# Summer
## Scheme of learning
# Year 5

White Rose Maths

#MathsEveryoneCan

# The **White Rose Maths** schemes of learning

## Teaching for mastery

Our research-based schemes of learning are designed to support a mastery approach to teaching and learning and are consistent with the aims and objectives of the National Curriculum.

### Putting number first

Our schemes have number at their heart.
A significant amount of time is spent reinforcing number in order to build competency and ensure children can confidently access the rest of the curriculum.

### Depth before breadth

Our easy-to-follow schemes support teachers to stay within the required key stage so that children acquire depth of knowledge in each topic. Opportunities to revisit previously learned skills are built into later blocks.

### Working together

Children can progress through the schemes as a whole group, encouraging students of all abilities to support each other in their learning.

### Fluency, reasoning and problem solving

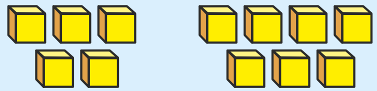
Our schemes develop all three key areas of the National Curriculum, giving children the knowledge and skills they need to become confident mathematicians.

## Concrete – Pictorial – Abstract (CPA)

Research shows that all children, when introduced to a new concept, should have the opportunity to build competency by following the CPA approach. This features throughout our schemes of learning.

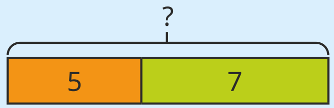
### Concrete

Children should have the opportunity to work with physical objects/concrete resources, in order to bring the maths to life and to build understanding of what they are doing.



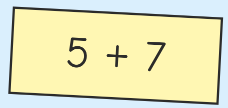
### Pictorial

Alongside concrete resources, children should work with pictorial representations, making links to the concrete.
Visualising a problem in this way can help children to reason and to solve problems.




### Abstract

With the support of both the concrete and pictorial representations, children can develop their understanding of abstract methods.




If you have questions about this approach and would like to consider appropriate CPD, please visit www.whiterosemaths.com to find a course that's right for you.

# Teacher guidance

Every block in our schemes of learning is broken down into manageable small steps, and we provide comprehensive teacher guidance for each one. Here are the features included in each step.

**Notes and guidance** that provide an overview of the content of the step and ideas for teaching, along with advice on progression and where a topic fits within the curriculum.

**Things to look out for**, which highlights common mistakes, misconceptions and areas that may require additional support.

Year 5 | Autumn Term | Block 1 – Place Value | Step 1

## Roman numerals to 1,000

### Notes and guidance

In Year 4, children learned about Roman numerals to 100. In this small step, they explore Roman numerals to 1,000, and the symbols D (500) and M (1,000) are introduced.

Children explore further the similarities and differences between the Roman number system and our number system, learning that the Roman system does not have a zero and does not use placeholders.

Children use their knowledge of M and D to recognise years using Roman numerals. Asking children to write the date in Roman numerals is one way to reinforce the concept daily.

### Things to look out for

- Children may mix up which letter stands for which number.
- Children may add the individual values together instead of interpreting the values based on their position, for example interpreting CD as 600 instead of 400
- It is often more difficult to convert numbers that require large strings of Roman numerals.
- Children may think that numbers such as 990 can be written as XM instead of CMXC.

### Key questions

- What patterns can you see in the Roman number system?
- What rules do we use when converting numbers to Roman numerals?
- What letters are used in the Roman number system? What does each letter represent?
- How do you know what order to write the letters when using Roman numerals?
- What is the same and what is different about representing the number "five hundred and three" in the Roman number system and in our number system?

