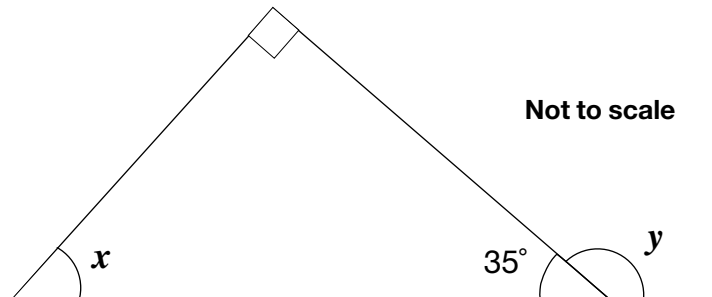
19

Total

2000 Test A

23

Look at this diagram,

Calculate the size of angle x and angle y .Do **not** use a protractor (angle measurer). $x =$ $y =$

23a

1 mark

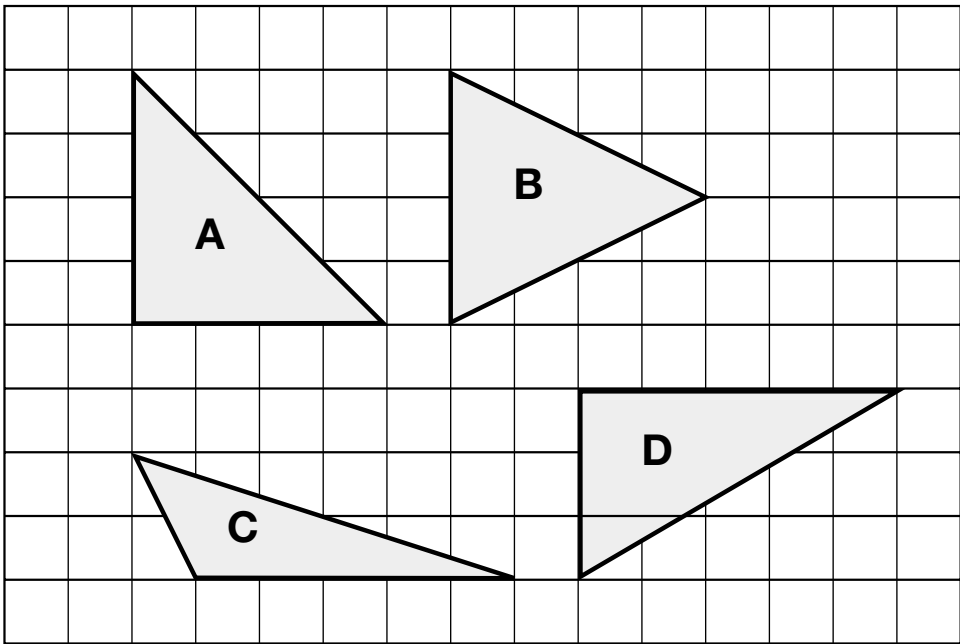
23b

1 mark

Total

12

Here are four triangles drawn on a square grid.



Write the letter for each triangle in the correct region of the sorting diagram.

One has been done for you.



	has a right angle	has an obtuse angle	has a 3 acute angles
is isosceles	A		
is not isosceles			

12

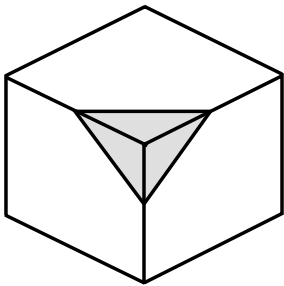
2 marks

Total

2002 Test B

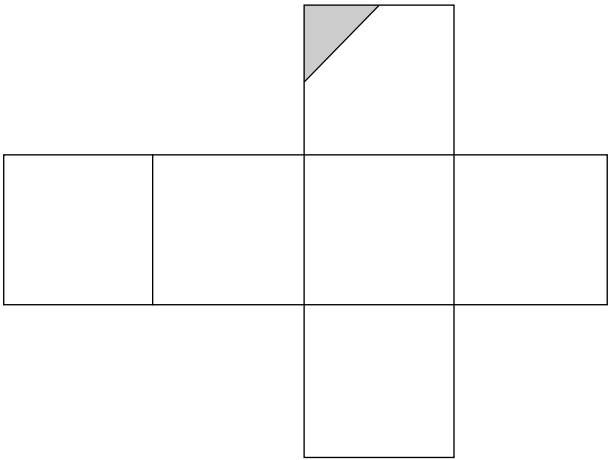
19

A cube has shaded triangles on three of its faces.



