Unit 16
Geometry – position and direction

Mastery Expert tip! "Allowing the children to use computer geometry packages meant they could plot lots of points quickly and easily, without the complication of drawing grids and axes by hand. This provided great practice to reinforce the correct order of coordinates."

Don't forget to watch the Unit 16 video!

WHY THIS UNIT IS IMPORTANT

Coordinate geometry is one of the most powerful ideas in basic mathematics. Coordinates use numbers to describe positions on a grid and connect the worlds of arithmetic and geometry. In later work, coordinates will be used with algebra to allow children to visualise the behaviour of mathematical rules, connections and conditions. This unit focuses on the use of coordinates to describe positions and movements, and provides a solid foundation in some key ideas that will be used in a wide variety of more advanced concepts.

WHERE THIS UNIT FITS

→ Unit 15: Geometry – angles and 2D shapes

→ **Unit 16: Geometry – position and direction**

This unit introduces children to coordinate grids, using them to describe positions of points and translations from one point to another. It builds on the knowledge developed in Unit 15 of properties and symmetry of 2D shapes to identify and represent such shapes using coordinates.

Before they start this unit, it is expected that children:

- know how to read positions on a number line (to the nearest half unit)
- understand how maps and plans can be used to represent a 'real-life' scene
- understand a range of simple ideas and vocabulary related to position and direction: for example left/right and horizontal/vertical.

ASSESSING MASTERY

Children can read and write coordinates for positions in the first quadrant, i.e. points to the right of and above the origin (0,0). They can plot points given a pair of coordinates and understand the convention that the first coordinate represents the horizontal distance to the right of the origin and the second coordinate represents the vertical distance above the origin. They understand translations as movements on the coordinate grid; they can describe the result of making a translation described in words and they can find the translation required for the movement between given positions. They can use simple geometrical reasoning on a coordinate grid to draw patterns and complete shapes.

COMMON MISCONCEPTIONS	STRENGTHENING UNDERSTANDING	GOING DEEPER
Children may confuse the order of coordinates.	Explain that the order of coordinates is *conventional*, in the sense that it is a convention that everyone has agreed to follow.	Provide children with a variety of coordinates, including half units, and ask them to plot them on a grid.
Children may confuse the ideas of coordinates and translations.	Be clear that coordinates tell us where things are, and have a simple notation in the form (6,5); translations tell us how to move, and are written out in words.	At a deeper level, coordinates *are* translations – from the origin to the point we are interested in. Ask children to describe the translation to go from the origin to a point and to explain the pattern that they find.

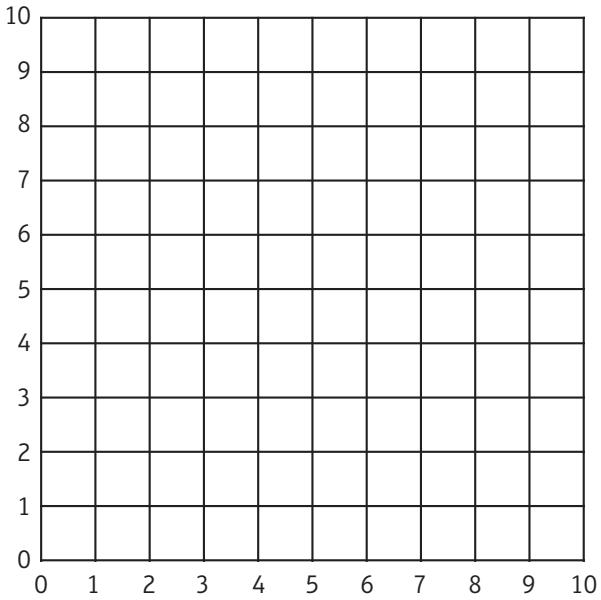
Unit 16: Geometry – position and direction

WAYS OF WORKING

Use these pages to introduce the unit focus to children. Use the characters to discuss concepts and phrases that children have not heard before.

STRUCTURES AND REPRESENTATIONS

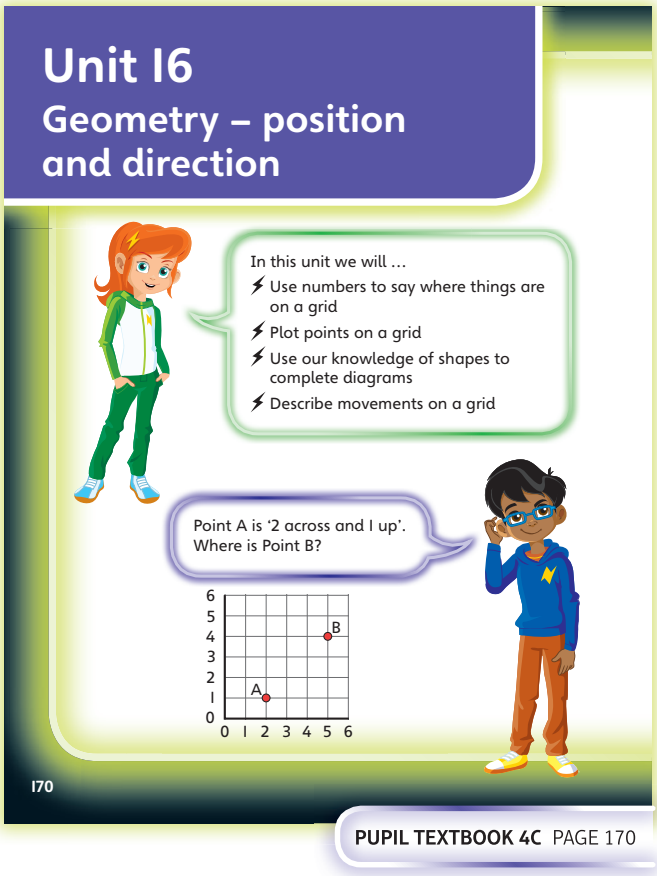
Coordinate grid: Children use coordinate grids throughout the unit to describe positions of points and translations from one point to another.



KEY LANGUAGE

There is some key language that children will need to know as part of the learning in this unit.

- coordinates
- position
- horizontal, vertical
- up, down
- left, right
- square, rectangle
- vertex, vertices



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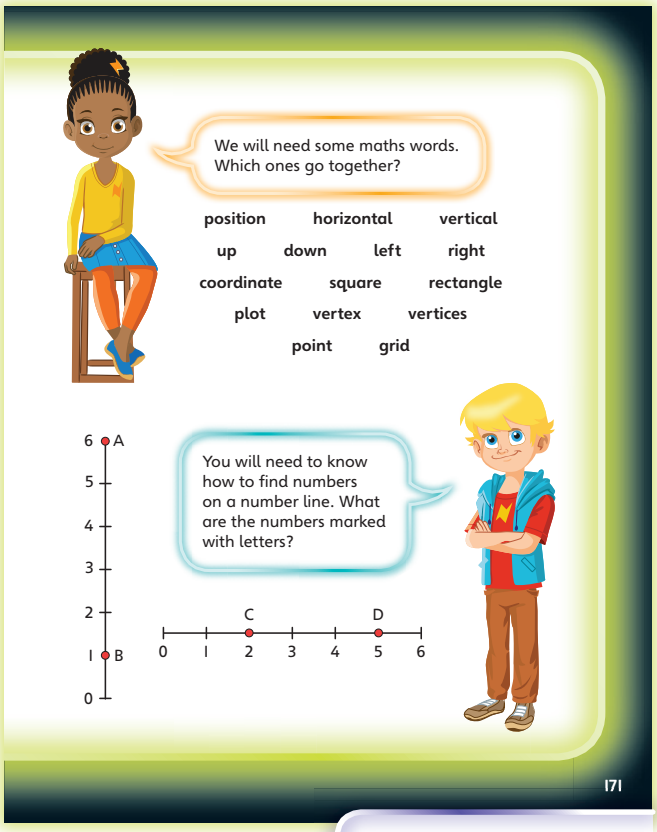

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Describing position (1)

Learning focus

In this lesson, children will describe relative positions on a map, initially without a grid and then with a grid. They will develop understanding and skills that will be needed when numbered axes and coordinates are introduced in the next lesson.

Small steps

- Previous step: Completing a symmetric shape
- **This step: Describing position (1)**
- Next step: Describing position (2)

NATIONAL CURRICULUM LINKS

Year 4 Geometry – Position and Direction

Describe positions on a 2D grid as coordinates in the first quadrant.

ASSESSING MASTERY

Children can describe the relative positions of objects using terms such as near, closest, centre, between, and half-way between. They can use a grid to describe the positions of objects in relation to others, counting squares as necessary.

COMMON MISCONCEPTIONS

Children may need support to identify when places are half-way between other places. Ask:

- *Describe the position of A relative to B and C. What can you tell me about the distance from A to B and from A to C? Are they the same? Complete this sentence: A is _____ between B and C.*

STRENGTHENING UNDERSTANDING

To strengthen understanding of how to describe relative position, position children around the classroom or the playground and ask them to describe their position relative to other children. Encourage them to describe their position in different ways.

GOING DEEPER

Ask children to find a map on the internet and to make up questions about the locations of places. A partner can then try to find the places from the information.

KEY LANGUAGE

In lesson: map, next to, near, closest, centre, between, half-way between, **grid**, left, right, up, down

Other language to be used by the teacher: horizontal, vertical

RESOURCES

Optional: access to the internet, simple maps

In the eTextbook of this lesson, you will find interactive links to a selection of teaching tools.

Before you teach (1)

- Can children describe their position relative to other children or objects?
- Have children met situations where they need to find places on maps?

Discover

WAYS OF WORKING Pair work

ASK

- Question 1 a): *Tell me some places you can see on the map.*
- Question 1 a): *Which places are close to each other? Which places are far apart?*
- Question 1 a): *How many playgrounds are there?*

IN FOCUS This activity develops the ability to describe one place relative to another, encouraging children to use different ways to describe position.

PRACTICAL TIPS Use a real map (perhaps of the local area around your school) as an alternative or addition to the map shown here.

ANSWERS

Question 1 a): Bella is looking for the roller coaster.

Question 1 b): The roller coaster is half-way between the log flume and the dropzone ride. (Other descriptions are possible.)

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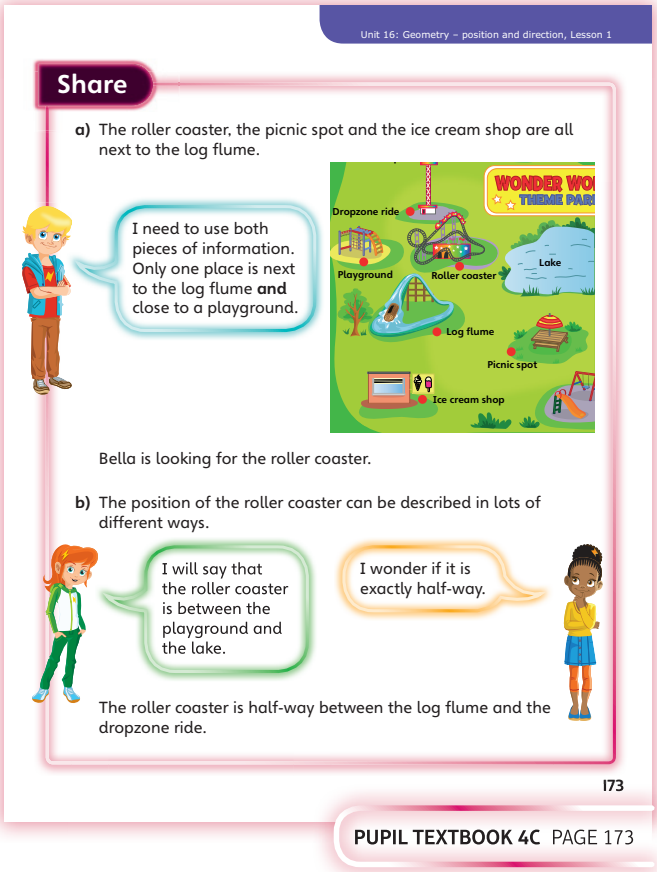
Share

WAYS OF WORKING Whole class teacher led

ASK

- Question 1 a): *Why does Dexter say he needs to use both pieces of information?*
- Question 1 b): *Whose description gives a better idea of where the roller coaster is: Astrid's or Flo's?*
- Question 1 b): *Can you describe the position of the roller coaster in any other way?*

IN FOCUS This activity establishes that the location of one place can be described relative to other places in different ways. It introduces terms such as 'next to' and 'between'. Question 1 b) introduces the idea that descriptions can be made more precise by using words such as 'half-way'.



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Think together

WAYS OF WORKING Whole class teacher led (I do, We do, You do)

ASK

- Question 2 a): *Which place is closest to the ice cream shop? Which place is furthest away?*
- Question 2 a): *Does your description only apply to the café, or could it be describing another place? Do you need to add to your description?*
- Question 3 a): *How many squares are there across the map? How many squares up and down?*
- Question 3 a): *How can you use the squares to find somewhere half-way between two points?*

IN FOCUS Question 3 introduces a grid of squares, which makes it easier to describe where places are. Emphasise that since the squares are all the same size, locations can be given accurately by counting the number of squares. The grid uses horizontal and vertical lines – introduce this terminology, making sure that children understand which is which.

STRENGTHEN Give children additional practice in identifying locations from your descriptions before asking them to describe locations for themselves. Put children in pairs to describe locations to each other to help them develop the idea that they need to be precise, so that only one location fits the description.

DEEPEN Challenge children to think about the most efficient way to describe locations. Before the grid is introduced, you could encourage them to use left/right and above/below as well as near/far and so on.

ASSESSMENT CHECKPOINT Use question 1 to assess whether children can find places given a description of their location. Use question 2 to assess whether they can describe locations unambiguously.

ANSWERS

Question 1 a): The toilets.

Question 1 b): The lake.

Question 1 c): The gift shop.

Question 1 d): The roller coaster.

Question 2 a): Example: The ice cream shop is close to the bottom of the map, near the log flume.

Question 2 b): Example: The café is between the gift shop and the coach park.