### Possible sentence stems

- The letter ______ represents the number ______
- I know ______ is greater than ______ because ______

### National Curriculum links

- Read Roman numerals to 1,000 (M) and recognise years written in Roman numerals



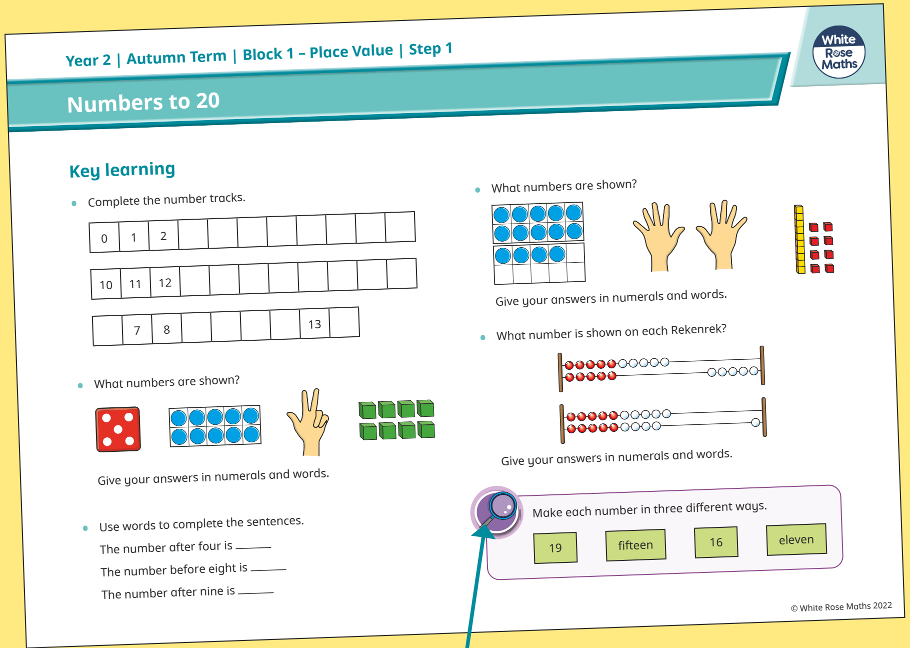
**Key questions** that can be posed to children to develop their mathematical vocabulary and reasoning skills, digging deeper into the content.

**Possible sentence stems** to further support children's mathematical language and to develop their reasoning skills.

**National Curriculum links** to indicate the objective(s) being addressed by the step.

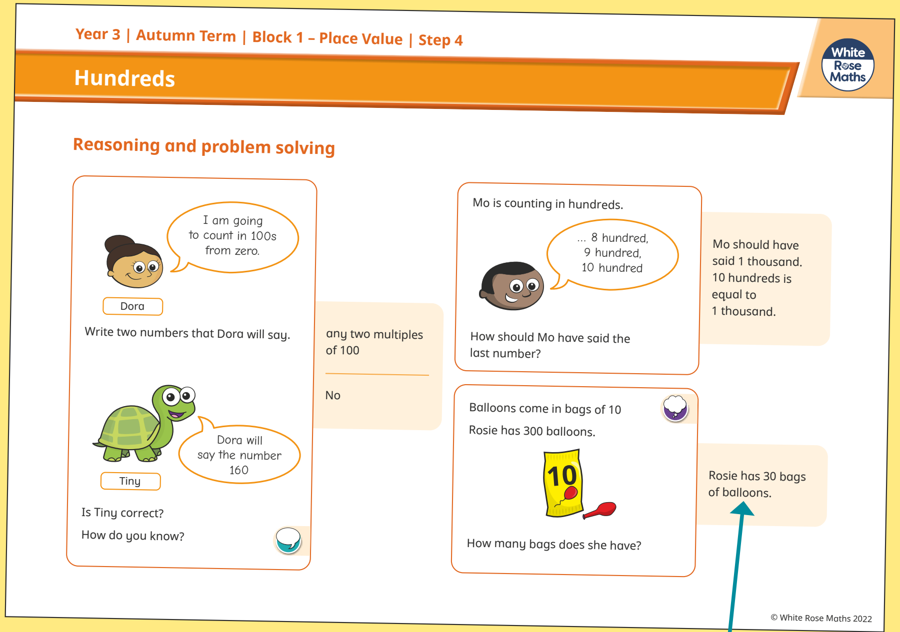
# Teacher guidance

A **Key learning** section, which provides plenty of exemplar questions that can be used when teaching the topic.




