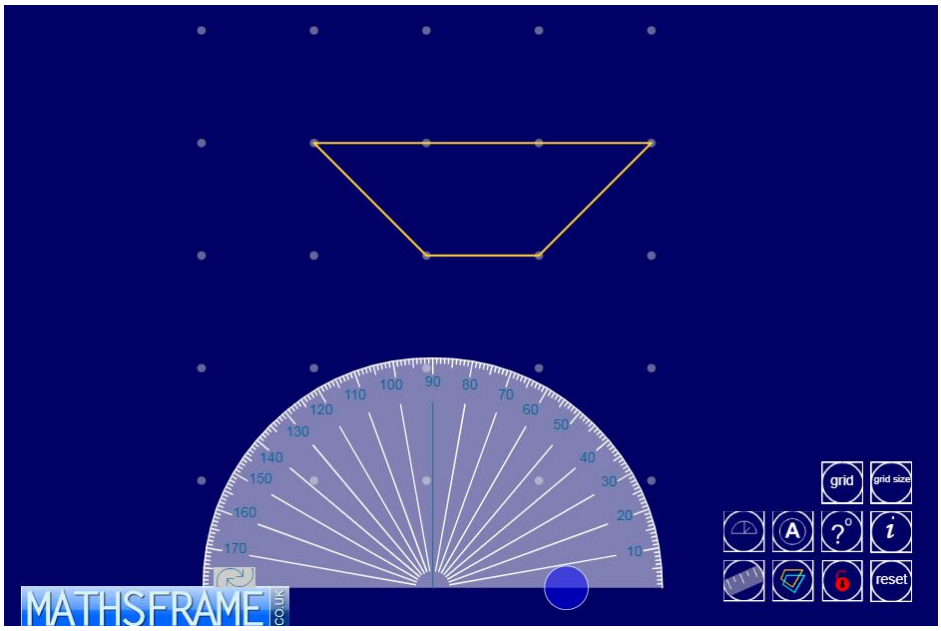
Planning Overview
Year 6 Geometry

Draw 2-D shapes using given dimensions and angles
Recognise, describe and build simple 3-D shapes, including making nets
Compare and classify geometric shapes based on their properties and sizes and find unknown angles in any triangles, quadrilaterals, and regular polygons
Illustrate and name parts of circles, including radius, diameter and circumference and know that the diameter is twice the radius
Recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles.
Describe positions on the full coordinate grid (all four quadrants)
Draw and translate simple shapes on the coordinate plane, and reflect them in the axes.

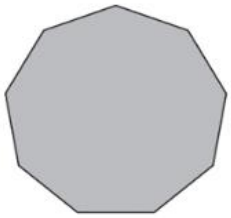
6G–1 Draw, compose, and decompose shapes according to given properties, including dimensions, angles and area, and solve related problems.

Draw and compose 2D shapes	Recap how to use a protractor to measure and draw angles from previous curriculum. Use the Protractor ITP for support teaching this.  Recap perimeter, area, angles, lines and length using SATs questions such as those below. If additional teaching is needed then track back to Year 3, 4 or 5 geometry plan.

4 Here is the shape of a regular nonagon.

The length of one edge is 5cm.

Find the **perimeter** of this shape in m.

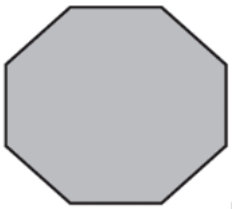


cm

1 mark

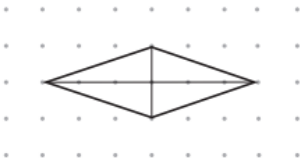
15 A regular octagon has a perimeter of 28.8cm.

Calculate the **length** of one edge.

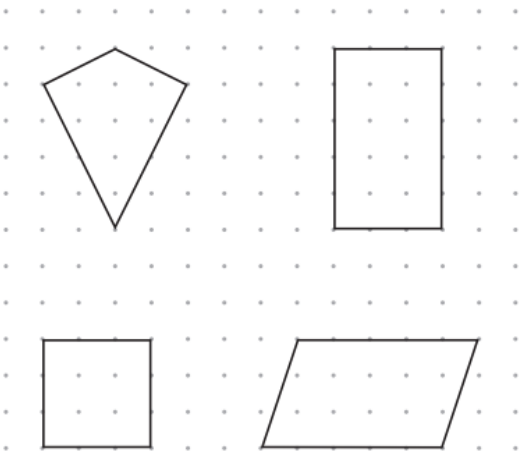


1 mark

18 The diagonals of this quadrilateral cross at right angles.



Tick **all** the quadrilaterals that have diagonals which cross at right angles.



19 The area of a rugby pitch is 6,108 square metres.

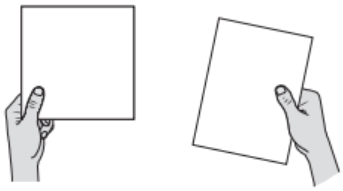
A football pitch measures 112 metres long and 82 metres wide.

How much larger is the area of the football pitch than the area of the rugby pitch?

Show your method

square metres

20



A square tile measures 20 cm by 20 cm.

A rectangular tile is 3 cm **longer** and 2 cm **narrower** than the square tile.

What is the **difference in area** between the two tiles?

Ask the children to use their conceptual understanding of the above concepts to draw shapes that fit certain criteria e.g.

- Draw a rectangle on squared-centimetre paper with a perimeter of 18cm
- Draw a square with 3cm sides
- Draw an isosceles triangle where the bottom 2 angles are 40 degrees each.
- Draw a pentagon, on squared-centimetre paper, with an area of 15cm2

Example 1

Task: draw a rectangle with a perimeter of 14cm.

Example solution:

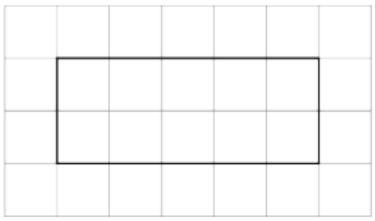


Figure 28: a 5cm by 2cm rectangle on a squared-centimetre grid

Task: draw a pentagon with an area of $10cm^2$.

Example solution:

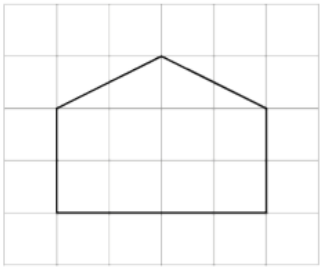
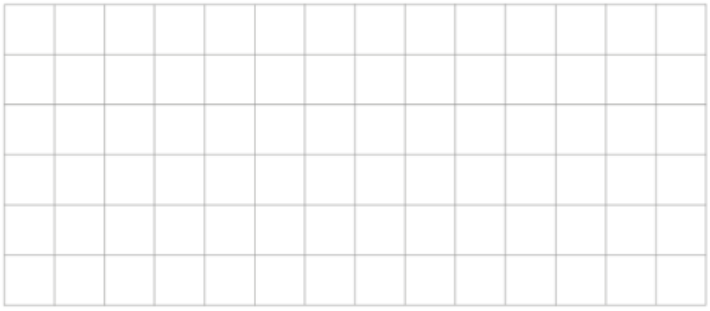


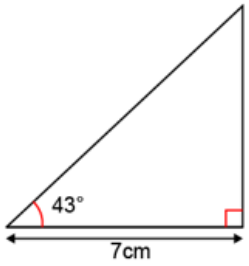
Figure 29: an irregular pentagon with an area of $10cm^2$

Ready to Progress Guidance

3. Draw a hexagon on this squared-centimetre grid. Include one side of length 4cm and one side of length 3cm.



5. Here is a sketch of a triangle. It is not drawn to scale. Draw the full-size triangle accurately. Use an angle measurer (protractor) and a ruler.



Not drawn to scale

Mastery

Accurately draw two right-angled triangles with sides of different lengths.

Compare them and describe what's the same and what's different about them.

NRICH – Shape Draw. Can the children draw a shape based on the clues? Can they make their own clues?

Can they find a shape that satisfies all the clues?