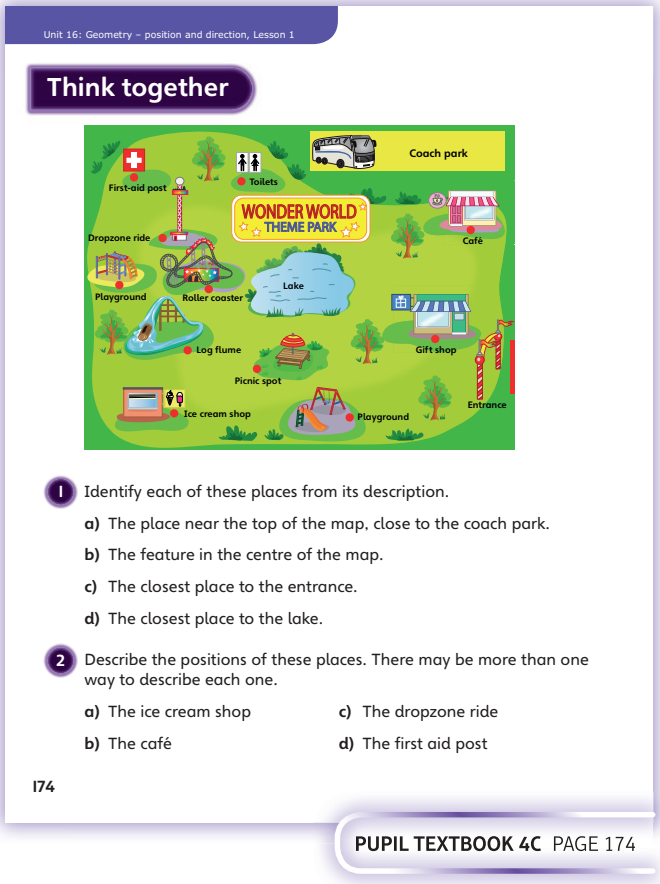
Question 2 c): Example: The dropzone ride is next to the playground and the roller coaster.

Question 2 d): Example: The first aid post is at the top left of the map.

Question 3 a): The log flume.

Question 3 b): The toilets.

Question 3 c): The gift shop.



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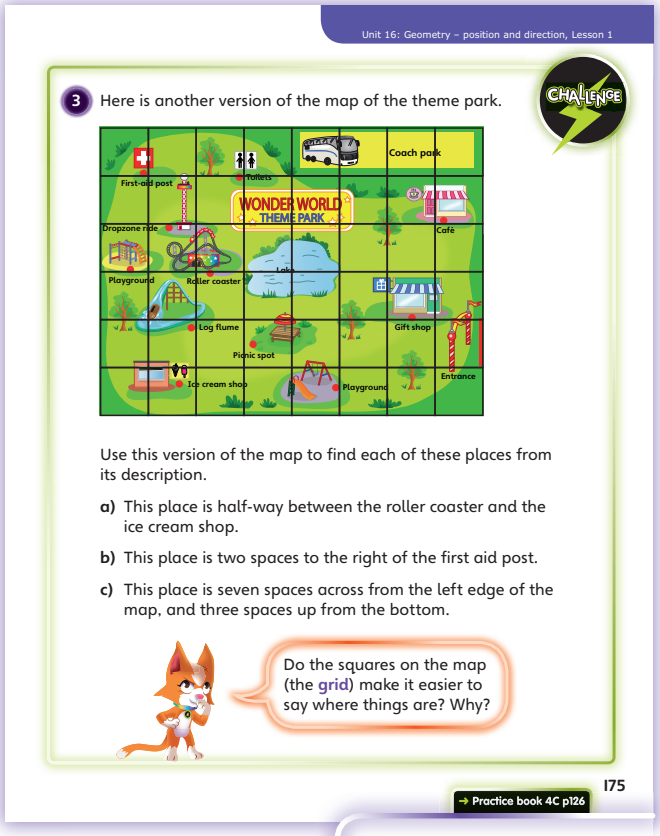

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Practice

WAYS OF WORKING Independent work

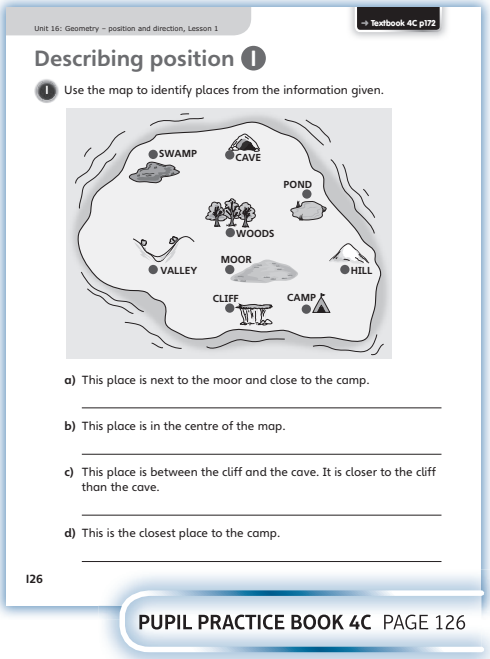
IN FOCUS Question 2 involves describing locations relative to other places on a map. Encourage children to use a variety of ways of describing locations, rather using the same term (for example, 'next to') in all their descriptions. Question 4 clarifies that all places between two points are not necessarily half-way between.

STRENGTHEN In question 5, ask children questions about the grid (for example, 'How many squares across …' and 'How many squares up …'). Describe some locations for them to identify using the grid before they use it to describe locations to a partner.

DEEPEN Ask children to investigate how many places they need to reference to describe a location. For example, 'the moor is half-way between the valley and the hill' references two locations – the valley and the hill. Ask them to explain how many places they need to reference when using a grid: only one, as the other information is given by the number of squares in two directions.

ASSESSMENT CHECKPOINT Use question 1 to assess whether children can find places given a description of their location. Use question 2 to assess whether they can describe locations unambiguously. Use question 3 to check that they are confident at identifying positions that lie on a given straight line.

ANSWERS Answers for the **Practice** part of the lesson appear in the separate **Practice and Reflect answer guide**.



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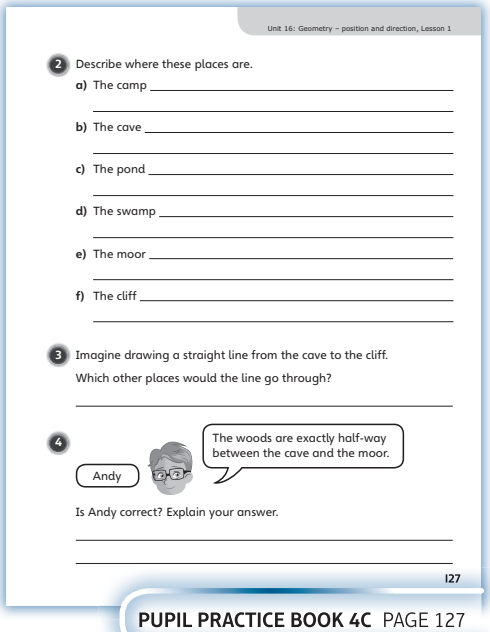

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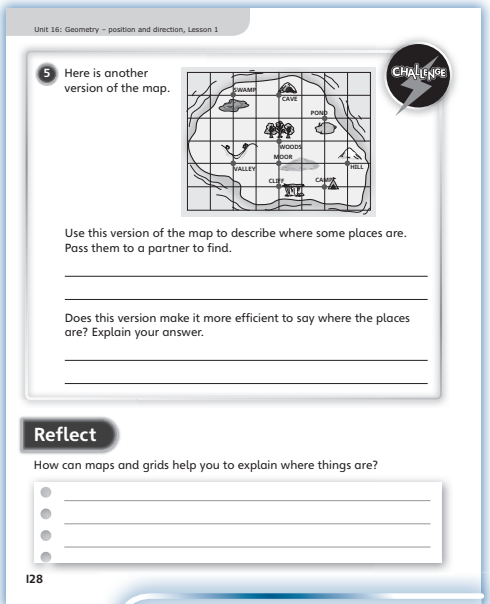
Reflect

WAYS OF WORKING Independent thinking

IN FOCUS This activity provides an opportunity for children to reflect on the maps they have used, with and without grids, and the different ways in which they have specified locations.

ASSESSMENT CHECKPOINT Check that children understand the importance of providing descriptions that identify only one possible location. They may realise that this is easier to do with a grid.

ANSWERS Answers for the **Reflect** part of the lesson appear in the separate **Practice and Reflect answer guide**.



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After the lesson

- Can children describe positions relative to other locations?
- Were children confident in using directions left/right and up/down on a grid?
- Are children prepared for the introduction of a formal system of coordinates in the next lesson?

Describing position 2

Learning focus

In this lesson, children will use coordinates in the first quadrant to describe positions on a grid, using the conventional order and notation.

Small steps

- Previous step: Describing position (1)
- **This step: Describing position (2)**
- Next step: Drawing on a grid

NATIONAL CURRICULUM LINKS

Year 4 Geometry – Position and Direction

Describe positions on a 2D grid as coordinates in the first quadrant.

ASSESSING MASTERY

Children can use coordinates to describe the positions of objects on a grid. They understand the importance of being consistent in the order in which the coordinates are given (horizontal then vertical), and they recognise and use the conventional notation for coordinates.

COMMON MISCONCEPTIONS

Children may write coordinates in the wrong order. Indicate point (4,2) and ask:

- *How many squares along is this point? How many squares up? Which do you put first when writing coordinates?*

STRENGTHENING UNDERSTANDING

It may be useful for some children to think about the coordinate axes as number lines. For example, you could ask: *How far along this number line [the horizontal axis] do you need to go? And how far up this number line [the vertical axis]?*

GOING DEEPER

More confident learners can be challenged to answer questions 'without the pictures'. For example, ask them which is closer to (4,4): (9,4) or (4,0), and encourage them to explain their answer.

KEY LANGUAGE

In lesson: **coordinates**, position

Other language to be used by the teacher: parentheses, horizontal, vertical, origin, grid

STRUCTURES AND REPRESENTATIONS

coordinate grid

RESOURCES

Optional: computer geometry package

In the eTextbook of this lesson, you will find interactive links to a selection of teaching tools.

Before you teach

- Are children confident in describing relative positions on an unnumbered grid?
- Do children appreciate the usefulness of measuring positions from a common reference point?

Discover

WAYS OF WORKING Pair work

ASK

- Question 1 a): *What is different about this map compared to the maps in the last lesson?*
- Question 1 a): *What do you think the numbers in (2,2) mean?*

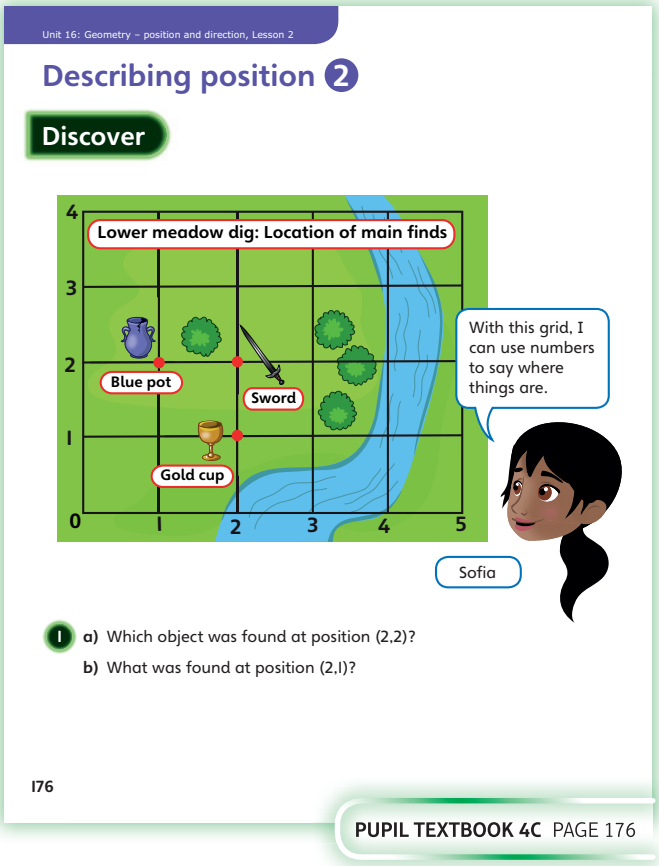
IN FOCUS This activity introduces the coordinate grid and the concept that the location of objects on the map can be given by two numbers (the horizontal and vertical coordinates). Question 1 a) has been chosen so that the order of the coordinates does not matter and question 1 b) establishes that there needs to be an agreed order for the numbers.

PRACTICAL TIPS Do not explain the order of the coordinates at this stage. The most important idea to establish is that there needs to be *some* consistent order for the coordinates – the remainder of the lesson will be used to reinforce what the conventional order is.

ANSWERS

Question 1 a): The sword was found at position (2,2).

Question 1 b): The gold cup was found at position (2,1).