Activity symbols that indicate an idea can be explored practically

**Reasoning and problem-solving** activities and questions that can be used in class to provide further challenge and to encourage deeper understanding of each topic.




Answers provided where appropriate

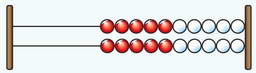
# Activities and symbols

## Key Stage 1 activities

Key Stage 1 includes more hands-on activities alongside questions.

An activity to be led by the teacher

Use a Rekenrek in the ready position.



Ask children to show a number on their Rekenrek.

An outside activity or one that uses resources from nature

Find some seeds and leaves to represent Autumn.

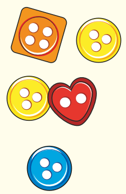
Ask children to sort the objects in three different ways and then compare their answers with a partner.

An activity introduced by a reading from an appropriate fiction or non-fiction book

Read *The Button Box* by M Reid.

Give children a selection of buttons and ask them to sort the buttons in as many different ways as they can.

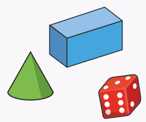
Encourage them to think about size, shape, colour and number of holes.



An investigation

Give children a selection of 3D shapes.

Ask children to sort the objects into two groups and then challenge a partner to say how the objects have been sorted.



## Key Stage 1 and 2 symbols

The following symbols are used to indicate:

- concrete resources might be useful to help answer the question
- a bar model might be useful to help answer the question
- drawing a picture might help children to answer the question
- children talk about and compare their answers and reasoning
- a question that should really make children think. The question may be structured differently or require a different approach from others and/or tease out common misconceptions.



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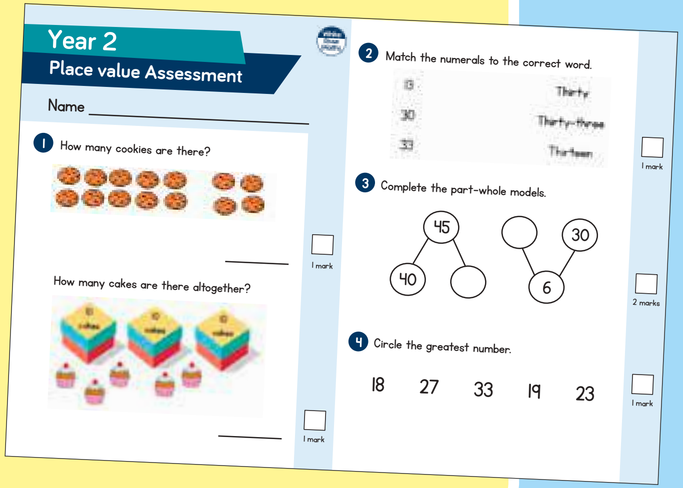
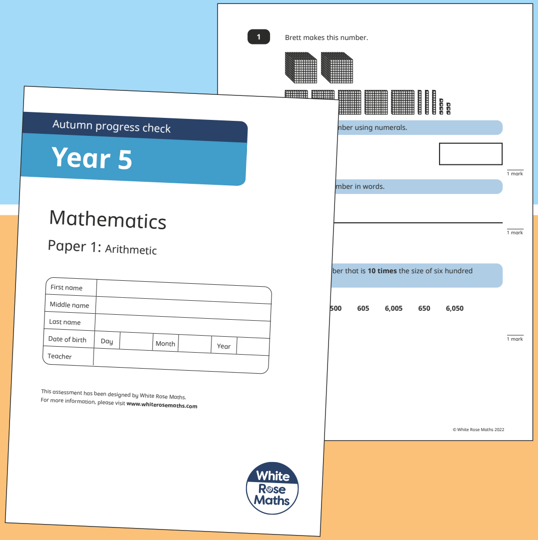
# Free supporting materials