The shape has two pairs of parallel sides.	The area of the shape is $24cm^2$.
The shape has four right angles.	The shape's perimeter is numerically larger than its area.
The length of each side is an even number.	The shape is irregular.
The shape is a quadrilateral.	The shape has two lines of symmetry.

Within this objective, children need to also be able to reason about dimensions or areas given for part of a shape to determine the values for other parts of a shape or for a compound shape
The following example is from the Ready to Progress Guidance

Problem: find the perimeter of the large rectangle on the right.

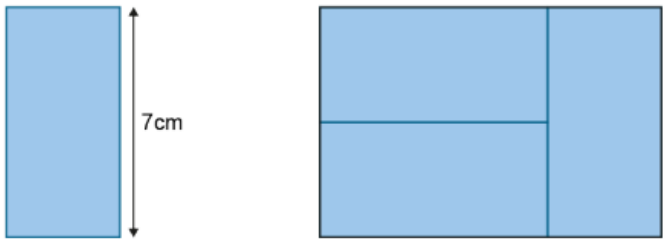


Figure 30: problem involving a compound shape made from 3 identical rectangles

Drawn to scale, not actual size

Solution: perimeter of large rectangle = 35cm

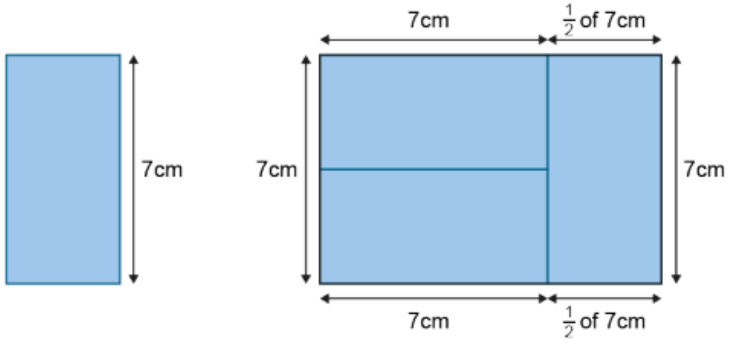
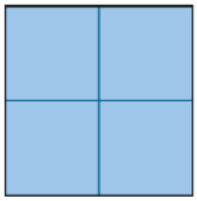


Figure 31 solving a problem involving a compound shape made from 3 identical rectangles

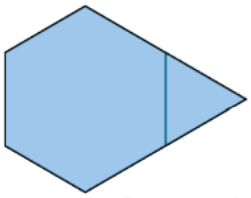
Drawn to scale, not actual size

Children to tackle questions such as the ones below from the Ready to Progress guidance.

4. Here is a square made from 4 smaller squares. The area of the large square is 64cm². What is the length of 1 side of each small square?



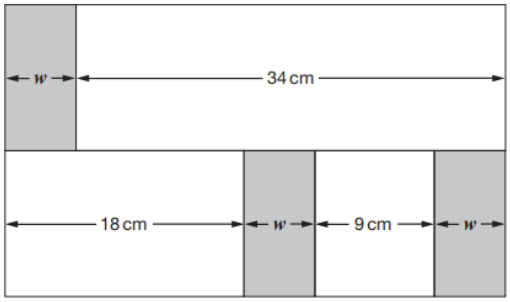
6. Here is a picture of a pentagon made from a regular hexagon and an equilateral triangle. The perimeter of the triangle is 24cm. What is the perimeter of the pentagon?



Drawn to scale, not actual size

Apply this understanding to SATs questions

22 In this diagram, the shaded rectangles are all of equal width (*w*).



Not to scale

Calculate the width (*w*) of one shaded rectangle.

Show your method

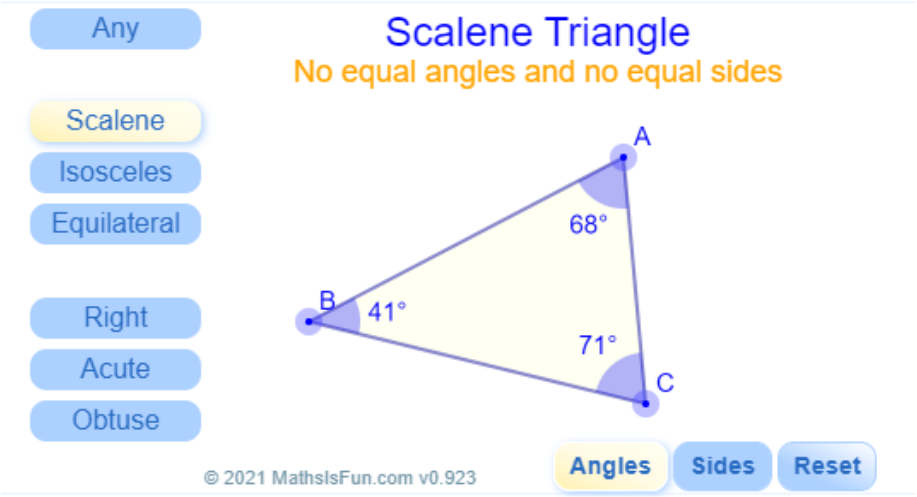
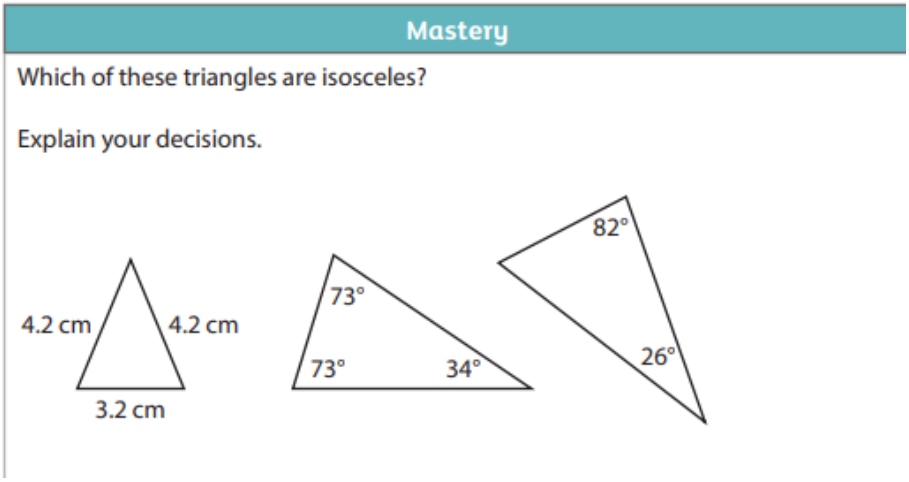
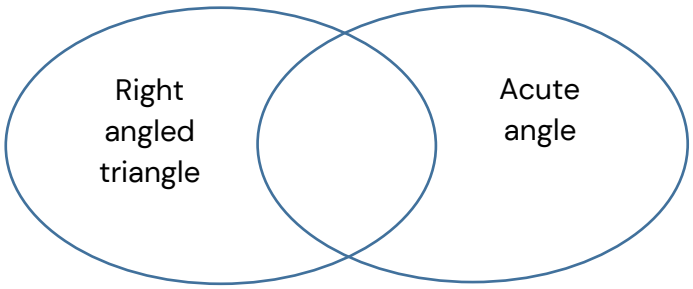
cm