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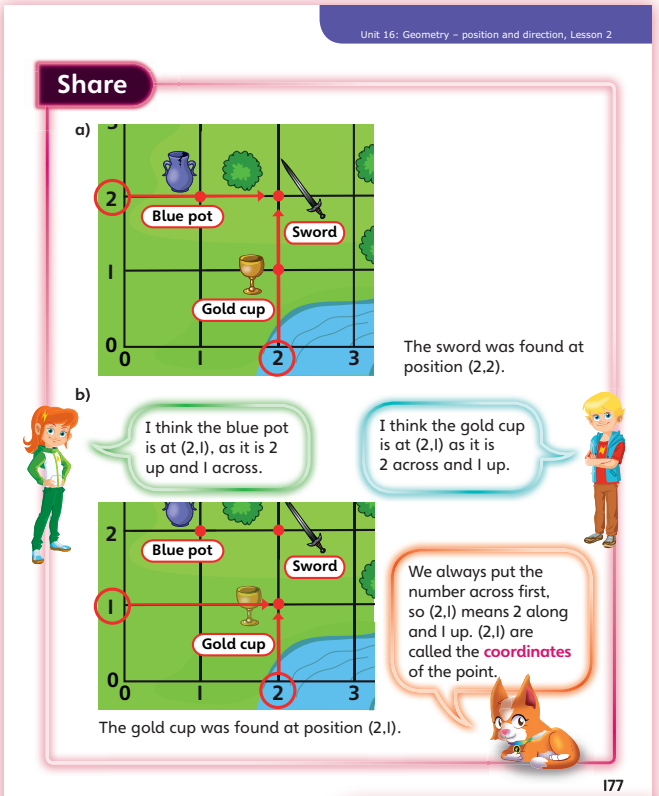
Share

WAYS OF WORKING Whole class teacher led

ASK

- Question 1 a): *What do you notice about the two numbers? Does it matter whether you go across or up first?*
- Question 1 b): *Does it matter whether you use the first number to go across or up?*
- Question 1 b): *What is at (1,2)?*

IN FOCUS This introduces children to a number of important concepts: always give the 'across' number first, followed by the 'up' number; these numbers are called coordinates; and coordinates are written as two numbers, separated by a comma and surrounded by parentheses. Also draw attention to the fact that the grid numbering starts from the bottom left corner, so that the horizontal coordinate is measured to the right, and the vertical coordinate is measured upwards.



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Think together

WAYS OF WORKING Whole class teacher led (I do, We do, You do)

ASK

- Question 1: *Can you see that some other things have been found and marked on the map?*
- Question 3: *Do you think coordinates are a good way of recording where things were found? Would it be easier to just say something like 'The silver pin was found near the trees'?*

IN FOCUS Question 3 emphasises the advantage of coordinates over word descriptions to accurately describe positions.

STRENGTHEN Reinforce children's understanding of the correct order of coordinates by asking questions such as: *Which position would be in the river: (4,1) or (1,4)?* Draw a grid on the board clearly showing going across then up.

DEEPEN Ask further questions based on the map of the dig. For example: *Imagine that another gold cup was found, one grid space from the first one: what could its coordinates be? A shield was found half-way between the spear and the red pot: what were its coordinates?*

ASSESSMENT CHECKPOINT Use question 1 to assess whether children can find locations given by coordinates. Use question 2 to check that children can give coordinates of specified locations correctly.

ANSWERS

Question 1 a): The blue pot is located at (1,2).

Question 1 b): The statue is located at (5,3).

Question 1 c): The spear is located at (2,3).

Question 2 a): The coordinates of the silver tray are (1,1).

Question 2 b) i): The red pot was found at (0,3).

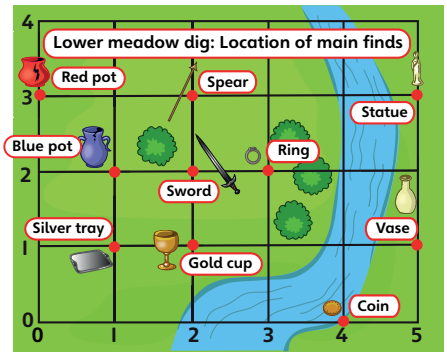
Question 2 b) ii): The coin was found at (4,0).

Question 2 b) iii): The vase was found at (5,1).

Question 3: The pin could not have been found at C (2,3).

Think together

1 Sofia marked the positions of some other objects on the map.



a) What is located at (1,2)?

b) What is located at (5,3)?

c) What is at the position with coordinates (2,3)?

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2 a) Give the coordinates of the silver tray.

b) Where were these objects found?

i) The red pot

ii) The coin

iii) The vase

3 A dog walker found an old silver pin in the middle of the trees. Which of these could **not** be the position where the pin was found?

A (2,2)

B (3,2)

C (2,3)

I need to remember to find the first coordinate along the horizontal line and the second coordinate upwards from there.

→ Practice book 4C p129

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Practice

WAYS OF WORKING Independent thinking

IN FOCUS Questions 4 and 7 require children to interpret the information given on the plan to decide where to plant. Question 5 introduces children to the origin of the grid – that is, the reference point from which all of the distances on the grid are measured. If necessary, discuss what makes this a sensible choice of origin: all measurements can be made to the right and up, and the location of any position in the diagram can be expressed by a pair of positive coordinates.

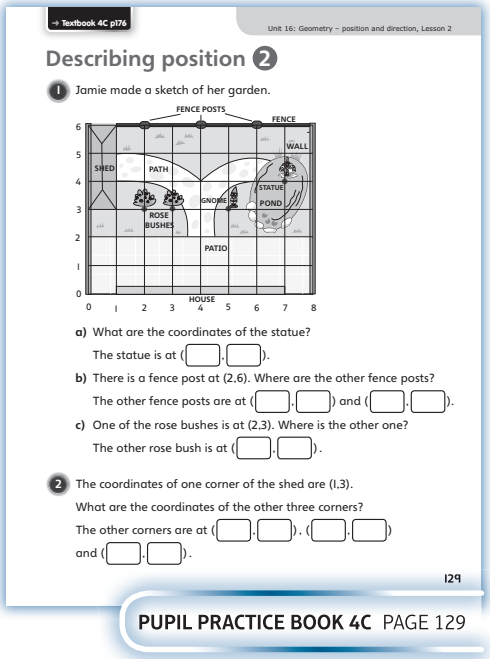
STRENGTHEN Children who are still finding it difficult to remember the correct order of coordinates may benefit from additional practice using a computer geometry package. This approach can take away some of the risk and uncertainty involved in trying to remember the order – instead, children can simply enter the coordinates and see where the computer plots a point.

DEEPEN Ask children to mark a tree on the map of Jamie's garden and then write out the coordinates of that tree. Their partner can describe the position of a new object using coordinates which they then have to plot.

THINK DIFFERENTLY Question 6 is more open-ended and allows an element of interpretation as the sides of the shed are parallel to the house, giving more than one possible answer. Children are likely to keep to integer coordinates, as used throughout this lesson. So the points furthest from the house could be (0,6) or (1,6).

ASSESSMENT CHECKPOINT Use questions 1 and 2 to assess whether children are writing coordinates correctly, giving the 'distance across' followed by 'distance up'.

ANSWERS Answers for the **Practice** part of the lesson appear in the separate **Practice and Reflect answer guide**.



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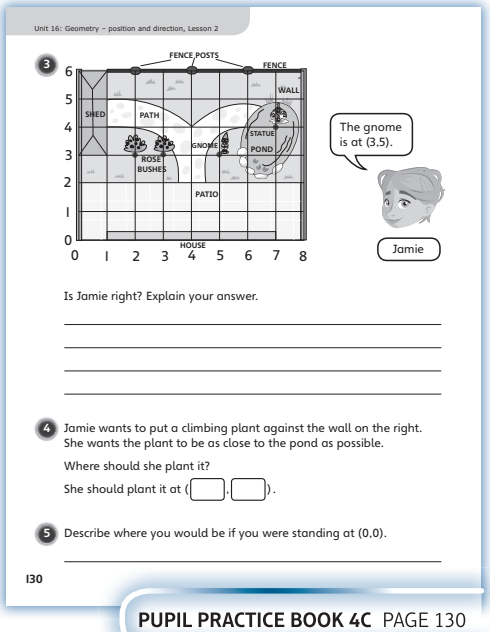

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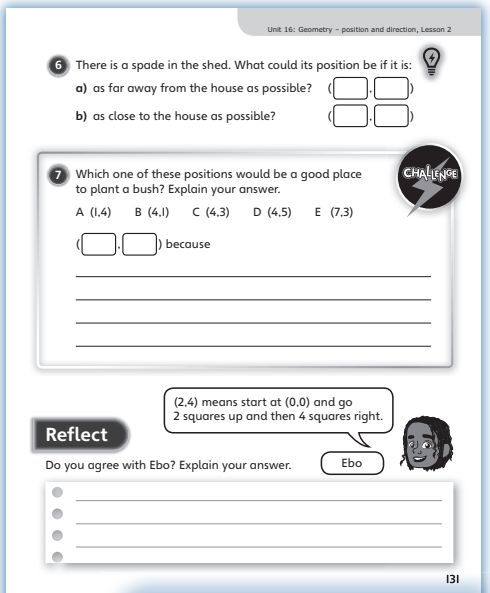
Reflect

WAYS OF WORKING Independent thinking

IN FOCUS This activity provides a final opportunity to revisit the key learning point for this lesson – the use of coordinates to specify positions in the first quadrant.

ASSESSMENT CHECKPOINT Check that children understand that the coordinates represent horizontal and vertical distances from the origin (in that order), and so the example given is incorrect.

ANSWERS Answers for the **Reflect** part of the lesson appear in the separate **Practice and Reflect answer guide**.



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After the lesson

- Are children using coordinates correctly?
- What opportunities can you provide for additional practice in plotting points?

Drawing on a grid

Learning focus

In this lesson, children will use coordinates to plot points in the first quadrant and to construct simple shapes by plotting their vertices. They will also plot points to complete shapes.

Small steps

- Previous step: Describing position (2)
- **This step: Drawing on a grid**
- Next step: Reasoning on a grid

NATIONAL CURRICULUM LINKS

Year 4 Geometry – Position and Direction

Plot specified points and draw sides to complete a given polygon.

ASSESSING MASTERY

Children can plot points in the first quadrant. They can continue simple patterns, determining and plotting the coordinates that are required, and they can draw simple geometric shapes, given a list of coordinates for the vertices.

COMMON MISCONCEPTIONS

Children may still interpret coordinates in the wrong order. Children need to know that the order matters (and that we therefore need to agree on one order or the other) and they also need to know what the conventional order is. Indicate point (4,2) and ask:

- *Does it matter whether you give the across coordinate first, or the up coordinate first? How will I know which you are giving first?*

STRENGTHENING UNDERSTANDING

All of the plotting exercises in this lesson could usefully be carried out (or repeated) using a computer geometry package. Seeing the same coordinate system used in as many different contexts as possible should help to strengthen understanding of the system. In the previous lesson, children used coordinates used on maps – this lesson introduces floor robots and more abstract grids as additional contexts in which the same rules apply.

GOING DEEPER

Challenge more confident children to research how computer games designers use coordinates to specify positions on the screen of a device.

KEY LANGUAGE

In lesson: **plot**, coordinates, **point**, vertices, horizontal, vertical, predict

Other language to be used by the teacher: rule, vertex, pattern, rectangle, square, triangle, pentagon

STRUCTURES AND REPRESENTATIONS

coordinate grid

RESOURCES

Mandatory: squared paper

Optional: computer geometry package, squared paper, ruler

In the eTextbook of this lesson, you will find interactive links to a selection of teaching tools.

Before you teach

- Do children understand the conventional order of coordinates?
- What support will you provide for children who need additional practice?

Discover

WAYS OF WORKING Pair work

ASK

- Question 1 a): *The robot is plotting a new point. How many points has it plotted before this one?*
- Question 1 a): *How do the numbers on the grid help you to see where the points will be plotted?*

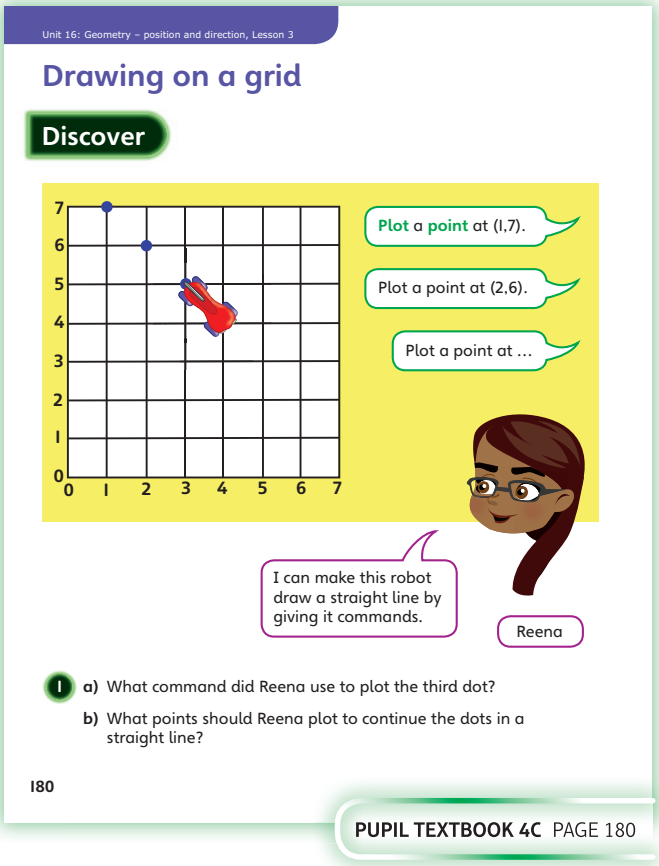
IN FOCUS This activity provides further experience with coordinates, in a new context. The use of a 'robot' moves the emphasis from 'remembering what the correct order of coordinates is' to 'using the available clues to work out what the robot is doing'. Check that children understand the idea of 'plot a point' – it may be necessary to explain that this is simply the way that the robot is told where to draw the little circles on the grid.

PRACTICAL TIPS If available, use a simple computer geometry package to demonstrate plotting different points.

ANSWERS

Question 1 a): The command Reena used to plot the third dot is: Plot a point at (3,5).

Question 1 b): Reena should plot the points (4,4), (5,3), (6,2), and (7,1) to continue the dots in a straight line.