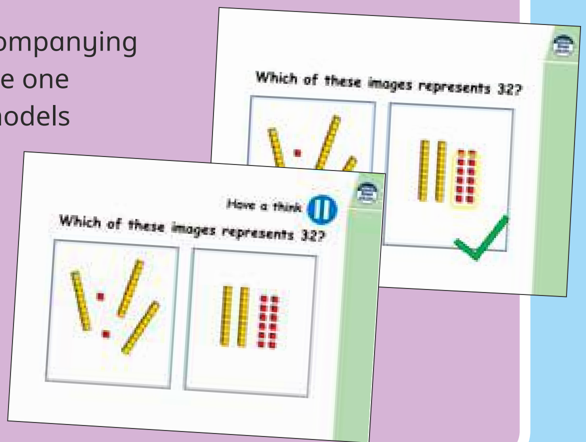
**End-of-block assessments** to check progress and identify gaps in knowledge and understanding.



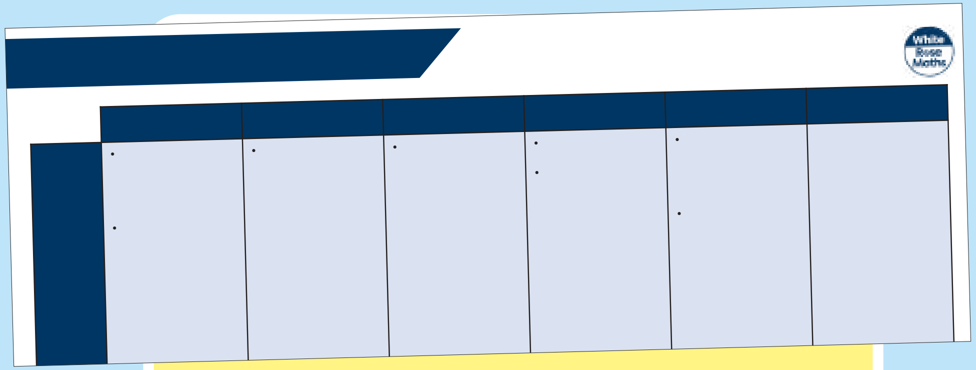




**End-of-term assessments** for a more summative view of where children are succeeding and where they may need more support.

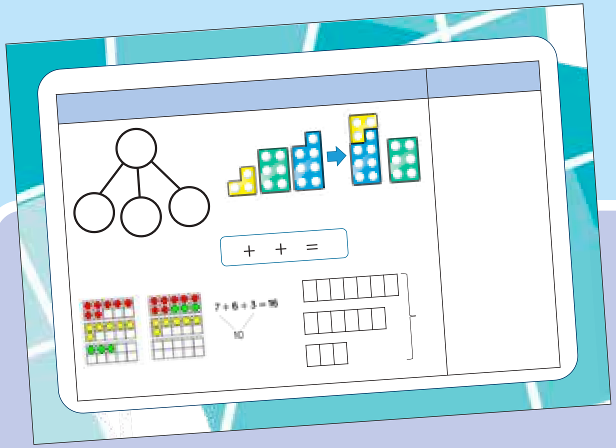
Each small step has an accompanying **home learning video** where one of our team of specialists models the learning in the step. These can also be used to support students who are absent or who need to catch up content from earlier blocks or years.