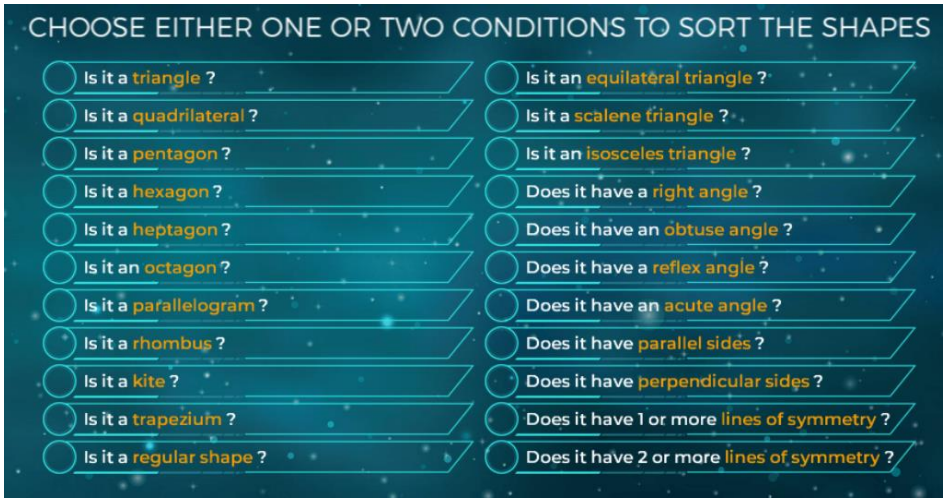
2 marks

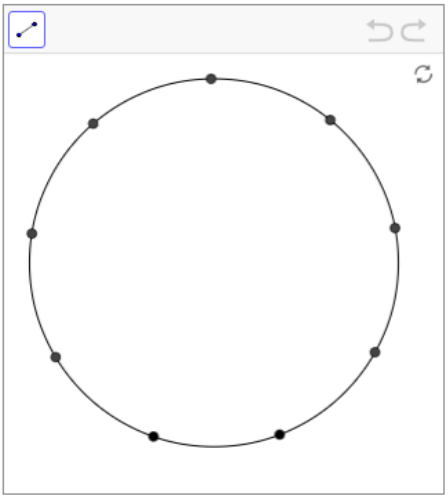
Mastery with Greater Depth

A triangle has been drawn carefully. You are told that the biggest angle is 20° larger than the second biggest angle and 40° larger than the smallest angle.

Work out how big each angle is.

Compare and classify geometric shape based on their properties and sizes – triangles	**Triangles** Recap types of triangles from the previous curriculum. Ask children to create definitions for each type of triangle and use these definitions to help them to categorise a selection of triangles. 'Interactive triangles' on mathsisfun.com may help some children create definitions   Ask children to sort triangles into Venn diagrams. Can children make predictions about their Venn diagram before they start sorting? 

	Children to sort triangles into a Carroll diagram. This interactive Carroll diagram on mathsframe.co.uk allows children to pick their own sorting criteria.  Ask the children to use their understanding about triangles to complete reasoning activities Who am I? I have one right angle and no equal sides. Who am I? I have a pair of equal sides and two angles of 45 degrees. Who am I? I have one angle of 80, one of 40. Who am I? Possible or impossible? I am isosceles and have two right angles. Is this possible? I am equilateral and two of my angles are 45. Is it possible? I am scalene and have one right angle and one obtuse angle. Is it possible? What's my angle? I am a right-angled scalene triangle. One of my angles is 25°. What is the other? I am isosceles. One of my angles is 30°. What could my other two be? I am isosceles. All three angles are acute – what could they be?

	NRICH – 9 pin triangles (easier problem) **Nine-pin Triangles** **Age 7 to 11** **Challenge Level** ★ How many different triangles can you make on a circular pegboard that has nine pegs? You may like to use the interactivity to try out your ideas. Click on two of the dots to create a line between them. If you prefer to work on paper, you might find this sheet of nine-peg boards useful.  NRICH – Triangles all around (harder problem) **Triangles All Around** **Age 7 to 11** **Challenge Level** ★★★ You might like to have a look at Nine-Pin Triangles before trying this problem. How many different triangles can you draw on a circular pegboard which has four equally spaced pegs? What are the angles of each triangle? If you have a six-peg circular pegboard, how many different triangles are possible now? What are their angles? How many different triangles could you draw on an eight-peg board? Can you find the angles of each? You may like to use the interactivity to try out your ideas. When you have selected the number of dots you need, select the line drawing tool, then click on two dots to draw a line between them.
Compare and classify geometric shape based on their properties and sizes – quadrilaterals	**Quadrilaterals** Consider the definitions for common quadrilaterals. Children to match definitions to shapes. Parallelogram Opposite sides equal, opposite sides parallel, opposite angles equal, diagonals bisect each other Put the children into pairs. Ask one child to think of a quadrilateral. The other child gets to ask up to 3 'yes or no' questions to find out what the mystery quadrilateral is.

Ask children to use these definitions to answer reasoning questions. Can a shape be called more than one name? is a rectangle also a parallelogram? Why?

True or false

- A parallelogram with a right angle is a rectangle.
- A trapezium with a right angle is a rectangle
- A rectangle with equal sides is a square
- Every kite is a rhombus

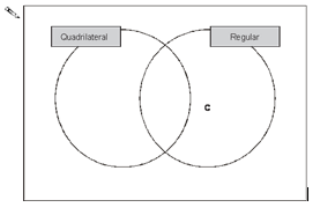
Children will also be expected to be able to sort quadrilaterals in the same way that they sorted triangles.

SATs Question

Here are four shapes in a Carroll diagram.

	Regular	Not regular
Quadrilateral	A	B
Not a quadrilateral	C	D

Use this information to write the letters **A**, **B** and **D** in the Venn diagram below.

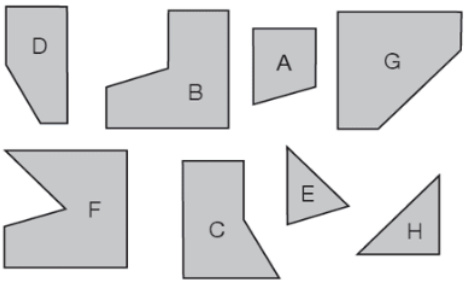


2 marks

Polygons

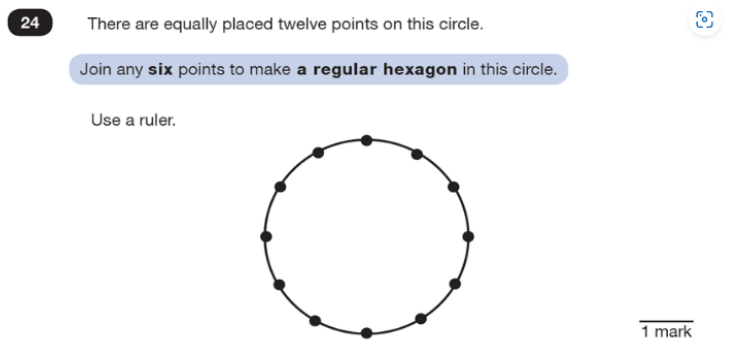
Ensure that children can identify a range of regular and irregular polygons.

3 Each of these shapes has been cut into polygons.



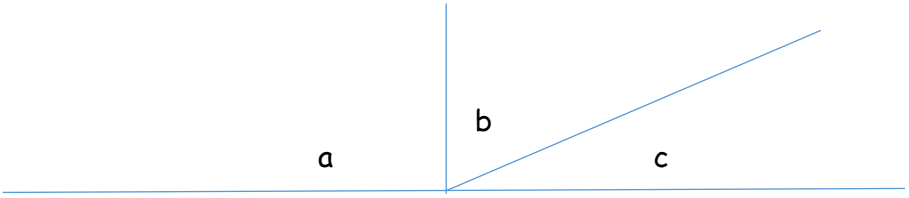
Write the letters of the shapes that are **Pentagons**.

1 mark

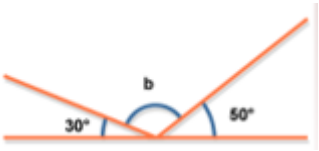
<table>
<tr><td></td><td>


Children can sort polygons in a similar way to how they sorted triangles and quadrilaterals

Always, sometimes, never
Is it always, sometimes or never true that the number of lines of reflective symmetry in a regular polygon is equal to the number of its sides n.</td></tr>
<tr><td>Find missing angles on a straight line or in a circle</td><td>Recap learning from year 5 around angles on a straight line.
Give children a protractor and ask them to explain how they know that a straight line is 180 degrees using the concrete resource in their hands.