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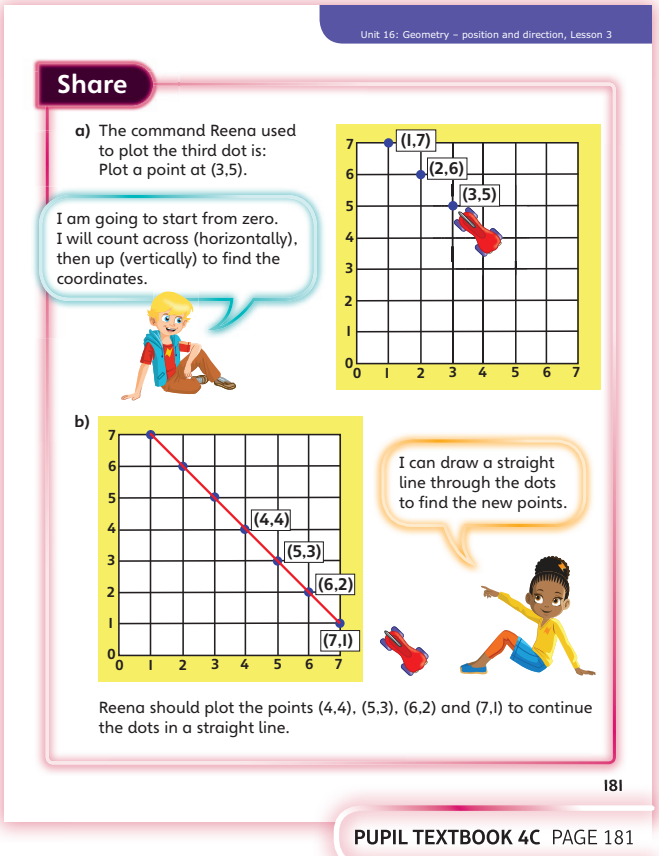
Share

WAYS OF WORKING Whole class teacher led

ASK

- Question 1 a): *Why did Dexter choose to count from zero? Why does he count across and then up? Do you know the meaning of 'horizontal' and 'vertical'?*
- Question 1 b): *How does Flo find where the next points are? Could you find them without drawing the line?*
- Question 1 b): *If you say the numbers in the wrong order, where will the robot will plot the points?*

IN FOCUS Remind children of the terms 'horizontal' and 'vertical' from their work in Unit 14 with graph axes. Make reference to the similarities to grids here and the order in which coordinates are written and carried out.



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Think together

WAYS OF WORKING Whole class teacher led (I do, We do, You do)

ASK

- Question 1: *How many squares do you need to go across for the point (0,2)? How will you plot that?*
- Question 2: *Can you see a pattern in the coordinates? Can you predict the next point without drawing the line?*

IN FOCUS Question 1 provides an opportunity to focus on the role of 0 on the axes. Children need to plot a point on the vertical axis and so the grid needs to have a properly labelled origin.

STRENGTHEN Children may need extra support when reading coordinates with 0, remind them that the bottom left corner is at (0, 0). Ask them to give the coordinates of the top left corner and the bottom right corner.

DEEPEN Extend question 3 by giving children the coordinate (10,10) and ask them to predict what the coordinates of the points would be if they were to draw a straight diagonal line towards (0,0).

ASSESSMENT CHECKPOINT Use question 1 to assess whether children can plot given points. Use question 2 to assess whether they can work out the coordinates of points to complete shapes or continue lines. Use question 3 to assess whether children know how to work out coordinates between whole-number values.

ANSWERS

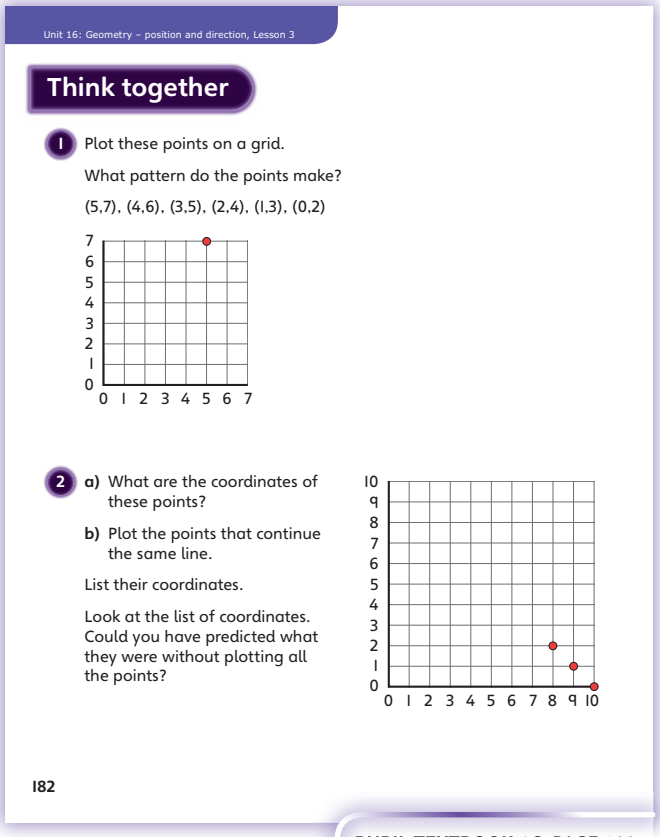
Question 1: The points lie on a straight diagonal line from (0,2) to (5,7).

Question 2 a): (10,0), (9,1) and (8,2)

Question 2 b): (7,3), (6,4), (5,5), (4,6), (3,7), (2,8), (1,9), (0,10)

Question 3: Plot (3,3). Plot (1,3). Plot (1,2·5). Plot (2,2·5). Plot (2,1·5). Plot (1,1·5). Plot (1,1). Plot (3,1). Plot (3,0). Plot (0,0).

(The decimals can be written as fractions – for example, $2\frac{1}{2}$ instead of 2·5, and so on.)



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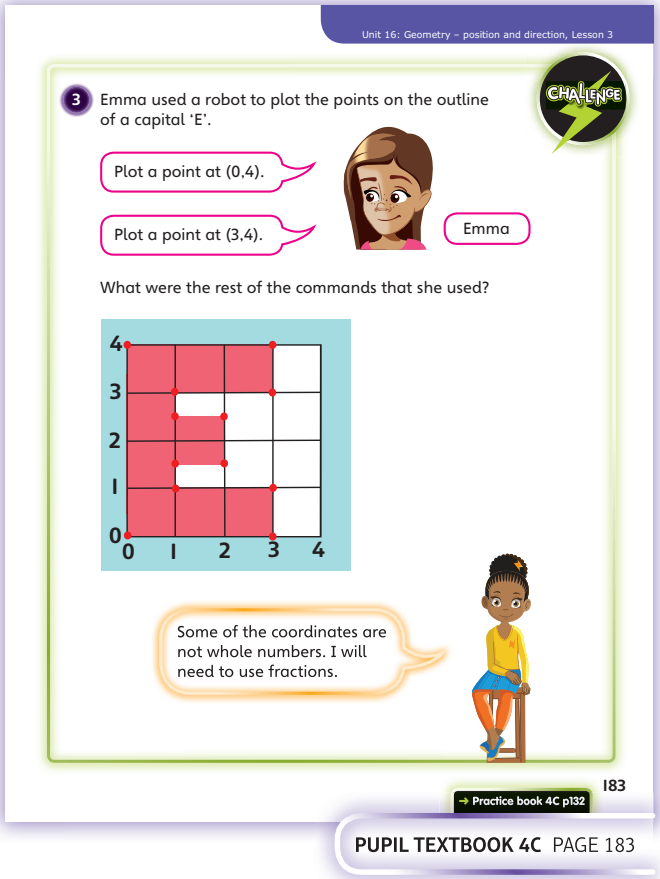

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Practice

WAYS OF WORKING Independent thinking

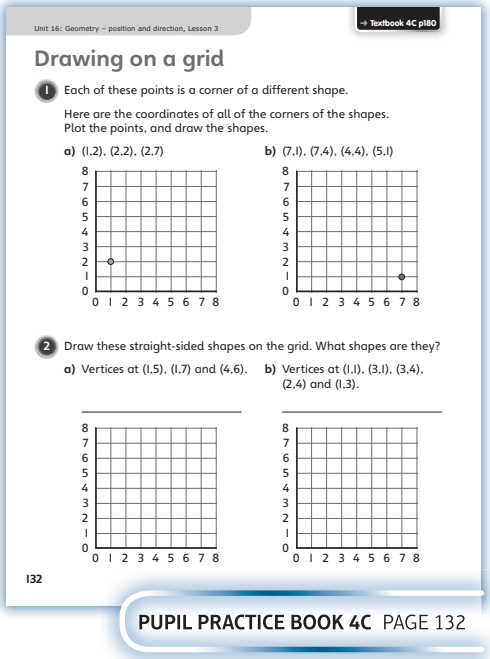
IN FOCUS Question 2 links this lesson's work on coordinates with children's existing knowledge of shapes, as well as providing further practice in plotting coordinates. Make sure that children understand the term 'vertices', as well as 'triangle', 'rectangle' and 'pentagon'.

STRENGTHEN Question 1 provides an opportunity to reinforce children's understanding of the coordinate system. All of the required points could fit on the grid, even if plotted in the wrong order. Where children find this difficult, refer back to the examples used earlier in the lesson.

DEEPEN Encourage more confident children to think more deeply about the properties of shapes and their relationships to coordinates. For example, you could use question 3 to ask: *Do three points always make a triangle, and five points a pentagon, and so on?* The answer is no – where three consecutive points are in a straight line, the 'middle' one would not be a vertex of a polygon.

ASSESSMENT CHECKPOINT Use questions 1 and 2 to assess whether children can plot given points. Use question 3 to check children's familiarity with the conventional order of coordinates. Children who understand that the first coordinate is measured horizontally should be able to spot that line 1 will be horizontal, because the distance 'across' changes but the distance 'up' is constant. Similarly, line 2 must be vertical because the points are all the same distance 'across' the grid.

ANSWERS Answers for the **Practice** part of the lesson appear in the separate **Practice and Reflect answer guide**.



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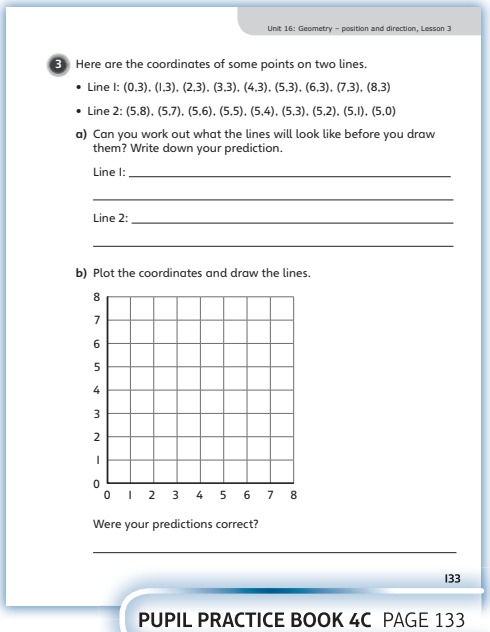

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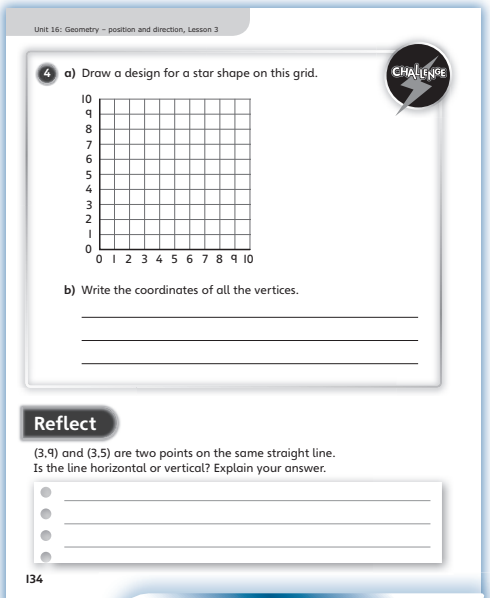
Reflect

WAYS OF WORKING Independent thinking

IN FOCUS This question provides a simple check on the main learning from this lesson, ensuring once again that children are using the order of coordinates properly, and that they can visualise vertical and horizontal straight lines, given a sequence of coordinates.

ASSESSMENT CHECKPOINT Assess whether children can explain why the line is vertical. Explanations should include the idea that both points are three units across from (0,0), but at different heights.

ANSWERS Answers for the **Reflect** part of the lesson appear in the separate **Practice and Reflect answer guide**.



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After the lesson

- Children should now be familiar with the idea that coordinates can be used to draw a variety of shapes, as well as plotting simple points. Can you provide examples of how this is used – for example, in computer graphics?

Reasoning on a grid

Learning focus

In this lesson, children will use the properties of shapes and points to help them make constructions on the coordinate grid.

Small steps

- Previous step: Drawing on a grid
- **This step: Reasoning on a grid**
- Next step: Moving on a grid

NATIONAL CURRICULUM LINKS

Year 4 Geometry – Position and Direction

Describe positions on a 2D grid as coordinates in the first quadrant.

ASSESSING MASTERY

Children can use simple properties of shapes to plot missing points and complete geometrical diagrams.

COMMON MISCONCEPTIONS

Children may need support to link their developing understanding of coordinates with their existing knowledge of the properties of shapes. Ask:

- *What do you know about the sides of a square? How can you use that to work out where the next vertex will be plotted?*

STRENGTHENING UNDERSTANDING

Use a computer geometry package to provide additional practice with the material covered in this lesson and to check solutions to the exercises. Also note that some of the exercises contain incomplete information, and some assumptions will be needed, for example assuming that some angles on sketched shapes are intended to be right angles. If this step proves difficult, ask questions such as: *Where do you think this line is supposed to go – will it be straight up, or at an angle?*

GOING DEEPER

Ask children to explore more complex problems, perhaps using a computer geometry package. For example, they could try to identify the remaining two vertices of squares where (5,4) and (9,4) are opposite vertices; or where (3,5) and (9,6) are adjacent vertices.

KEY LANGUAGE

In lesson: grid, coordinates, symmetry, vertices, vertex, line, square, rectangle, horizontal, vertical, plotted

STRUCTURES AND REPRESENTATIONS

coordinate grid

RESOURCES

Optional: computer geometry package, squared paper, chalk, tape

In the eTextbook of this lesson, you will find interactive links to a selection of teaching tools.

Before you teach

- Are children confident in working with properties of simple shapes – for example, finding the area of a square, or understanding that the opposite sides of a rectangle have equal lengths?