Here is the net of the cube.

Draw in the two missing shaded triangles.



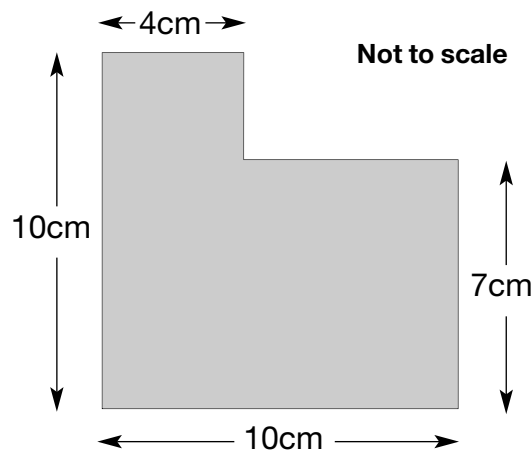
19

1 mark

Total

22

What is the **area** of this shape?



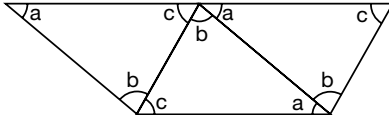
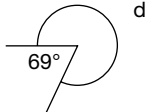
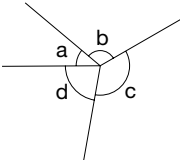
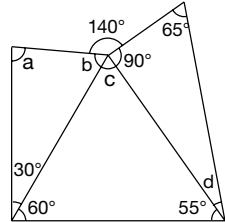
22

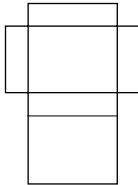


1 mark

2002 Mental Arithmetic

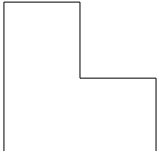
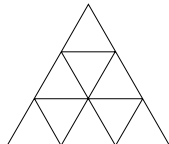
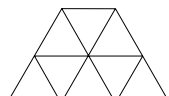
12	An equilateral triangle has a perimeter of twenty-four centimetres. How long is one of its sides?	cm	
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Planning sheet	Day One	Unit 8 <i>Angles, 2D and 3D shapes, perimeter and area</i>	Term: <i>Spring</i>	Year Group: 6
Oral and Mental		Main Teaching		Plenary
Objectives and Vocabulary	Teaching Activities	Objectives and Vocabulary	Teaching Activities	Teaching Activities / Focus Questions
Recall multiplication and division facts up to 10×10 . Recall squares. <				