Spot the mistake
Sam says that these angles are all correct. Is he right to think this? do we need to measure each angle to know if he is correct or not?
 

a = 90
b= 45
c= 35

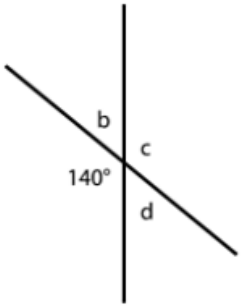
Teach children strategies for identifying a missing angle on a straight line – possibly using a bar model
 

Our whole would be 180 degrees. Our angles are all parts. We know 2 of those parts so would need to add those together and then subtract that amount from our whole. To check we can add all of the parts together and make sure that they equal 180°

<table>
<tr><td colspan="3">180°</td></tr>
<tr><td>30°</td><td>b = ?</td><td>50°</td></tr>
</table>
</td></tr>
</table>

Use this understanding to find missing angles in a full turn. What must all of our angles add up to now?

How would we calculate each of the missing angles in this diagram below (taken from BBC bitesize)



We know that b and 140° must equal 180° so b must be 40°. C and b are both on another straight like so c must be 140°. C and d are on a straight line together and if c is 140° then d must be 40°. We can check if all of this is correct by making sure that all of the angles equal 360° altogether.

As the children what they notice about the opposite angles. Each of the opposite angles are the same size.

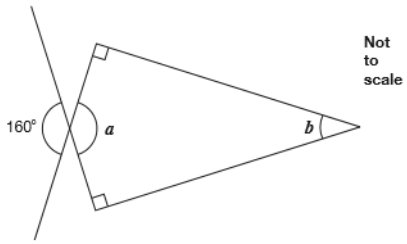
Investigate some other opposite angles in diagrams and establish this as a mathematical rule.

'Vertically opposite angles are the angles directly opposite each other when a straight line crosses over another straight line.

They are always equal.'

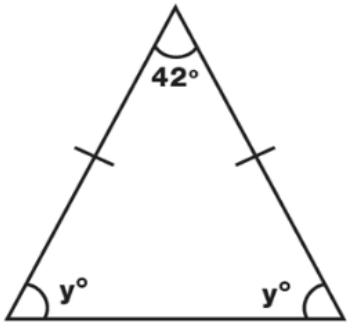
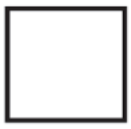
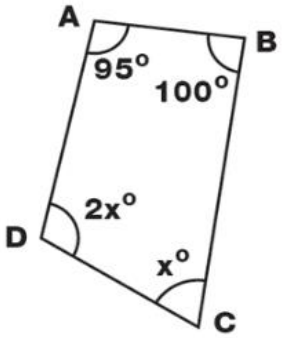
How can that understanding allow us to calculate what angle a is on this diagram? Can children extend their understanding and what they know about a straight line to find any other angles using 160 and the value of a?

17 Calculate the size of angles a and b in this diagram.

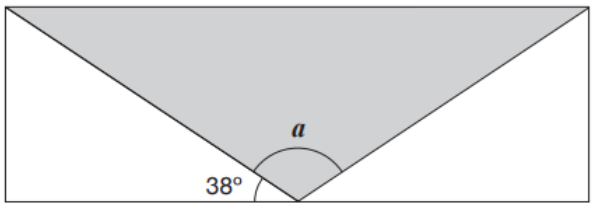


$a =$ ☐ ° 1 mark

$b =$ ☐ ° 1 mark

Recognise missing angles triangles and quadrilaterals	Show children a range of triangles and quadrilaterals with their angles marked on and labelled. What do children notice about all of the angles in a triangle and all of the angles in the quadrilaterals? Ask them to write a mathematical generalisation about angles in a triangle and angles in a quadrilateral. 'The sum of all angles in a triangle is 180°' 'The sum of all of the angles in a quadrilateral is 360°' **11** Find the **value of y** in the following triangle.   1 mark **11** Here is a diagram of a quadrilateral ABCD. Each angle is marked in the diagram. Find the **value of** x in the diagram.  Using this information and applying some additional information about diagonally opposite angles and angles on a straight line children to work through SATs questions In the below question make sure that children understand that the opposite angle to the 38° angle is also 38°. Both of these are on a straight line with a so 38° x 2 needs to be taken away from 180°.

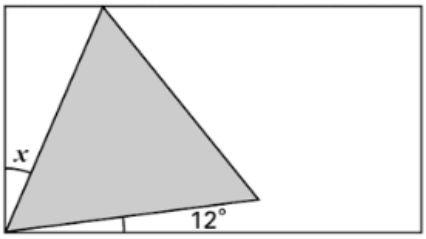
15 A shaded **isosceles** triangle is drawn inside a rectangle.



Not to scale

Calculate the size of angle a.

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

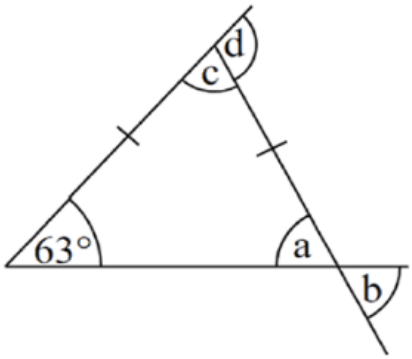


Not to scale

Calculate the value of angle x.

In this question make sure that children understand that we need to consider the square and that each of the angles of the square are 90°. We also need to understand that this is an equilateral triangle and so each of the triangles angles are 60° (because 180 divided equally into 3 is 60) 60° and 12° gives us 72° and if we then subtract 72 from 90 we can find out the value of x.

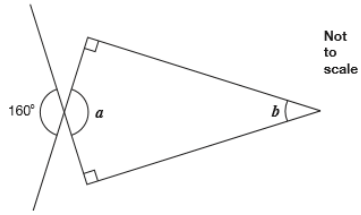
Work out the **missing** angles in the following diagram.

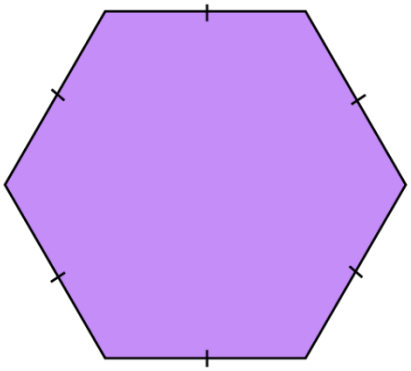


Not to scale

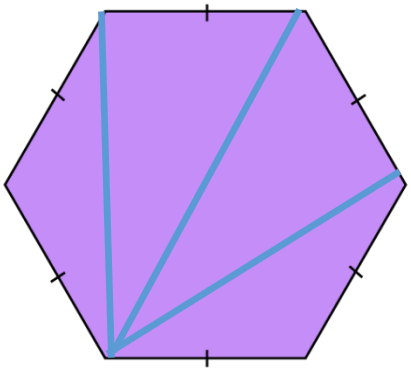
a = ☐° b = ☐° c = ☐° d = ☐°

In this isosceles triangle 2 sides and 2 angles are equal. We know that the other angle in the triangle is 63° so 180° - 63° and that

	answer divided by 2 will give us angles a and c. Angles c and d will total 180° so we can then work out angle d and angle a and b are diagonally opposite so will be equal. **17** Calculate the size of angles a and b in this diagram.  $a =$ ☐ ° 1 mark $b =$ ☐ ° 1 mark Children should now be able to tackle the value of angle b in this question. We already established that a is 180 because it is an opposite angle. We know that this is a quadrilateral and will have a total angle sum of 360°. We also know that it has 2 right angles 90 | 90 | 180 | b 360 **Mastery with Greater Depth** A triangle has been drawn carefully. You are told that the biggest angle is 20° larger than the second biggest angle and 40° larger than the smallest angle. Work out how big each angle is.
Find unknown angles in regular polygons	How can we use triangles to help us to calculate the interior angles of a regular polygon? Demonstrate to children how we can turn regular polygons into several small triangles and then using what we know about triangles can use that to calculate the sum of that polygon's interior angle.



Give each child a regular hexagon. Ask the children to use straight lines to cut the hexagon into triangles.



The children will end up with something like this. Ask them to count up how many triangles they have made out of their hexagon and how if we know that each triangle has internal angles of 180° we can use that to calculate the total of internal angles of the regular hexagon.