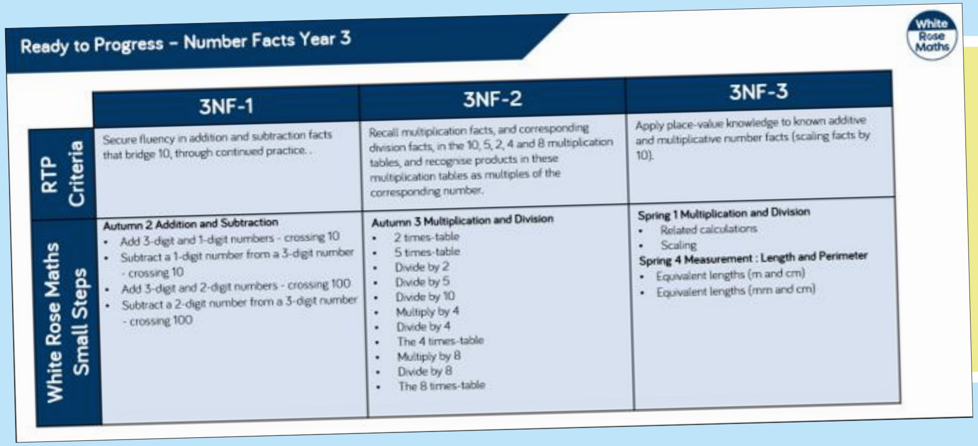
# Free supporting materials



**National Curriculum progression** to indicate how the schemes of learning fit into the wider picture and how learning progresses within and between year groups.



**Calculation policies** that show how key approaches develop from Year 1 to Year 6.

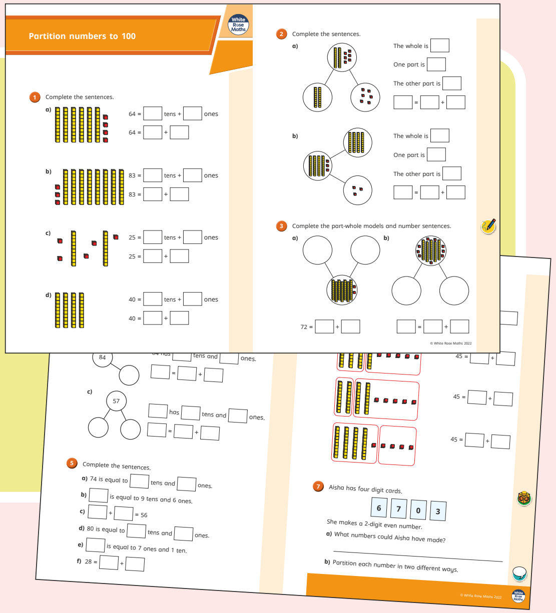


Ready to Progress – Number Facts Year 3

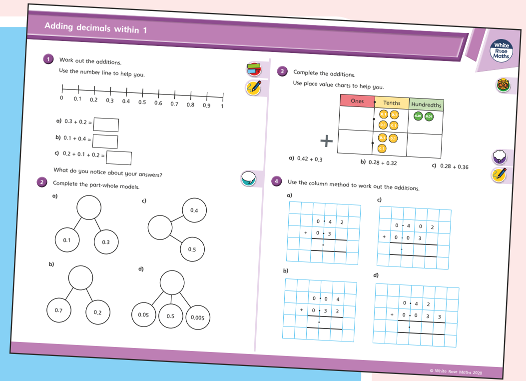
| | 3NF-1 | 3NF-2 | 3NF-3 |
|---|---|---|---|
| RTP Criteria | Secure fluency in addition and subtraction facts that bridge 10, through continued practice. | Recall multiplication facts, and corresponding division facts, in the 10, 5, 2, 4 and 8 multiplication tables, and recognise products in these multiplication tables as multiples of the corresponding number. | Apply place-value knowledge to known additive and multiplicative number facts (scaling facts by 10). |
| White Rose Maths Small Steps | **Autumn 2 Addition and Subtraction**<br>• Add 3-digit and 1-digit numbers - crossing 10<br>• Subtract a 1-digit number from a 3-digit number - crossing 10<br>• Add 3-digit and 2-digit numbers - crossing 100<br>• Subtract a 2-digit number from a 3-digit number - crossing 100 | **Autumn 3 Multiplication and Division**<br>• 2 times-table<br>• 5 times-table<br>• Divide by 2<br>• Divide by 5<br>• Divide by 10<br>• Multiply by 4<br>• Divide by 4<br>• The 4 times-table<br>• Multiply by 8<br>• Divide by 8<br>• The 8 times-table | **Spring 1 Multiplication and Division**<br>• Related calculations<br>• Scaling<br>**Spring 4 Measurement : Length and Perimeter**<br>• Equivalent lengths (m and cm)<br>• Equivalent lengths (mm and cm) |