Discover

WAYS OF WORKING Pair work

ASK

- Question 1 a): *Where did the robot start drawing?*
- Question 1 a): *How many lines will it have to draw in total? How long will they be?*

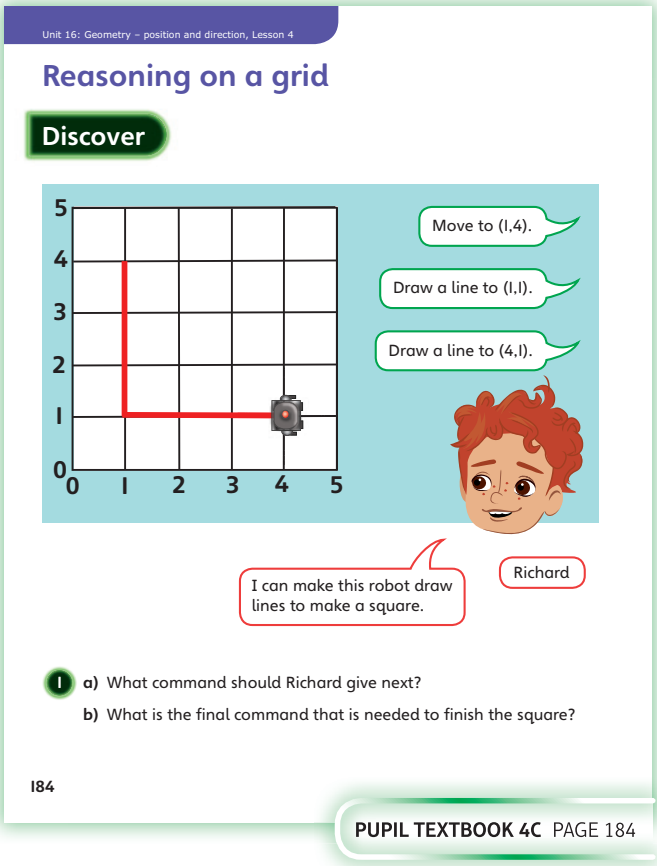
IN FOCUS This exercise provides a simple example of using geometrical knowledge (the fact that the sides of a square are of equal length) to complete a construction using coordinates. The robot is again used here to take the focus away from trying to remember the correct order of coordinates – instead, children can simply look at the robot and see how it responded to the commands that were already given. This means that it may not be necessary to remind children how the coordinate system works – children who are still unsure of the order of the coordinates should be encouraged to use the information in the question to check.

PRACTICAL TIPS Create a simple grid on the floor (using tape) or outside in the playground (using chalk). Children can alternate being the 'robot'. Ask children to plot specific coordinates so together they create different shapes.

ANSWERS

Question 1 a): The next command Richard should give is: Draw a line to (4,4).

Question 1 b): The final command that is needed to finish the square is: Draw a line to (1,4).



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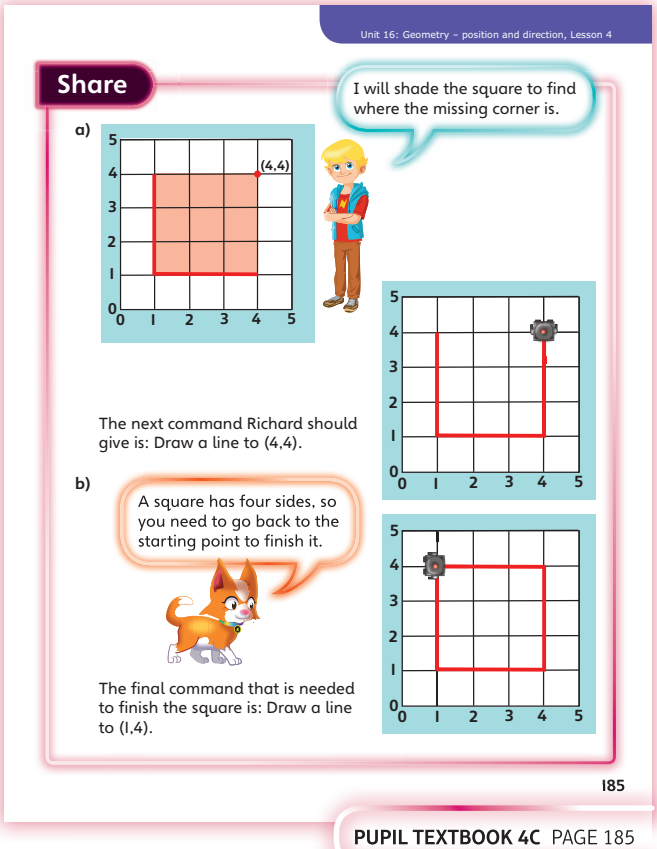
Share

WAYS OF WORKING Whole class teacher led

ASK

- Question 1 a): *How has Dexter worked out where the square will be?*
- Question 1 b): *It took five commands to draw the square – but a square has only got four sides! Why is there an extra command?*

IN FOCUS Ensure children understand that the idea of shading the square is simply to help locate the final corner. In this question, children need to focus on the lengths and directions of lines rather than the area of the square.



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Think together

WAYS OF WORKING Whole class teacher led

ASK

- Question 1: *There are no angles marked on the diagram. What should the angles be? Have you got enough information to draw the shape accurately?*
- Question 2: *What shape are you trying to draw? What do you know about the sides of that shape?*

IN FOCUS Question 2 is a 2-step problem: children need to work out the length of the side of the square from the given points and then use this knowledge to work out the other two coordinates. Question 3 has a number of possible answers, depending on whether the given points are taken as adjacent or opposite corners of the square.

STRENGTHEN Children who need additional practice could use a computer geometry package to reproduce the diagram from question 1.

DEEPEN Encourage children to look for patterns in the coordinates for the original and reflected shapes in question 4. They should notice that the horizontal coordinates do not change and they should be able to relate this to the fact that the reflected points move directly downwards.

ASSESSMENT CHECKPOINT Use questions 1, 2 and 3 to assess whether children can use their knowledge of the properties of squares and rectangles to find missing coordinates. Use question 4 to assess whether they can apply reflecting a shape in a mirror line to a coordinate grid.

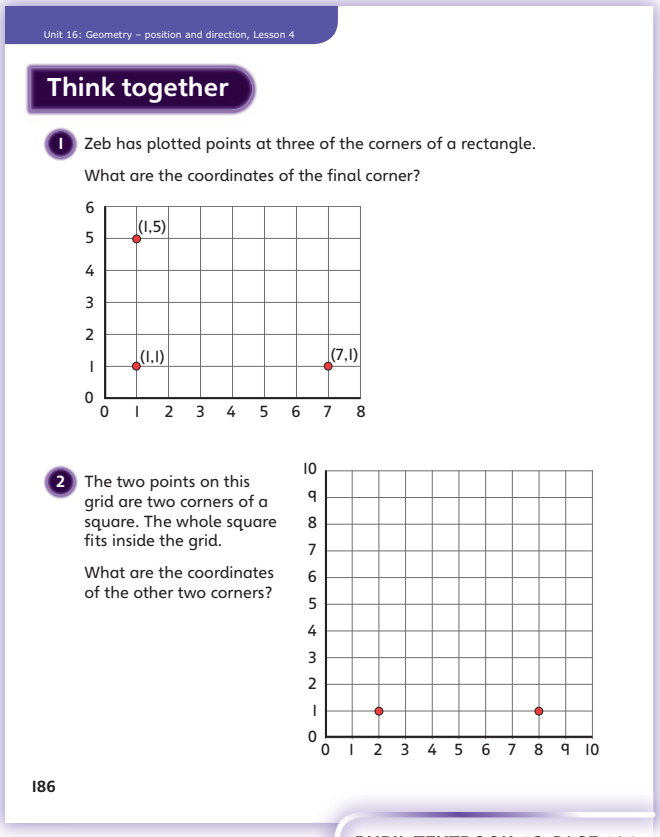
ANSWERS

Question 1: The coordinates of the final corner are (7,5).

Question 2: The other two corners are at (2,7) and (8,7).

Question 3: If the two marked points are taken as adjacent vertices of the square, then the remaining vertices are at (4,1) and (8,1), or at (4,9) and (8,9). If the marked corners are taken as opposite vertices of the square, the remaining vertices are at (6,3) and (6,7).

Question 4: The coordinates required to complete the shape are: (1,2), (2,1), (5,2), and (6,1).



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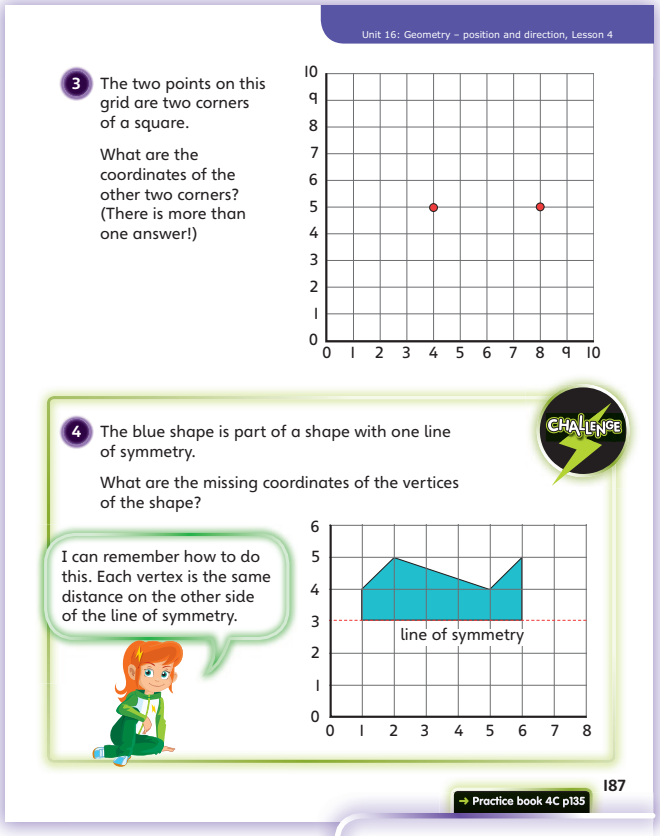

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Practice

WAYS OF WORKING Independent thinking

IN FOCUS Question 2 provides a further opportunity to combine the properties of shapes with the context of drawing on a coordinate grid. Use opportunities like this to explain that, although mathematics is taught as a series of separate topics, in reality there are many links and connections. Focusing on mathematical connections is a good means of changing the emphasis of learning – away from memorising, and towards understanding.

Question 4 requires some deeper thinking. Children will need to consider the possible orientations of the rectangle in part b). Since these are not specified in the question, the width could be taken as 5 units and the height as 7, or vice versa.

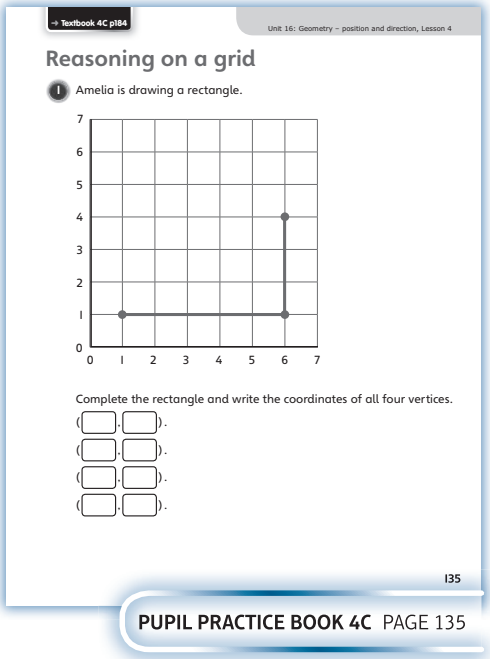
STRENGTHEN Ask children to visualise what the completed rectangle in question 1 will look like. If children find it difficult to picture the completed shape, cut out a small piece of paper that will fit in the required space.

DEEPEN Give children practice questions in which they are given, for example, three vertices of a parallelogram and need to find the fourth vertex. Ask them to explain how they found the fourth vertex.

THINK DIFFERENTLY Question 3 is a more open-ended task – there are four different possible orientations for the rectangle, depending on which of the vertices is taken to be at (4,4). Note that the question indicates the orientation of the rectangle; without this there would be further solutions.

ASSESSMENT CHECKPOINT Use question 2 to assess whether children can work accurately with coordinates and that they can make effective use of their understanding of the properties of shapes.

ANSWERS Answers for the **Practice** part of the lesson appear in the separate **Practice and Reflect answer guide**.



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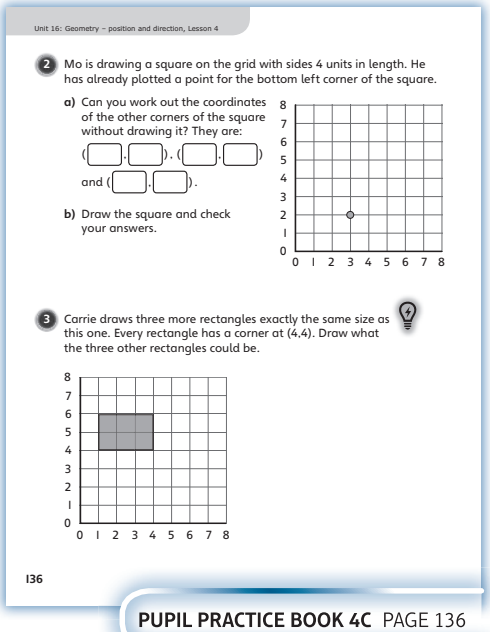


PUPIL PRACTICE BOOK 4C PAGE 136

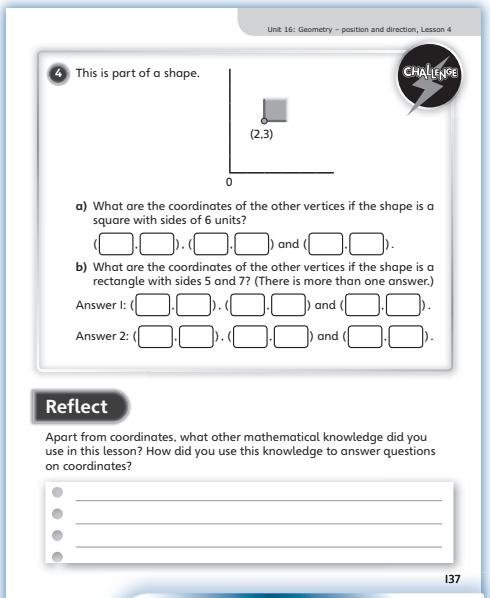
Reflect

WAYS OF WORKING Independent thinking

IN FOCUS This activity asks children to think about the other mathematical ideas that were needed in this lesson and is a further opportunity to establish connections between topics.