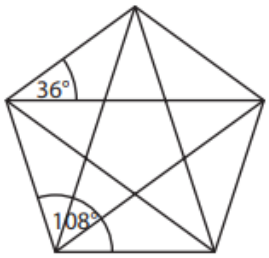
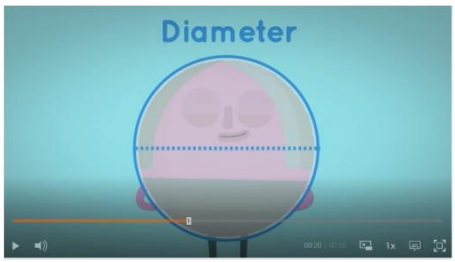
180° x 4 = 720

Repeat with a regular pentagon, heptagon, octagon, nonagon, etc.

Children to complete a table as they are investigating each of these shapes

Number of sides of the shape	Number of triangles created from the shape	Total interior angle of the regular polygon
6	4	720
5		
7		

Encourage the children to notice a pattern to do with the number of sides of the regular polygon and the number of triangles that can be mode out of that polygon.

	'I have noticed that the number of triangles that you can make out of a regular polygon is always 2 less than the number of sides the polygon has got' Can the children turn this into a formula to calculate the internal angle of any regular polygon? Number of sides on the regular polygon – 2 x 180° = internal angle of the regular polygon. Sam says 'The interior angles of a regular decagon are 1800°' Is he correct? How do you know? **Mastery with Greater Depth** This is a regular pentagon. Two angles (108° and 36°) are shown. Which other angles can you work out? Explain your reasoning. 
Illustrate and name parts of circles, including radius, diameter and circumference and know that the diameter is twice the radius	Introduce the children to the different measurable parts of a circle. All circles have a **circumference, diameter and radius**. They can be measured using a ruler or tape measure. • The circumference is the distance all the way around a circle. • The diameter is the distance right across the middle of the circle. • The radius is the distance halfway across the circle. The radius is always half the length of the diameter. BBC bitesize has a useful video to support this new learning 

Present the children with a circle to measure. How would they measure the diameter? Would they need to measure the radius or would the diameter measurement help them to establish this? How could they measure the circumference? Model how to do this with a tape measure or with some string and a ruler.

25 A car tyre has a diameter of 48 cm.

What is the **radius** of the car tyre?

_____ 1 mark

Mastery

Captain Conjecture says, 'The diameter of a circle is twice the length of its radius.'

Do you agree?
Explain your answer.

Captain Conjecture says, 'All circles with a radius of 4 cm have circumferences that are the same length.'

Do you agree?
Explain your answer.

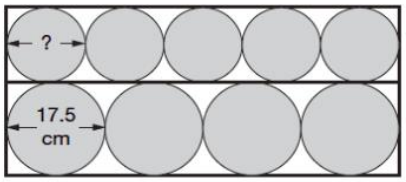
Apply understanding to SATs questions

11 A bicycle wheel has a diameter of 64 cm.

What is the **radius** of the bicycle wheel?

_____ cm 1 mark

25 Four large circles and five small circles fit exactly inside this rectangle.

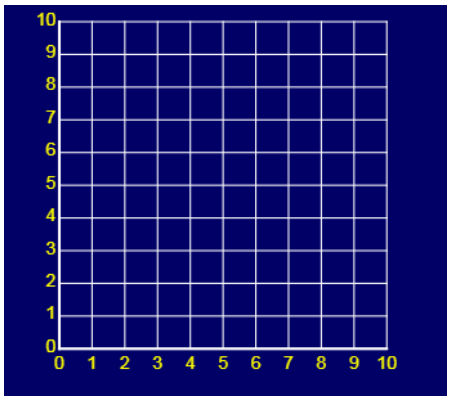
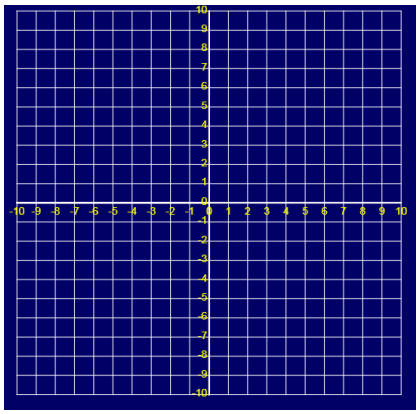
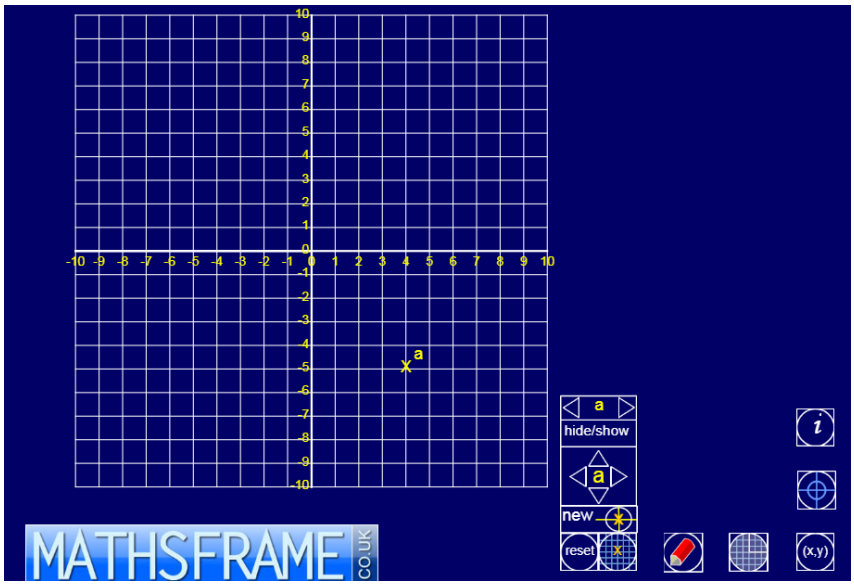


Not actual size

The **diameter** of a large circle is **17.5** centimetres.

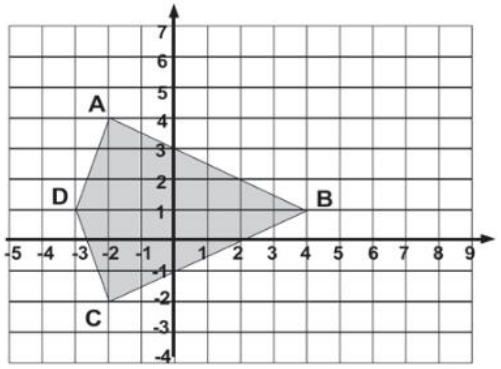
Calculate the **diameter** of a small circle.

_____ cm

Describe positions on the full coordinate grid (all four quadrants)	Introduce children to a 4 quadrant grid. Ask the children what they can see that is the same as the single quadrant grids that they have been used to seeing in previous year groups and what is different?   Images taken from Coordinates ITP – available on mathsframe.co.uk Position a point on a 4 quadrant grid and ask children what they think the coordinates of that point are. Allow time to address misconceptions such as reading the y coordinate first rather than the x coordinate or forgetting to use the – when locating a point in the negative section of the quadrant.  Sam says 'point a is at position (4,5) because I have read along to marker 4 and down to marker 5' Is he correct?

Children to complete fluency work around positioning points on a 4 quadrant grid and reading the coordinates of points that other children have plotted.

16 Here is a shape on the coordinate axes.



What are the **coordinates** of the points A, B, C, and D?