Planning sheet	Day Two	Unit 8 <i>Angles, 2D and 3D shapes, perimeter and area</i>	Term: <i>Spring</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>Recall multiplication and division facts up to 10×10.</p> <p>Use these facts to derive associated facts.</p>	<ul style="list-style-type: none"> Give the children 'quick-fire' questions based on the 2, 3, 4, 6, 8 and 9 times tables. <div> <p>Q What is 4×8?</p> <p>Q What is $36 \div 6$?</p> </div> <p>Build on this by asking questions involving 90, 180, 270, 360.</p> <div> <p>Q What is 4×9?</p> <p>Q What is 4×90?</p> <p>Q What is $360 \div 4$?</p> <p>Q What is $270 \div 90$?</p> </div> <p>Children show their answers using whiteboards.</p>	<p>Check that the sum of the angles of a triangle is 180 degrees. Calculate angles in a triangle or around a point.</p> <div> <p>Q What do we know about the angles of this triangle?</p> </div> <p>Establish the angles are all acute but we know nothing about the individual angles.</p> <ul style="list-style-type: none"> Carefully rearrange the triangles as shown below:  <div> <p>Q What does this arrangement tell us about angles a, b and c?</p> </div> <ul style="list-style-type: none"> Confirm that a, b and c lie on a straight line and therefore sum to 180°. Confirm that a, b and c are the angles within a triangle and therefore total 180°. Remind the children that this is something they need to remember. Separate the triangles and ask children questions about missing angles. <div> <p>Q If a is 40° and c is 60°, what is b?</p> </div> <p>Change the orientation of the triangle and ask other questions. Establish that changing the position of the triangle is unimportant. Use a protractor to measure the angles. Emphasise that when measuring angle small errors occur so the answer may not always come to 180°.</p>	<ul style="list-style-type: none"> Remind children there are 360° in a complete turn, so the angles about a point sum to 360°. Children need to remember this fact too. Draw this angle on the board:  <p>Establish that d is a reflex angle.</p> <div> <p>Q How could we calculate angle d without measuring?</p> </div> <p>Establish that d is $360^\circ - 69^\circ$.</p> <ul style="list-style-type: none"> On the board draw:  <div> <p>Q If a is 40°, b is 110°, c is 130°, what is d?</p> </div> <p>Establish d is $360^\circ - (40^\circ + 110^\circ + 130^\circ)$.</p> <ul style="list-style-type: none"> Repeat giving other sets of three angles for the children to use to find the missing angle. Repeat giving two angles in a triangle for children to find the third angle. 	<ul style="list-style-type: none"> Draw the following on the board:  <p>We want to find the missing angles.</p> <div> <p>Q Which are the easiest to find?</p> </div> <p>c and d</p> <div> <p>Q What do we need to know before we can find the value of b?</p> </div> <ul style="list-style-type: none"> Remind the children they need to remember angles in a triangle sum to 180° and angles around a point sum to 360°. Set a similar question involving triangles and angles about a point. <div> <p>By the end of the lesson children should be able to:</p> <ul style="list-style-type: none"> Calculate the third angle of a triangle, given the other two; Calculate angles at a point. <p>(Refer to supplement of examples, section 6, page 111.)</p> </div>
RESOURCES Whiteboards		VOCABULARY straight line reflex angle RESOURCES Resource sheet 8.1 Protractors		

Planning sheet	Day Three	Unit 8 <i>Angles, 2D and 3D shapes, perimeter and area</i>	Term: <i>Spring</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>Recall multiplication and division facts up to 10×10.</p> <p>Use these facts to derive associated facts.</p>	<ul style="list-style-type: none"> Give the children 'quick-fire' questions involving multiplication and division. <div> Q What is 4×7? Q What is $72 \div 9$? </div> Say: '$4 \times 7 = 28$ how can we use this to work out 4×17?' Demonstrate using arrow cards if necessary and write out $(4 \times 10) + (4 \times 7)$ Establish that the answer is $40 + 28 = 68$. Repeat using facts such as $2 \times 9 = 18$ to work out 2×19 and 12×9. Say: '$72 \div 9 = 8$ how can we use this to work out $7.2 \div 9$?' Establish the answer will be less than 1 and 10 times smaller at 0.8. Repeat using facts such as $24 \div 6 = 4$ to work out $2.4 \div 6$ and $24 \div 60$. 	<p>Describe and visualise properties of solid shapes. Visualise 3D shapes from 3D drawings and identify different nets for a closed cube.</p>	<ul style="list-style-type: none"> Show the children a closed cardboard box, an empty container such as a cereal box. <div> Q If this box was opened out into a single piece of cardboard, what would it look like? </div> <p>Give the children centimetre squared paper and ask them to sketch the single piece of cardboard to give the shape but not to scale, only a small diagram is needed.</p> Remind them this single piece of cardboard is called the net of the shape – it can be folded into the shape exactly. Agree the net is something like the shape below: <div>  </div> <p>Open the box to confirm this.</p> <p>Explain that the box is called a cuboid and you want the children to work on cubes now. Discuss the differences between cubes and cuboids, reminding them that all the faces of a cube are identical squares.</p> <div> Q What is the net of a closed cube with dimensions 3cm by 3cm by 3cm? </div> <p>Give children time to sketch a net on the squared paper. Collect one correct net from the children and discuss why this works.</p> Sketch the shape below on the board. <div>  </div> <div> Q Could this be the net of a cube? </div> <p>Agree that it cannot be and if necessary demonstrate using a strip of six squares. Ask children to continue to find nets for the 3cm cube on the cm squared paper. Collect answers, discuss which are correct and why. Establish there is more than one answer and compare different nets for the cube.</p> Remind children of the names and features of prisms and pyramids. Explain that the cube and cuboids are both prisms, and the name given to any pyramid refers to the shape of the base, e.g. square-based pyramid. 	<ul style="list-style-type: none"> Hold up a square-based pyramid. <div> Q How many faces has it? Q What shapes are they? </div> <p>Give out Activity sheet 8.2. Ask children which of the diagrams shown represents the net of a square-based pyramid.</p> <p>Repeat, asking children to identify the other pyramids represented.</p> On the board draw: <div>  </div> <p>Agree that this is the net of an open cube.</p> <p>HOMEWORK – Give children a sheet of squared paper.</p> <div> Q How many nets of an open cube made of 5 squares can you find? </div> <p>Remind them that you have already given them one net and the others are to be different.</p> <div> <p>By the end of the lesson children should be able to:</p> <ul style="list-style-type: none"> Construct models, shapes and patterns with increasing accuracy. <p>(Refer to supplement of examples, section 6, page 105.)</p> </div>
<p>RESOURCES</p> <p>Arrow cards</p>		<p>VOCABULARY</p> <p>net cube cuboid pyramid prism</p> <p>RESOURCES</p> <p>Centimetre squared paper Cardboard box Models of prisms and pyramids Activity sheet 8.2</p>		