ASSESSMENT CHECKPOINT Check that children appreciate that many of the geometrical ideas that they already know (such as symmetry and reflection, and the side and angle properties of squares and rectangles) can be usefully applied on a coordinate grid.

ANSWERS Answers for the **Reflect** part of the lesson appear in the separate **Practice and Reflect answer guide**.



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After the lesson

- Are children readily making connections between mathematical ideas?
- What further opportunities can you provide for making this kind of connection?

Moving on a grid

Learning focus

In this lesson, children will carry out simple translations on a coordinate grid, following instructions given in the form 'left/right and up/down'.

Small steps

- Previous step: Reasoning on a grid
- **This step: Moving on a grid**
- Next step: Describing a movement on a grid

NATIONAL CURRICULUM LINKS

Year 4 Geometry – Position and Direction

Describe movements between positions as translations of a given unit to the left/right and up/down.

ASSESSING MASTERY

Children can carry out simple translations – they can explain the effect of moving an arbitrary distance to the left/right and up/down. (The terminology of translations will be fully introduced in Year 5.) They can find the coordinates of a destination point, given the coordinates of the starting point and the translation. They know the conventional order in which translations will be given (horizontal movement, vertical movement). They can combine a succession of translations to produce a 'journey' with multiple stages.

COMMON MISCONCEPTIONS

Children may confuse the horizontal and vertical components of a translation with the corresponding coordinates of a point: for example, they may confuse 'move 2 right and 3 up' with (2,3). Ask:

- *What is your starting point? How many squares are you moving to the right/left/up/down? What is your end point?*

Some children count grid lines instead of squares, incorrectly starting the count at 1 at the starting point rather than counting 1 at a distance of one unit from the starting point. Ask:

- *What is your starting point? What is 1 right/up from your starting point? How do you know?*

STRENGTHENING UNDERSTANDING

To strengthen understanding of translations, children could use a computer geometry package to give instructions to move right/left and up/down. Alternatively, use a grid on the ground and ask children to carry out the translation by moving on the grid.

GOING DEEPER

Encourage more confident children to see a translation as a single (diagonal) movement from the starting point to the end point. Ask why it is convenient to describe each journey using two components (horizontal and vertical), even though it might make more sense to carry out the journey as a single (diagonal) movement.

KEY LANGUAGE

In lesson: across, right, left, up, down

Other language to be used by the teacher: horizontal, vertical, coordinates

STRUCTURES AND REPRESENTATIONS

coordinate grid

RESOURCES

Optional: computer geometry package

In the eTextbook of this lesson, you will find interactive links to a selection of teaching tools.

Before you teach

- Are children confident in using coordinates?
- Do you have a suitable space inside or outside the classroom where you could model translations using spoken instructions to move a child to a destination?

Discover

WAYS OF WORKING Pair work

ASK

- Question 1 a): *Can you see where the position of the drone is marked on the screen?*
- Question 1 a): *What are the coordinates of the drone? How does Sofia want it to move?*

IN FOCUS This activity provides a simple practical context in which the importance of being able to give instructions for movements should be clear. Notice that although this has returned to the context of a map, there is no scale given and the drone would need to be using the same set of coordinates as Sofia.

PRACTICAL TIPS You could use a practical activity to introduce the idea of translations: ask a child to move around the classroom (or other suitable space) following simple instructions such as 'Move 2 paces left, then 3 paces back'. This kind of activity helps to reinforce the idea that the points on the grid never move: the point (4,2) is always 4 across and 2 up from the origin, although a drone originally at that position can move to a new one.

ANSWERS

Question 1 a): Sofia wants to look at the jetty.

Question 1 b): Sofia sent the drone to the castle.

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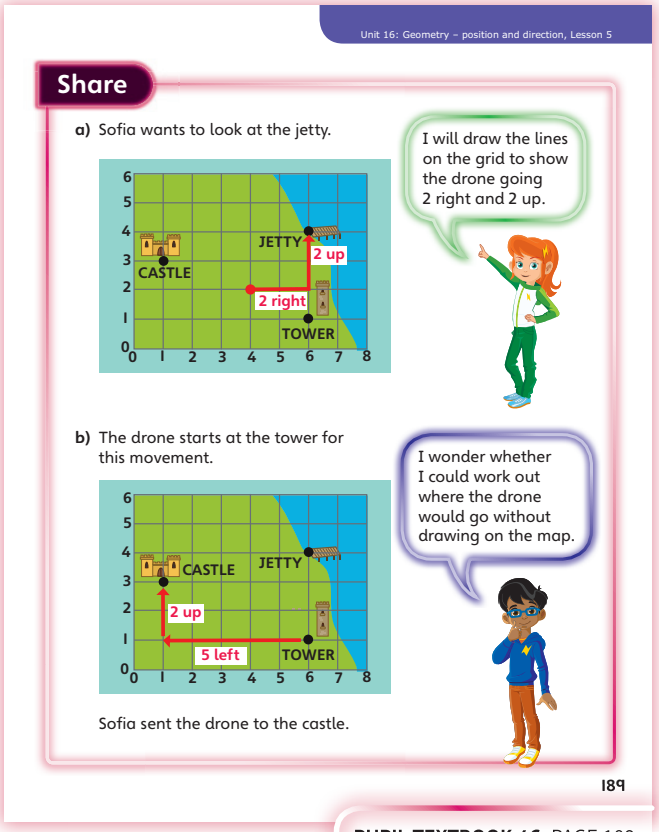
Share

WAYS OF WORKING Whole class teacher led

ASK

- Question 1 a): *How did Astrid mark the starting point for the drone?*
- Question 1 b): *Can you see how you could work out where the drone went without drawing?*

IN FOCUS Working out the final position of the drone without drawing is an important step. State that in 1 b), the drone is at (6,1), and moves 5 left. Ask which number will change, the 6 or the 1. Ask children to explain how they know.



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Think together

WAYS OF WORKING Whole class teacher led (I do, We do, You do)

ASK

- Question 1: *This drone is going to do all of these journeys, one after the other. What is the first place it will go to? Where will it go after that?*

IN FOCUS Question 2 can be tackled in a variety of ways. You could suggest trial and error – for each translation, try each of P, Q, and R as potential starting points until they find one that works. A better approach is to think about what each of the translations means; for example, if (3 right, 1 up) finishes on one of the marked locations it cannot start at R (which is already the rightmost point), and it cannot start at Q (which is already further 'up' than the other two points).

STRENGTHEN Provide further practice by asking other questions based on the diagram in question 1. For example, ask: *I am at A and I go 6 right and 1 down. Where do I finish?*

DEEPEN In question 2, ask children if they can see a link between, for example, the journey from P to Q and the journey from Q to P. Ask them to investigate whether this pattern is the same for the other journeys and to explain their findings.

ASSESSMENT CHECKPOINT Use questions 1 and 2 to assess whether children can carry out simple translations. Check that they understand translations with a single component, such as '4 down' in question 1, and that this could be written as '0 right, 4 down'.

ANSWERS

Question 1: B, D, C, E, A

Question 2 a): Q to P

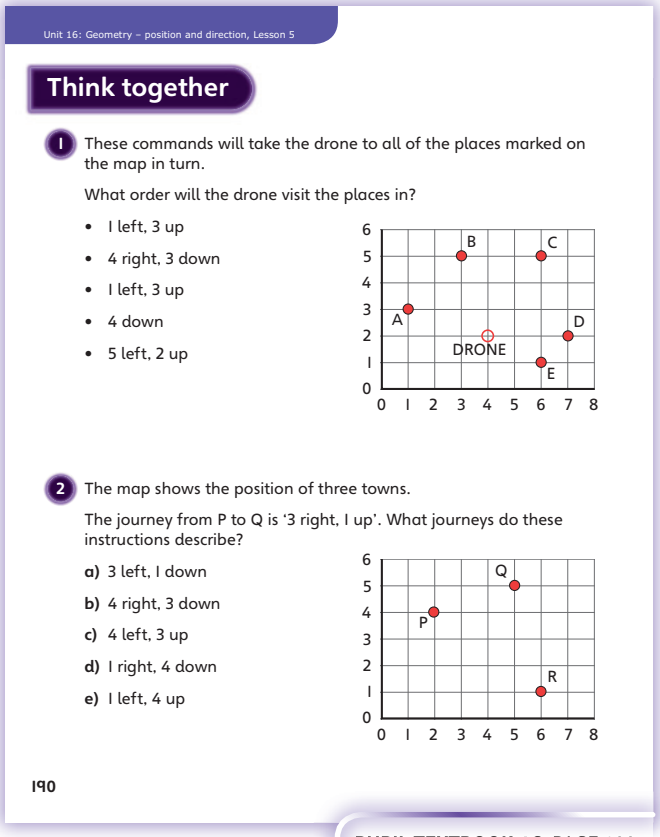
Question 2 b): P to R

Question 2 c): R to P

Question 2 d): Q to R

Question 2 e): R to Q

Question 3: B moves to (7,7), C to (11,7), and D to (11,4).



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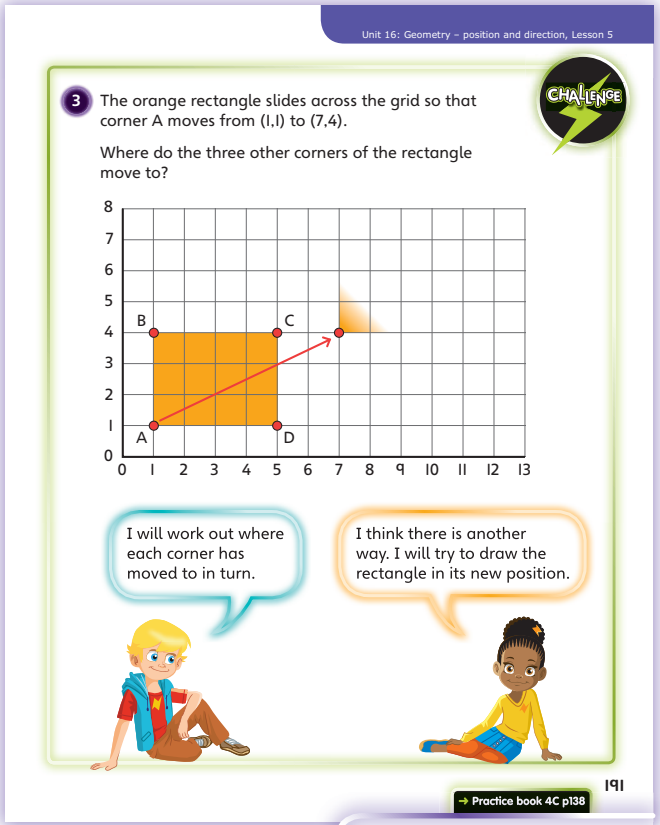

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Practice

WAYS OF WORKING Independent thinking

IN FOCUS Question 1 provides further practice at working out the effects of translations on the coordinate grid. Make sure that children understand that these movements all start from the marked position of the boat – they are not intended to be carried out in succession.

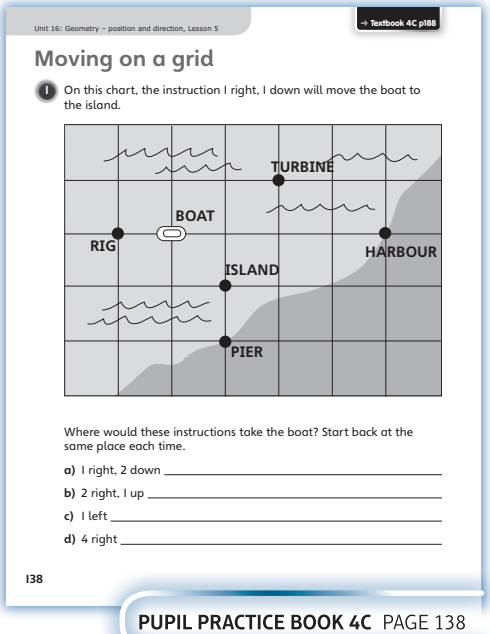
STRENGTHEN Use question 2 to check that children can follow a series of instructions to move to a succession of points on the coordinate grid. To give children additional practice, ask further questions based on this diagram, for example: *I am at (3,7), and I move 6 right and 3 down. Where am I now?*

DEEPEN Ask children questions similar to question 5, where the required translation will move the shape off the grid provided, for example move 10 right and 8 up. Children will need to use reasoning to work out the coordinates of the translated shape.

THINK DIFFERENTLY Question 4 requires children to use reasoning without the support of a grid showing the translation. In question 4 b) they need to 'think backwards' – they are given the end point and a displacement, and have to work out the start point.

ASSESSMENT CHECKPOINT Use questions 1 and 3 to assess whether children can carry out simple translations. Use question 2 to check whether they can follow a series of translations around the coordinate grid.

ANSWERS Answers for the **Practice** part of the lesson appear in the separate **Practice and Reflect answer guide**.