A (___, ___) B (___, ___) C (___, ___) D (___, ___)

1 mark

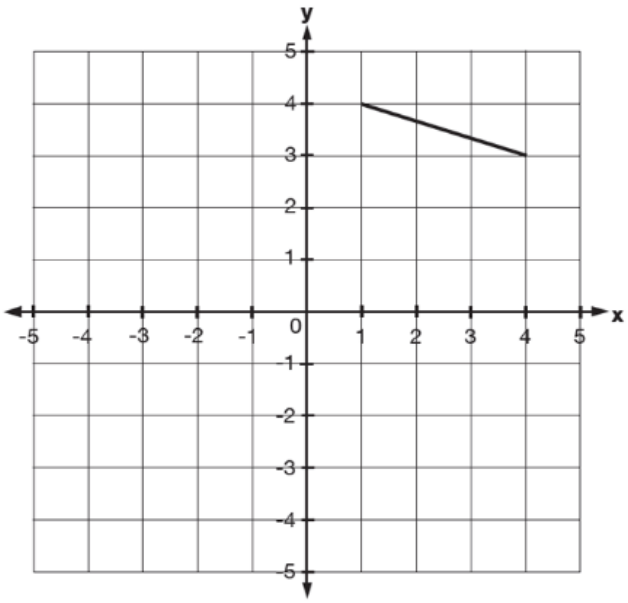
On the grid above, **draw** and **label** shape PQRS with the following coordinates:

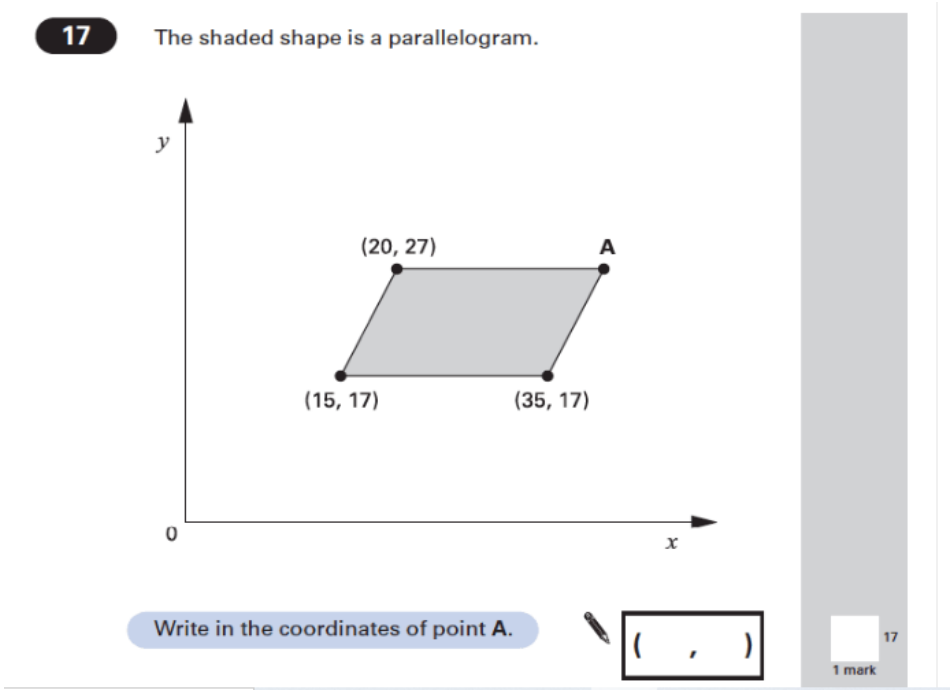
P(6,-2), Q(5,2), R(6,6), S(7,2)

20 The vertices of a quadrilateral have these coordinates.

(1,4) (4,3) (2,-2) (-3,1)

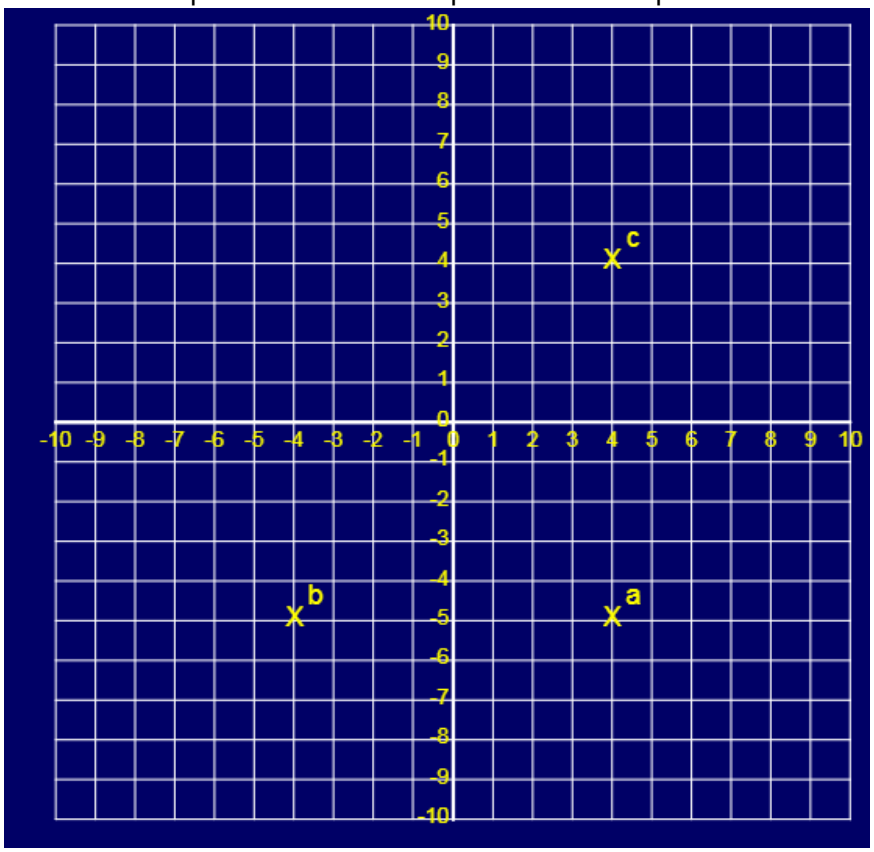
One side of the quadrilateral has been drawn on the grid.





Show children quadrants that have a partially drawn shape on them. Ask children to complete the shape by plotting the next point on the grid.

Where would point d need to be plotted to complete the rectangle?



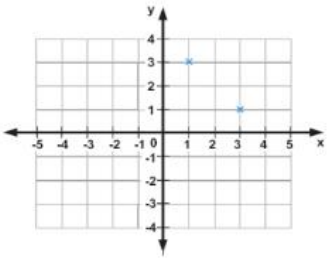
Apply shape and coordinate understanding to SATs questions

25 Points (1,3) and (3,1) on **marked** on the square grid.

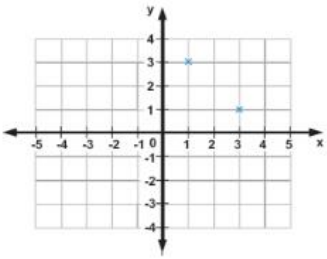
These points are **two** vertices of a shape.

Add other vertices to make the given shapes and **shade** each shape.