Planning sheet	Day Four	Unit 8 <i>Angles, 2D and 3D shapes, perimeter and area</i>	Term: <i>Spring</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>Describe and visualise properties of 2D and 3D shapes.</p> <p>VOCABULARY equilateral isosceles scalene parallel perpendicular faces edges right angle</p> <p>RESOURCES OHT 8.1 OHT 8.2 OHT 8.3 Whiteboards</p>	<ul style="list-style-type: none"> Show OHT 8.1. Explain it is a circle with 12 points spaced equally about the circumference. Join up three points to form a triangle. <div> Q Is the triangle equilateral, isosceles or scalene? </div> <p>Children write E, I or S on their whiteboards to show their answers. Repeat ensuring that the different types of triangle are represented; include a right-angled triangle.</p> <ul style="list-style-type: none"> Show OHT 8.2. Explain it is a grid of squares. On the grid draw a quadrilateral, e.g. <p>and label the vertices A, B, C, D.</p> <div> Q Is angle at C acute or obtuse? Q Are lines BC, AD parallel? Q Are lines AD, AB perpendicular, equal in length? </div> <ul style="list-style-type: none"> Repeat with different quadrilaterals. Show OHT 8.3. Explain that it represents a cuboid. Point to one of the faces, call it face A, identify another face. <div> Q Is this face parallel or perpendicular to face A? </div> <p>Repeat using other pairs of faces and edges.</p>	<p>Visualise 3D shapes from 2D drawings.</p> <p>RESOURCES Resource sheet 8.2 Activity sheet 8.3 OHT 8.4 OHT 8.5 Interlocking cubes</p>	<ul style="list-style-type: none"> Discuss the homework. remind children of the net for an open cube: <p>Agree that these nets are the same.</p> <p>Collect different nets from children. Establish which nets are the same, which are different and why.</p> <ul style="list-style-type: none"> Give children Activity sheet 8.3 and a number of interlocking cubes. Explain that the sheet shows four views of the same object which is made up of cubes. Discuss the shape. <div> Q How many cubes were used to make the shape? Q Can you make the shape? </div> <p>Establish that six cubes were used and get the children to make the shape using interlocking cubes, working in pairs or small groups. Ask children to hold their shape up in the same position as shown by the bottom left view. Get the children to rotate their shapes through quarter turns to show each of the four views, working anti-clockwise. (Looking at the shape with one eye closed helps.)</p> <ul style="list-style-type: none"> In pairs, ask children to use five of their six cubes to make a shape of their own. Using a shape made from six cubes show the children how to draw a view of the shape on OHT 8.4. Emphasise starting with the front edge and working away from this to build up the cubes that make the shape. <p>Give children a Resource sheet 8.2 and with ruler and pencil get them to draw a view of their own shapes. Pairs swap their drawings and make the shapes represented by the other pairs. Collect examples of drawings and shapes, discuss the 2D drawings and any difficulties the children had.</p>	<ul style="list-style-type: none"> Show the top view of the shape on OHT 8.5. <div> Q How many cubes were used to make this shape? Q Are there any cubes we cannot see? </div> <p>Encourage children to speculate about the number of cubes and decide that the greatest number of cubes could be more than 14.</p> <div> Q What is the least number of cubes we could use to make this shape? </div> <p>Give children time to make the shape if it helps. Conclude that 10 cubes is the least number.</p> <ul style="list-style-type: none"> Show both views on OHT 8.5. <div> Q How many cubes now? </div> <p>Establish there are 12 cubes needed, get children to make the shape.</p> <div> Q How many more cubes are needed to make a cuboid? </div> <p>Using the OHT views and the children's shapes establish that six extra cubes are needed and the cuboid is 2 by 3 by 3 cubes, a total of 18 cubes.</p> <div> By the end of the lesson children should be able to: <ul style="list-style-type: none"> Visualise 3D shapes from 2D drawings. <p>(Refer to supplement of examples, section 6, page 105.)</p> </div>