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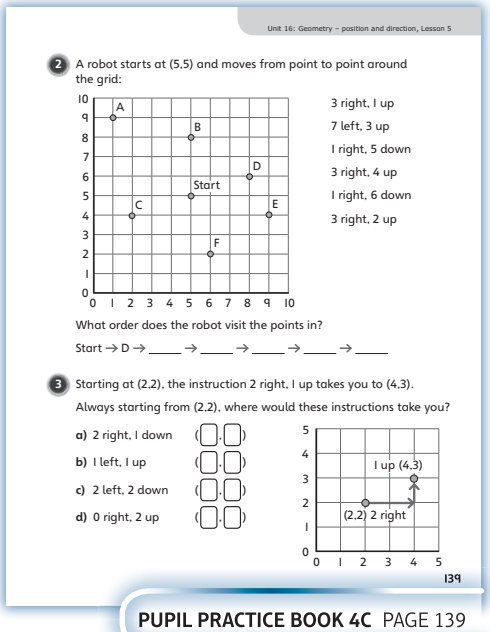


PUPIL PRACTICE BOOK 4C PAGE 139

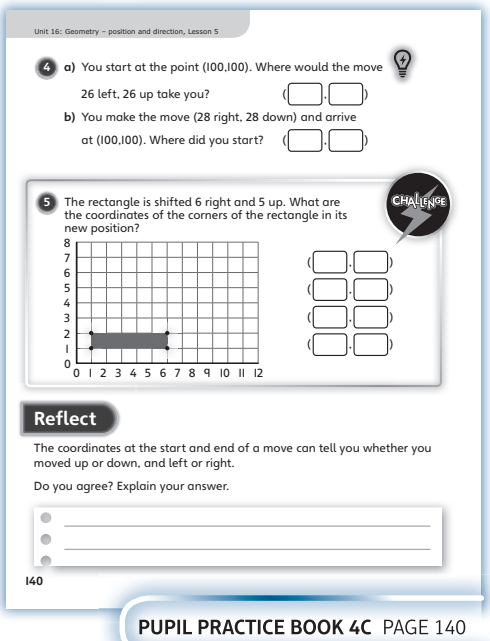
Reflect

WAYS OF WORKING Independent thinking

IN FOCUS This question provides an opportunity to reflect on the effect of a translation on the coordinates of a point.

ASSESSMENT CHECKPOINT Check that children understand that the first coordinate will increase after a translation to the right and decrease after a translation to the left; and that the second coordinate will increase after a translation upwards and decrease after a translation downwards.

ANSWERS Answers for the **Reflect** part of the lesson appear in the separate **Practice and Reflect answer guide**.



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After the lesson

- Are children able to determine the coordinates of the image of a point following a translation?

Describing a movement on a grid

Learning focus

In this lesson, children will work out the translations (expressed in the form 'right/left, up/down') that are needed to move from one position on the coordinate grid to another.

Small steps

- Previous step: Moving on a grid
- **This step: Describing a movement on a grid**

NATIONAL CURRICULUM LINKS

Year 4 Geometry – Position and Direction

Describe movements between positions as translations of a given unit to the left/right and up/down.

ASSESSING MASTERY

Children can state the translation that is required to move between any two points on a coordinate grid, giving their answer in the form '3 left, 2 up'. They can apply their understanding to a range of grid systems (including maps, scale diagrams and abstract coordinate grids).

COMMON MISCONCEPTIONS

Children may not immediately see that the type of translation that they have already met can be used in a range of practical situations. Ask:

- *Does this look like something you have done before? What does this remind you of? What do you think you could try?*

STRENGTHENING UNDERSTANDING

Make sure that children understand the change in emphasis here; in the previous lesson, they were working out the effect of a given translation, while in this lesson they find the translation that is needed to produce a certain movement. You may find it helpful to 'personalise' some of the questions in order to prompt children to think about the translations as an active and dynamic process of moving from one point to another: *If you were at this point A, and you wanted to move to this point B, what move would you need to make?*

GOING DEEPER

Challenge more confident children to investigate games where movements can be described using translations, for example chess, draughts or peg/Chinese solitaire. Ask them to find examples of cities laid out on a grid system, where translations might be a sensible way of describing journeys.

KEY LANGUAGE

In lesson: grid, move, journey, left, right, up, down

Other language to be used by the teacher: horizontal, vertical

STRUCTURES AND REPRESENTATIONS

coordinate grid

RESOURCES

Optional: computer geometry package, chess board

In the eTextbook of this lesson, you will find interactive links to a selection of teaching tools.

Before you teach

- Are children able to use coordinates to describe positions on a coordinate grid?
- Can they describe movements on the grid using translations (in words)?

Discover

WAYS OF WORKING Pair work

ASK

- Question 1 a): *Have you ever seen a city with a grid of streets like this? Why would you design a city like this?*
- Question 1 a): *Luis is standing at the crossroads of Second Street and First Avenue. Where are the other children?*

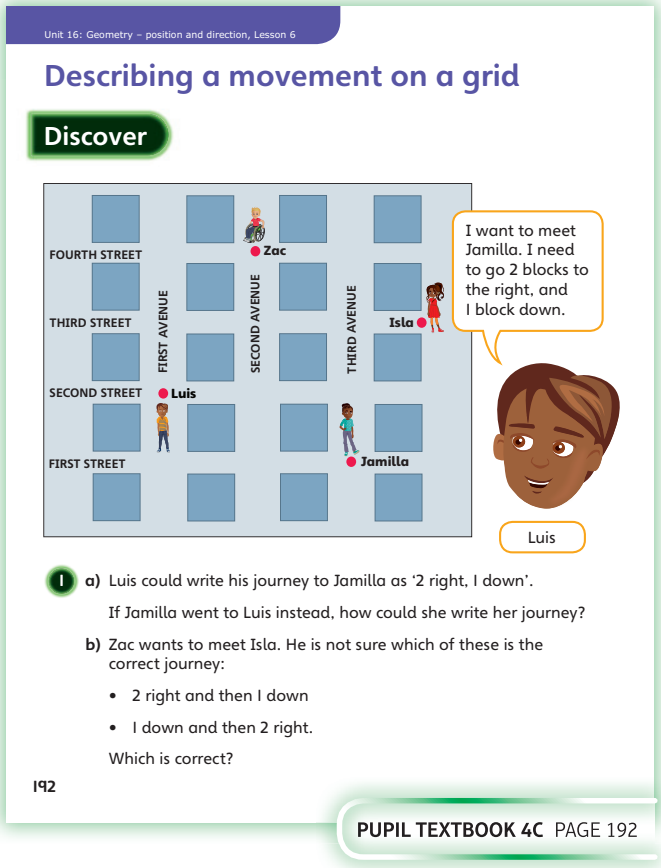
IN FOCUS This question provides another example of a situation where a grid system might be used and where it would be important to be able to describe movements in a consistent way.

PRACTICAL TIPS It may be necessary to acknowledge that the system of crossroads used here will only provide approximate locations. For example, Sam's position at the crossroads of Second Street and First Avenue does not mean that he is standing in the middle of either of those thoroughfares. Despite this lack of complete precision, the grid system is useful and will enable the convenient location of places or (as in this example) people.

ANSWERS

Question 1 a): Jamilla could write her journey to Luis as '2 left, 1 up'.

Question 1 b): The journeys are the same so both are correct.



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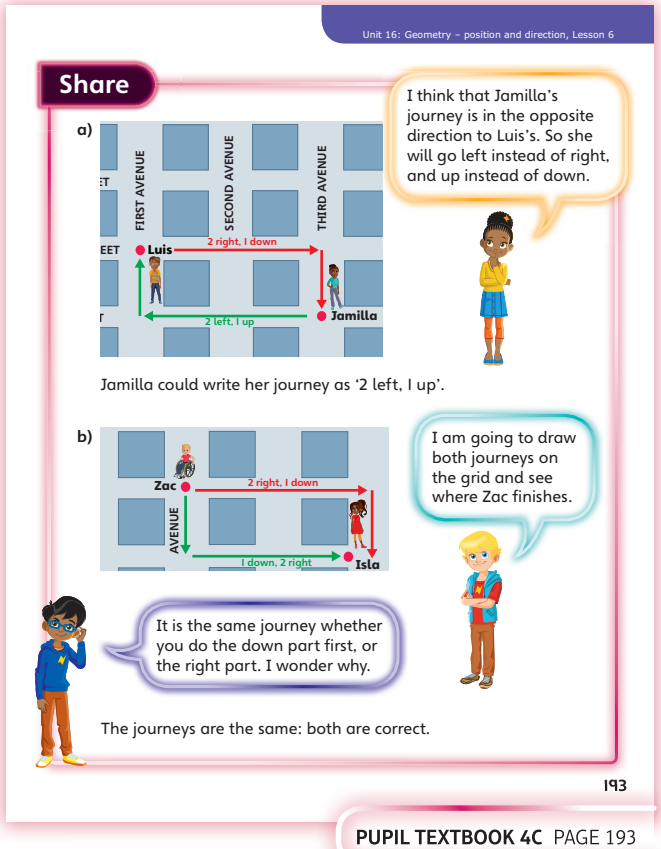
Share

WAYS OF WORKING Whole class teacher led

ASK

- Question 1 a): *Why does Flo say that Jamilla's journey is the opposite of Luis's?*
- Question 1 b): *Can you explain why the two journeys are the same?*

IN FOCUS This activity encourages children to look at the journeys as translations – that is, a movement of a particular distance in a particular direction, rather than between two specific points.



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Think together

WAYS OF WORKING Whole class teacher led (I do, We do, You do)

ASK

- Question 1 c): *How many squares up or down does Luis go? How can you describe this?*
- Question 3: *Where does this corner of the rectangle move to? Do all the corners move by the same amount?*

IN FOCUS Question 1 starts with translations that have both horizontal and vertical components, as in the **Share** activity. However, questions 1 c) and 1 d) are examples where one of the components is zero. Discuss whether children need to write 0 up/right, or whether they can omit this component. It is possible to leave the 'missing' component out completely (so, for example, a translation of 5 units right could simply be written as '5 right'), or include it with a zero value (for example, '5 right, 0 up'). Although the second option is slightly longer, it is more consistent and makes it clear than the missing component has not just been forgotten. In question 2, opposite journeys have been arranged side by side to encourage children to spot the pattern. Tell children to lay the answers out like this in their exercise books when answering the question.

STRENGTHEN Use question 2 to reinforce the idea that a translation should be described in the order **distance across**, **distance up** (or down). If children write the components in the 'wrong' order the translation will of course still work – '2 up then 1 right' is equivalent to '1 right then 2 up'. However, it is sensible to be consistent and give the components in the same order as is used with coordinates; this will reinforce the idea of 'horizontal first'.

DEEPEN Challenge children to generalise the process for finding the 'opposite' of a journey (i.e. finding the translation B to A, given the translation A to B).

ASSESSMENT CHECKPOINT Use questions 1 and 2 to assess whether children can find the horizontal and vertical components of any translation on a grid. Check that children know what to do if one component is zero.

ANSWERS

Question 1 a): Zac's journey is 1 right, 2 down.

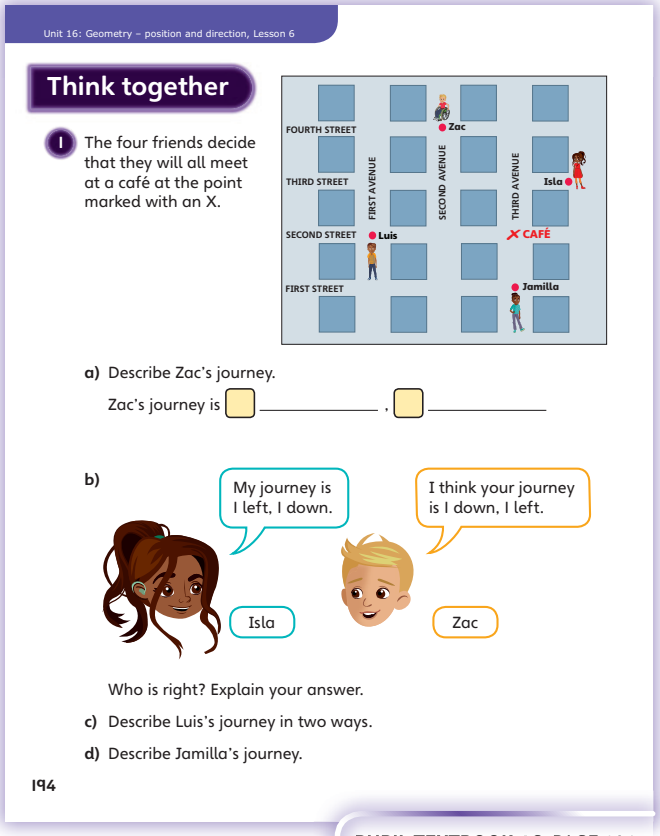
Question 1 b): Both Isla and Zac are right, although Isla's description is the order that will be used in more advanced work.

Question 1 c): Luis's journey is 2 right and 0 down or 0 up and 2 right.

Question 1 d): Jamilla's journey is 1 up.