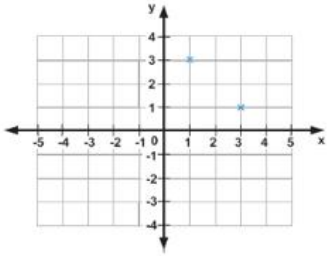
A Square



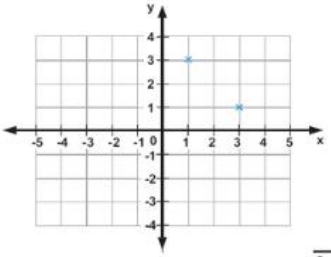
A Kite



A Parallelogram



A Trapezium



2 marks

Mastery

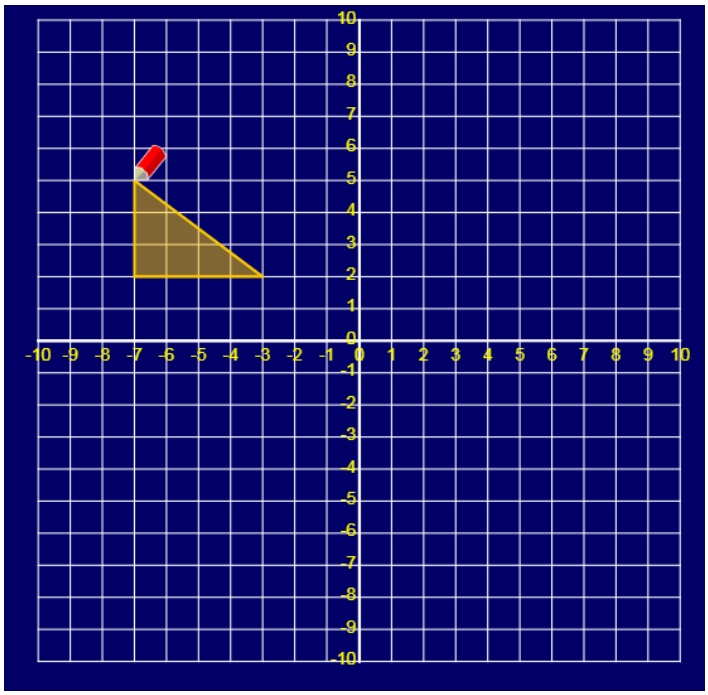
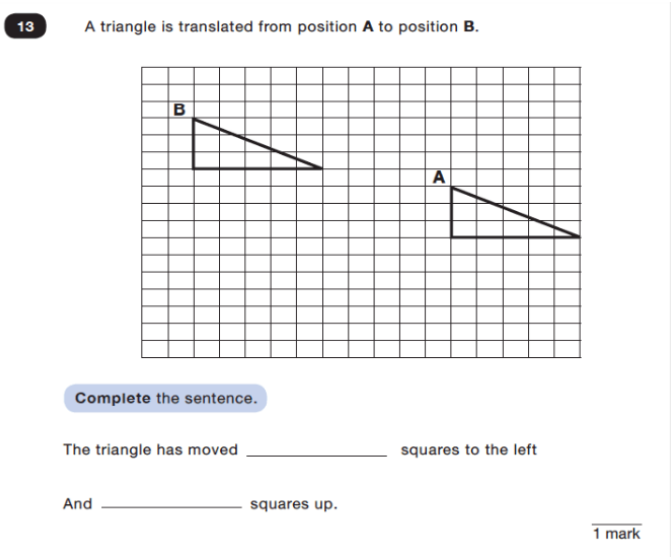
A square has two vertices at (0,0) and (3,3).
Work out and explain the coordinates where the other two vertices could be.

A square has two vertices at (–3,0) and (3,0).
Work out and explain the coordinates where the other two vertices could be.

Mastery with Greater Depth

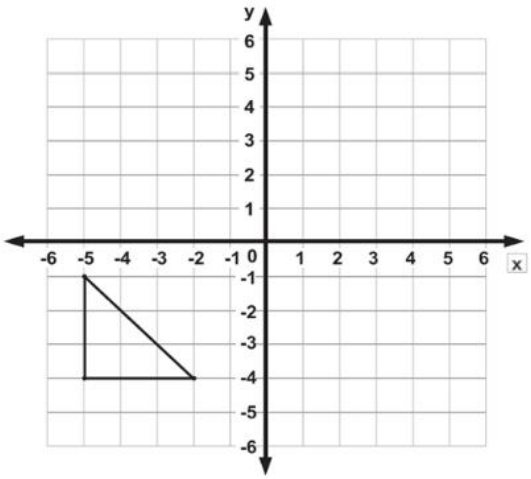
An isosceles triangle has two vertices at (–3,2) and (3,2).

Explore where the third vertex could be.

Draw and translate simple shapes on the coordinate plane, and reflect them in the axes.	Discuss mathematical translation with the children. Explain how this is where a shape is only moved, it is not in any way altered from the original shape in the process of being translated.  Ask the children to imagine that this triangle was moved 5 squares to the right and 3 squares down. Physically provide children with a triangle to move. Ask the children what the final position of the triangle will be. Model concentrating on one corner of the shape and ensuring that corner of the shape moves in the correct way accurately – that was we can make sure that that whole shape has also been translated accurately. Ask children to complete fluency questions around translating whole shapes physically and describing how a shape has been translated.  13 A triangle is translated from position **A** to position **B**. B A **Complete** the sentence. The triangle has moved _____ squares to the left And _____ squares up. 1 mark

Next discuss with the children drawing in a whole shape from one point to another. Model translating each point one at a time and then when each point is translated then drawing the whole shape by connecting the individual points.

14 Here a triangle is drawn on a coordinate grid.



The triangle is translated in the following order:

2up, 7 right and again **3 down.**

Draw the triangle in its new position.

1 mark

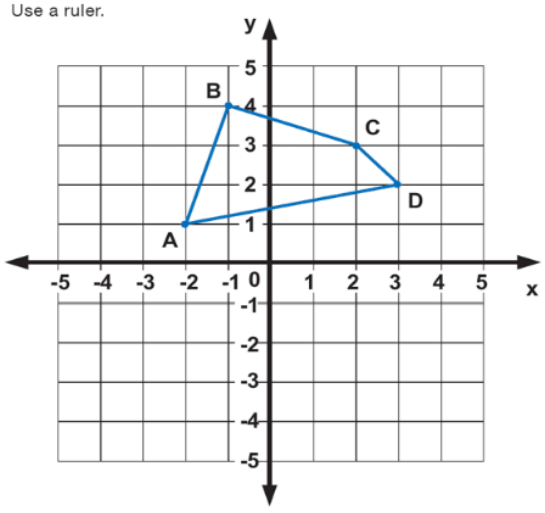
In this question children need to apply some of their drawing 2D shapes work as well as translation. They are told how to translate point b but then they will need to carefully replicate the drawing of the original shape onto the new translated position.

22 Here is a shape on a grid.

The shape is **translated** so that point **B** moves to (-1,-1).

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

Use a ruler.



1 mark

Ask children to translate a shape from one position to another and to record the coordinates of the original and the translated shape.

Translate shape A 2 squares right and 2 squares up

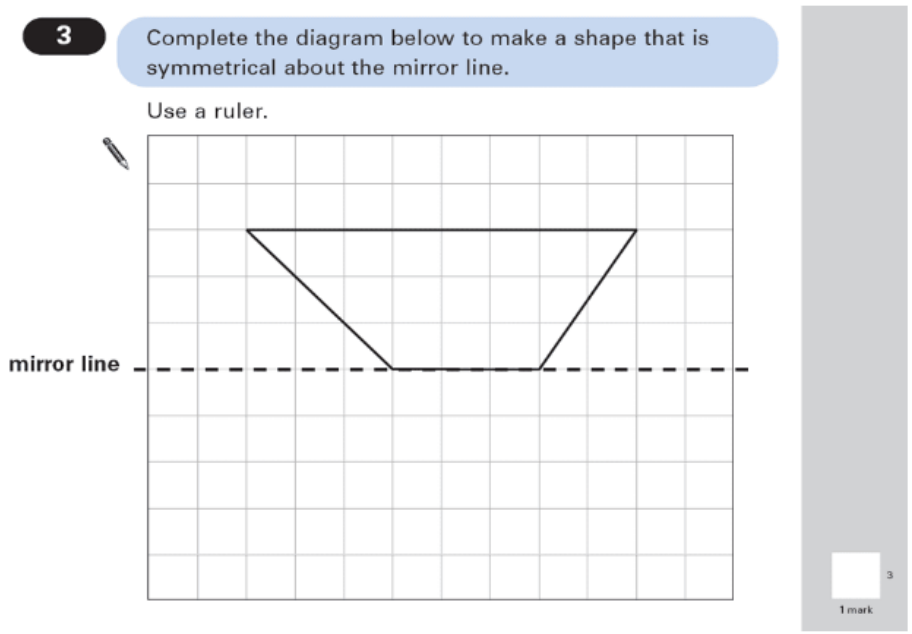
Shape a coordinates	Shape b coordinates
3,2	5,4
3,4	5,6
5, 3	7,5

Ask children to look for any patterns in the coordinates, what effect did moving the shape 2 squares to the right and 2 squares up have on the values of the coordinates?

Developing reasoning
Two triangles have the following co-ordinates: Triangle A: (3, 5) (7, 5) (4, 7) Triangle B: (3, 1) (7, 1) (4, 3) Describe the translation of triangle A to B and then from B to A.