Planning sheet	Day Five	Unit 8 <i>Angles, 2D and 3D shapes, perimeter and area</i>	Term: <i>Spring</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>Calculate the perimeter and area of simple compound shapes.</p> <p>VOCABULARY parallelogram hexagon factor area perimeter</p> <p>RESOURCES Activity sheet 8.4 Whiteboards</p>	<ul style="list-style-type: none"> Give the children Activity sheet 8.4. <div>Q What is the perimeter and area of the rectangle A?</div> <p>Ask the children to write down the perimeter and area of shape A on their whiteboard.</p> <p>Collect responses and ensure that the correct units are used: cm and cm². Remind children the area of a rectangle is 'length times breadth'.</p> <p>Repeat for shapes B and C. Establish that all three shapes have the same area, but different perimeters.</p> Ask children to name shapes D and E and to find their areas. Draw attention to the fact that shape D is half of shape B and drawing the rectangle around the triangle is a useful strategy. <p>Collect responses and discuss children's strategy for finding the area of shape E.</p> <ul style="list-style-type: none"> <div>Q What are the names of shapes F and G?</div> <p>Collect responses and check spelling of these words.</p> <div>Q What strategy can we use to find their areas?</div> <p>Discuss the children's responses and ask them to find the areas. Collect answers and correct errors.</p> <div>Q What rectangle could we draw that would have same area as shape F?</div> <div>Q What rectangle would have the same area as shape G?</div> <p>Collect answers and identify that finding the factors of the two areas of the shapes will give the rectangles.</p> 	<p>Calculate the perimeter and area of simple compound shapes that can be split into rectangles.</p> <p>VOCABULARY square centimetre (cm²) equilateral triangle perimeter</p> <p>RESOURCES Centimetre squared paper</p>	<ul style="list-style-type: none"> On the board, draw: <div>  <div>Q What information do we need to find the area and perimeter of this shape?</div> <p>Once this has been established add some dimensions, in cm, to the L-shape:</p> <div>Q What is its perimeter? Q What is its area?</div> <p>Agree the perimeter and show that the area can be found by dividing into rectangles and adding or by drawing a large outer rectangle and subtracting.</p> <div>Q What L-shapes can you draw that have an area of 36cm²?</div> <p>Discuss how to do this and demonstrate on the board. Find its perimeter and record this.</p> </div> Children work in pairs to find different L-shapes with area 36cm² and record perimeters. <div>Q What is the L-shape with the longest perimeter? Q What L-shape has the shortest perimeter?</div> Discuss their answers and correct any errors or misunderstandings. 	<ul style="list-style-type: none"> On the board draw the shape below. Emphasise it is not drawn to scale or accurately. <div>  <p>Say it is an equilateral triangle made up of smaller equilateral triangles. Each small equilateral triangle has sides 5cm.</p> <div>Q What is the perimeter of the big triangle?</div> <p>Establish each side is 15cm and the perimeter is $3 \times 15 = 45\text{cm}$.</p> </div> Remove smaller triangles, one at a time, e.g. <div>  <div>Q What is the perimeter of this shape?</div> <p>Repeat until only one small triangle is left.</p> </div> Remind children how to find the area of a rectangle and how using rectangles can help to find other areas. <div> <p>By the end of the lesson children should be able to:</p> <ul style="list-style-type: none"> Know the formula for finding the area of a rectangle; Begin to find the areas of compound shapes that can be split into rectangles. <p>(Refer to supplement of examples, section 6, page 97.)</p> </div>