Question 2: B to A: 5 right, 2 down
A to C: 3 left, 3 down
B to C: 2 right, 5 down
C to A: 3 right, 3 up
C to B: 2 left, 5 up

Question 3: The journeys are:
a): 2 right, 3 up
b): 4 right
c): 1 left, 2 down



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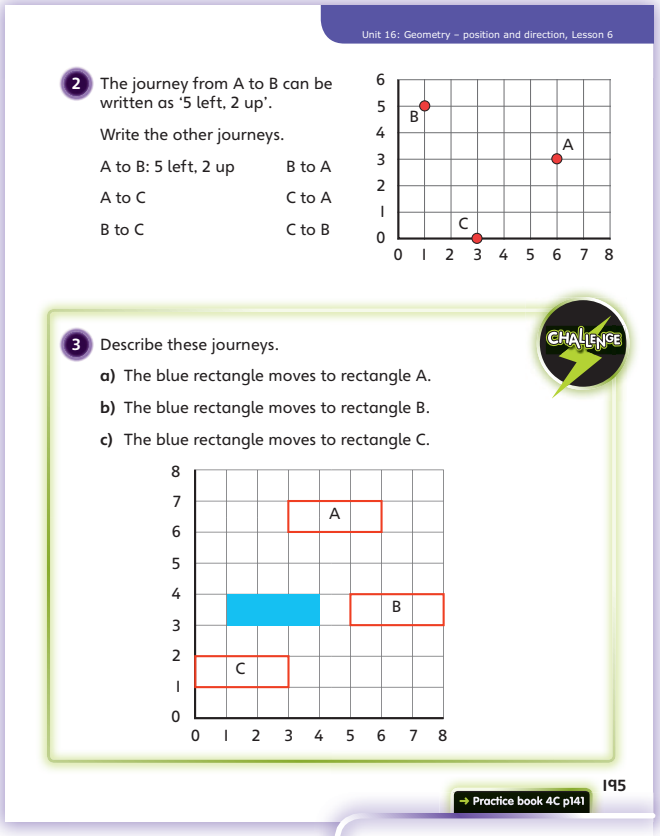

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Practice

WAYS OF WORKING Independent thinking

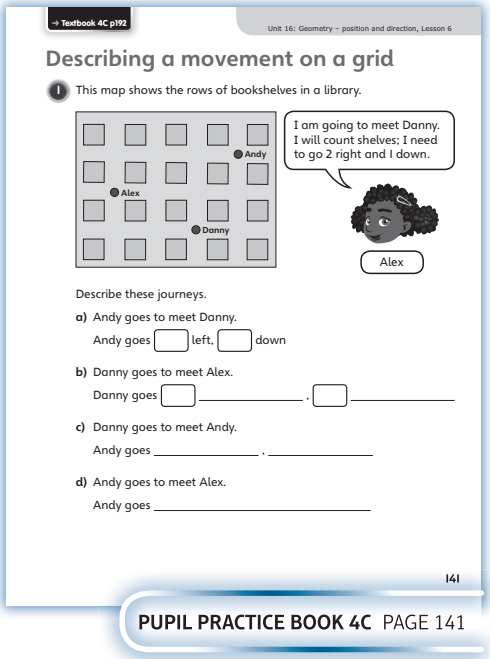
IN FOCUS Question 1 uses the same grid scenario that was introduced in the **Discover** exercise, but this time applies it to a different context: counting shelving blocks in a library. This helps to emphasise the idea that the same mathematical techniques can be applied to a variety of practical situations. Question 4 makes the point that a translation can be described using numbers, even without knowing the coordinates of any of the points.

STRENGTHEN Draw a grid on the board and mark two points. Ask a child to trace the distance across and then up/down, describing it as they do so. Repeat for different pairs of points until children can confidently state the journey.

DEEPEN In question 2, tell children to write down the coordinates of A, B and C. Ask them to look for patterns connecting the journey and the coordinates. If necessary, suggest that they look at the horizontal coordinates and journey components together, and similarly the vertical coordinates and components.

ASSESSMENT CHECKPOINT Use question 1 to assess whether children can describe translations on a grid system. Use question 2 to check that they can apply this knowledge to a coordinate grid.

ANSWERS Answers for the **Practice** part of the lesson appear in the separate **Practice and Reflect answer guide**.



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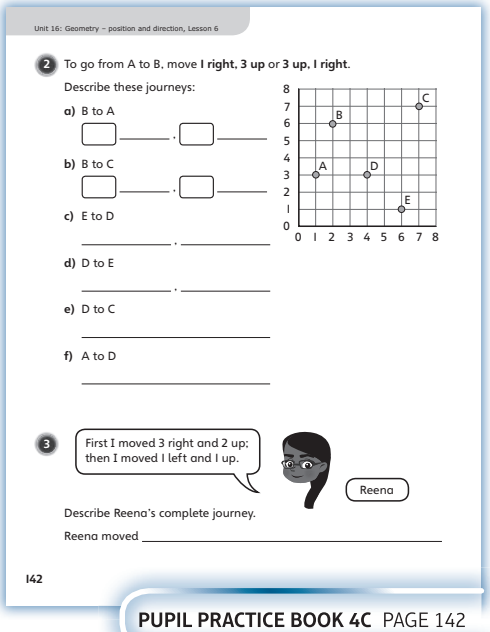

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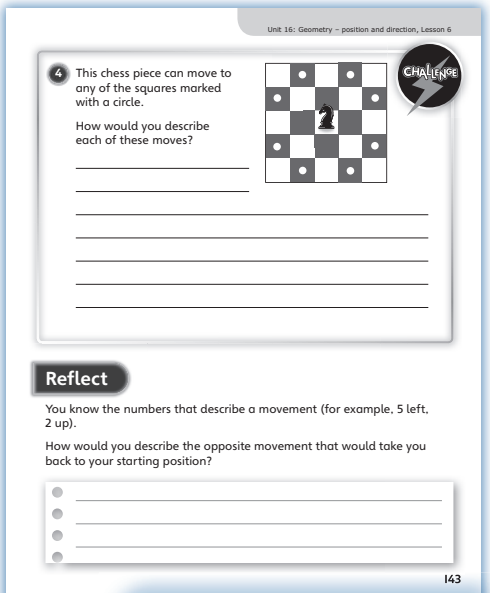
Reflect

WAYS OF WORKING Independent thinking

IN FOCUS This question looks at the idea of finding the opposite of a journey – that is, the translation that takes us back to the starting point. This provides an opportunity to think about translations in a more abstract way, finding the opposite of any journey, rather than a particular case.

ASSESSMENT CHECKPOINT Check that children can describe the process of finding the opposite of a particular journey (i.e. an example they choose). A more complete explanation should describe a more general process (for example: 'If it says "up", change it to "down"').

ANSWERS Answers for the **Reflect** part of the lesson appear in the separate **Practice and Reflect answer guide**.



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After the lesson

- Can children confidently find translations on a coordinate grid?

End of unit check

Don't forget the *Power Maths* unit assessment grid on p26.

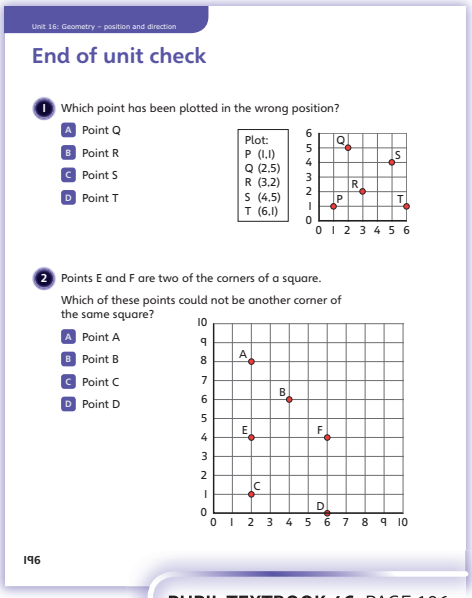
WAYS OF WORKING Group work adult led

IN FOCUS

- Question 1 provides an opportunity to check that children understand the order of coordinates when identifying and plotting points.
- Question 2 allows children to show their understanding of how shapes can be plotted on a coordinate grid.
- Questions 3, 4 and 5 enable children to demonstrate that they understand translations and the convention of right/left and up/down on a coordinate grid.
- Question 6 is a SATs style question that provides the children with an opportunity to give reasoning with their answer.

ANSWERS AND COMMENTARY

Children who have mastered the concepts in this unit can read, write and plot coordinates. They can use simple geometrical reasoning on a coordinate grid to draw patterns and complete shapes. They understand translations as movements on the coordinate grid; they can describe the result of making a translation described in words, and they can find the translation required for the movement between given positions.


Unit 16: Geometry – position and direction

End of unit check

1 Which point has been plotted in the wrong position?

A Point Q
B Point R
C Point S
D Point T

Plot:
P (1,1)
Q (2,5)
R (3,2)
S (4,5)
T (6,1)

2 Points E and F are two of the corners of a square.
Which of these points could not be another corner of the same square?

A Point A
B Point B
C Point C
D Point D

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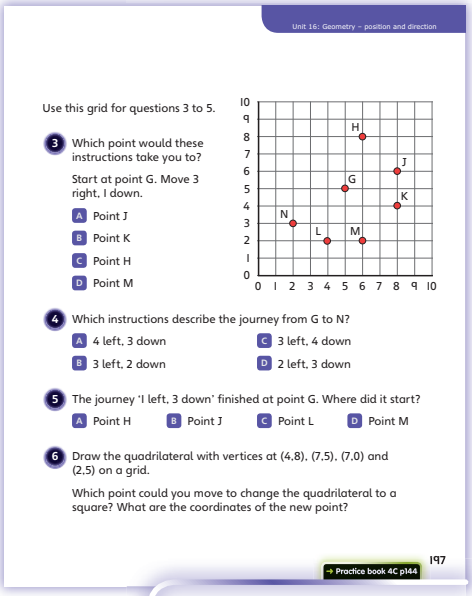
Unit 16: Geometry – position and direction

Use this grid for questions 3 to 5.

3 Which point would these instructions take you to?
Start at point G. Move 3 right, 1 down.

A Point J
B Point K
C Point H
D Point M

4 Which instructions describe the journey from G to N?

A 4 left, 3 down
B 3 left, 2 down
C 3 left, 4 down
D 2 left, 3 down

5 The journey '1 left, 3 down' finished at point G. Where did it start?

A Point H
B Point J
C Point L
D Point M

6 Draw the quadrilateral with vertices at (4,8), (7,5), (7,0) and (2,5) on a grid.
Which point could you move to change the quadrilateral to a square? What are the coordinates of the new point?

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→ Practice book 4C p144

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Q	A	WRONG ANSWERS AND MISCONCEPTIONS	STRENGTHENING UNDERSTANDING
1	C	A, B or D suggests that the child has not fully grasped the correct order of coordinates.	Children who need further practice may benefit from using a computer graph plotting package. These packages are very easy to use and children could use them to check their answers.
2	C	B suggests that the child has not understood that E and F could be opposite corners. D suggests that they think the given coordinates form the base of the square.	
3	B	A suggests that the child does not understand the direction of the components of a translation.	
4	B	C suggests that they have applied the magnitudes in the wrong order. D suggests that they have identified the magnitude of the two movements, but not the correct order.	
5	A	C suggests that they have started at G instead of finishing there.	
6	(4,8) to (2,0)	Some children may plot the coordinates in the wrong order.	

My journal

WAYS OF WORKING Independent thinking

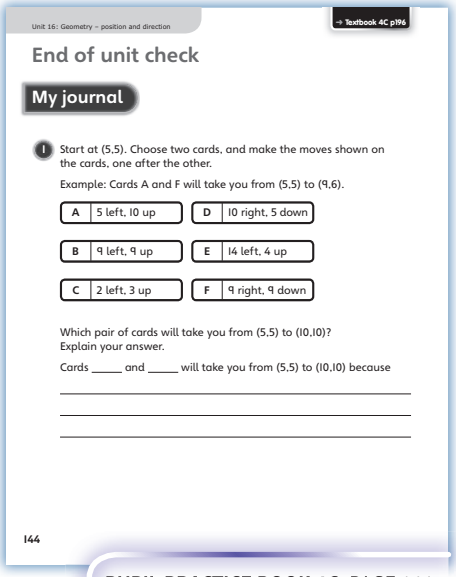
ANSWERS AND COMMENTARY

Cards A and D will combine to give a translation of 5 right, 5 up, which represents the movement from (5,5) to (10,10).

There are several stages involved in this solution – children will first need to identify the required translation, and then use their number sense and understanding of relative movement to identify the required pair of cards.

Question **2** uses a game which children have likely played before, where they must place four counters in a row without being intercepted. This could also be used in the classroom, where children must announce the position of each counter as they play.

Kim should place her counter in position (4,5) to win the game.



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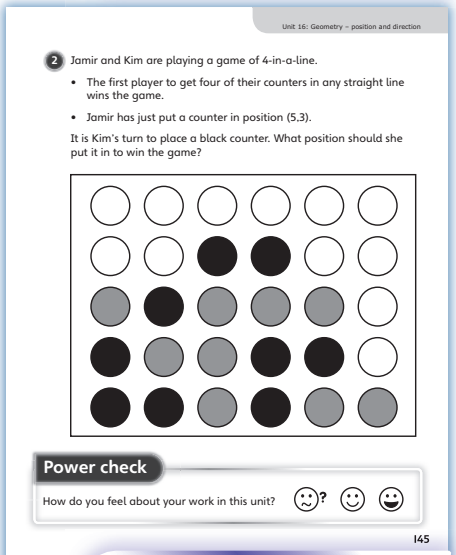
Power check

WAYS OF WORKING Independent thinking

ASK

- *Had you seen maps and plans used to show where things are before you started this unit?*
- *Do you think you are better able to describe positions and movements after doing the unit?*
- *Can you explain how to write a coordinate?*



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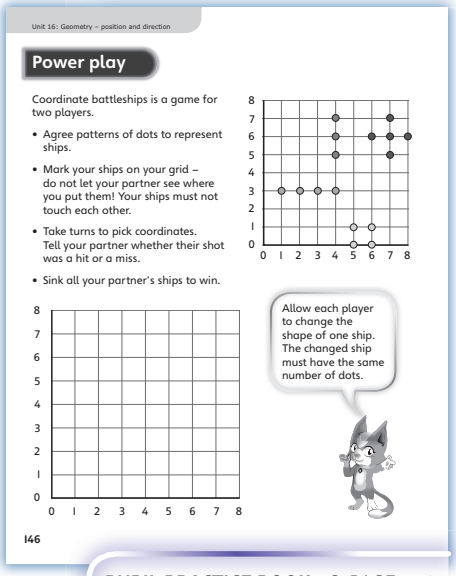
Power play

WAYS OF WORKING Pair work

IN FOCUS Use the game of battleships to provide a further example of the use of coordinates in a practical context.

ANSWERS AND COMMENTARY In this game, children extend the idea of a set of coordinates to include naming positions on a game board using the conventions that have been developed in this chapter – first give the direction across to the right, then the distance up. Model placing the battleships on a grid to emphasise that ships must not occupy adjacent points, including diagonally.



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After the unit

- How will the work in this unit prepare children for more advanced work, where directed numbers are used to describe translations, and coordinates in other quadrants?
- The order of coordinates is a good example of a mathematical convention – we could use any order, but we all need to agree on the same one. What other conventions will children need to know in mathematics?

Strengthen and **Deepen** activities for this unit can be found in the *Power Maths* online subscription.