Reflection

Recap symmetry from previous curriculums



Relate the term reflection to symmetry.

Discuss how we can reflect a shape on the y or the x axis. The shape does not change in any way other that the fact that it is now reflected.

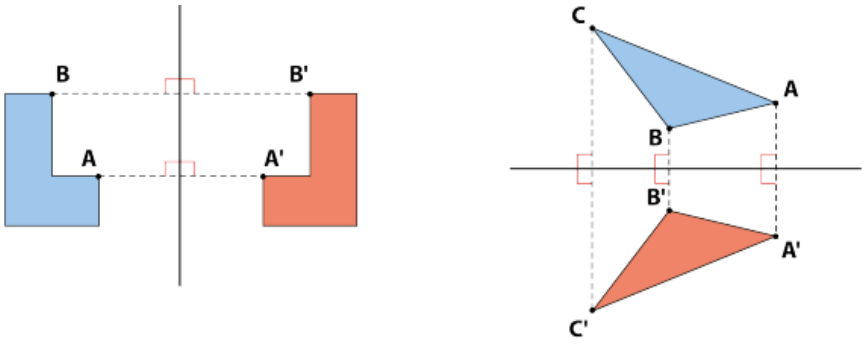
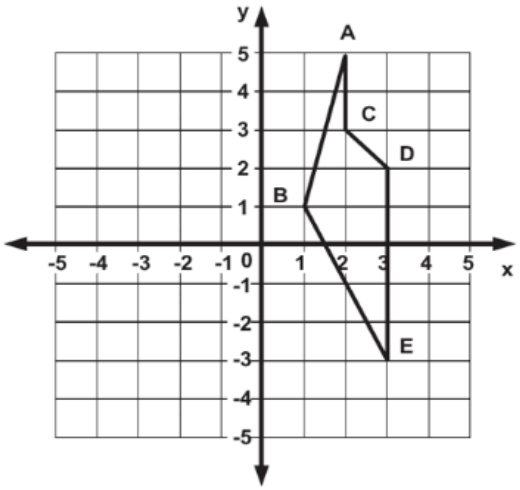


Image from NCTEM PD Materials

Show children how to view what a reflected shape will look like using a mirror or tracing paper.

Allow children to use this skill to answer SATs questions

11 The following square grid shows a shape.



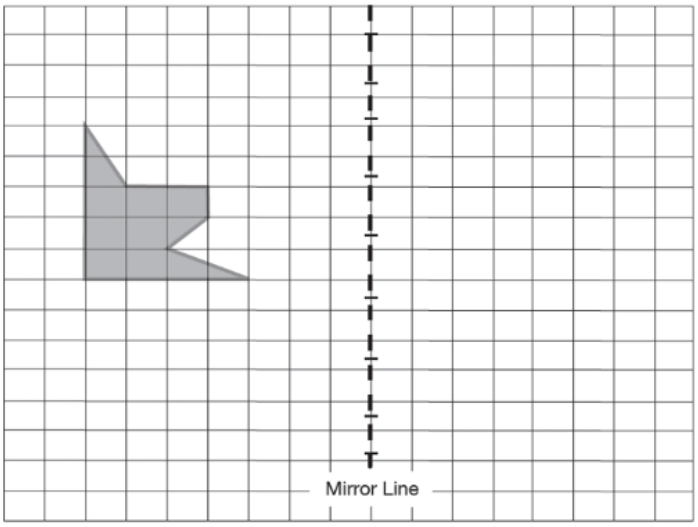
Reflect this shape in the y-axis.

1 mark

5 Here is a shape on a square grid.

Reflect the shape in the mirror line.

Use a ruler



1 mark

Mastery

Are these statements always, sometimes or never true?

- If a shape is reflected in an axis, it stays in the same quadrant.
- If a shape is translated to the right and up, it stays in the same quadrant.
- If a shape is translated to the left and down, it stays in the same quadrant.

Explain your decisions.

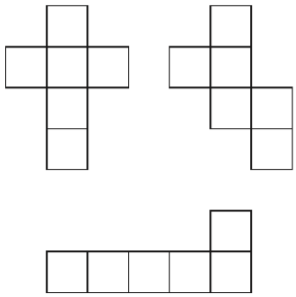
Mastery with Greater Depth

Joan says that if you reflect a shape (in an axis) and then reflect it again, the shape always ends up back where it first was as though you'd done nothing to it.

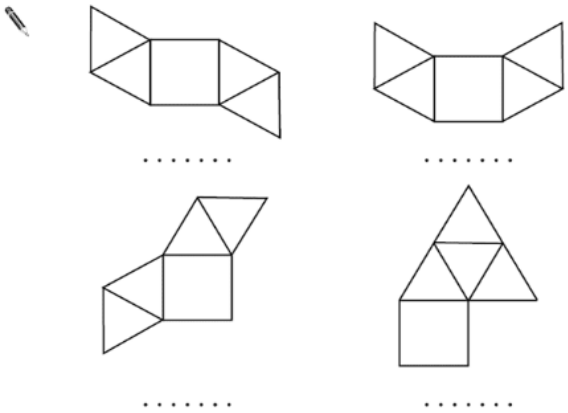
Do you agree with Joan?

Explain your decision.

Discuss with the children that it is possible to both translate and reflect a shape in a 2-part problem. Allow children to work through these types of questions.

Recognise, describe and build simple 3-D shapes, including making nets	Take packaging boxes that are various shapes – cube tissue box, cuboid cereal box, triangular prism Toblerone box, etc. Ask children to very carefully open these boxes up to see what the flattened form or each shape looks like. Use the term net and ask the children to describe the 2D shapes that created each 3D shapes net. 'The triangular prism net is made up on 2 triangles and 3 cuboids' Give children 3D shapes and paper and ask them to investigate drawing around each face or the 3D shape on the paper so that when it is cut out it will form a complete net for that 3D shape. Ask children to investigate a cube first. Did it matter how we drew the 6 squares? When we cut each net out did it always make a cube? Encourage children to visualise folding the net up to decide which piece of the flat net will go where in the construction process. **Mastery** Which of these could be the net of a cube? Explain your choices.  **Mastery with Greater Depth** Pascal says that any net made with six squares can be folded to make a cube. Do you agree with him? Explain your reasoning. Encourage children to visualise other 3D shapes from flat nets

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.**

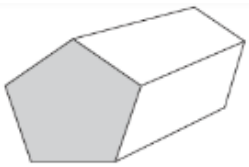


. . . .

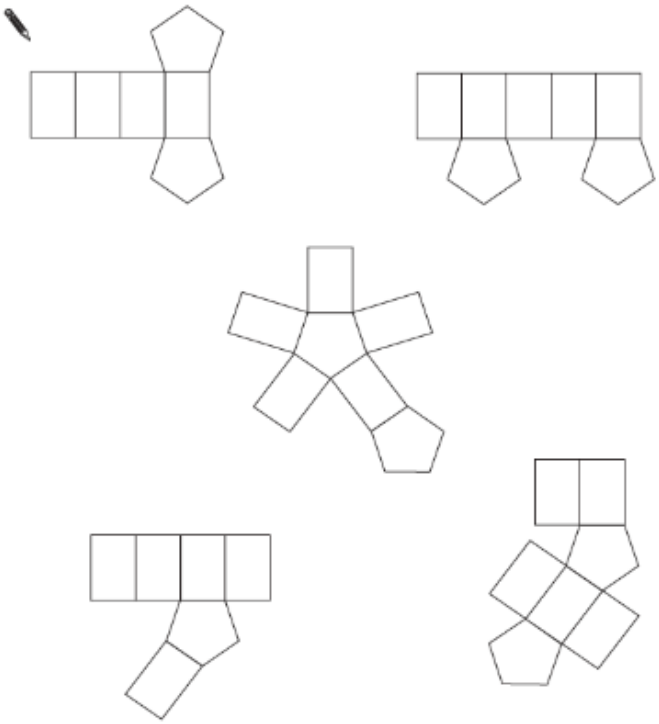
. . . .

13

2 marks



Tick (✓) the one shape that is a net for the pentagonal prism.



13

1 mark