**Ready to progress** mapping that shows how the schemes of learning link to curriculum prioritisation.

# Premium supporting materials

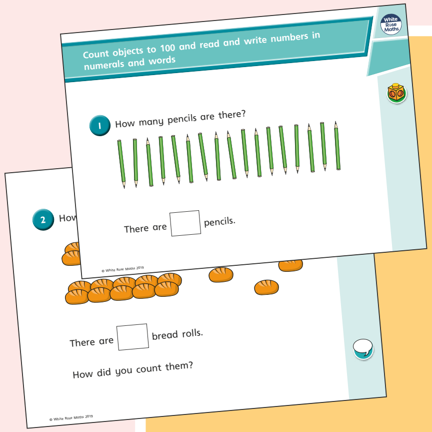



**Worksheets** to accompany every small step, providing relevant practice questions for each topic that will reinforce learning at every stage.

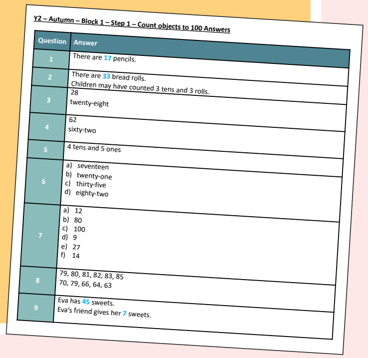



**Display** versions of the worksheet questions for front of class/whole class teaching.


Also available as printed **workbooks**, per block.



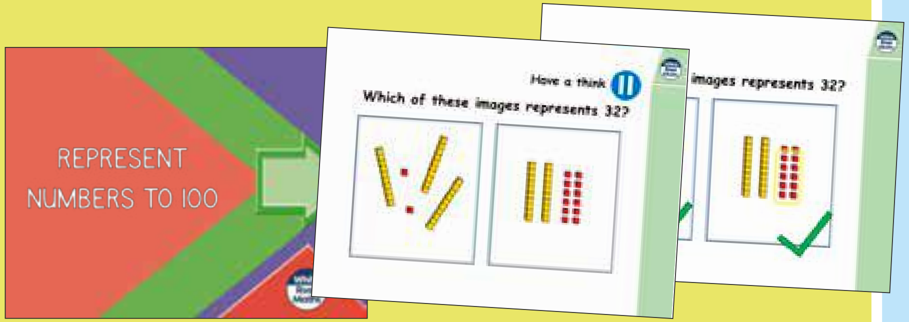

**PowerPoint™** versions of the worksheet questions to incorporate them into lesson planning.



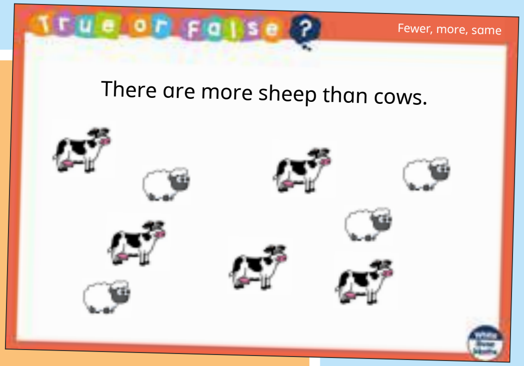

**Answers** to all the worksheet questions.

# Premium supporting materials

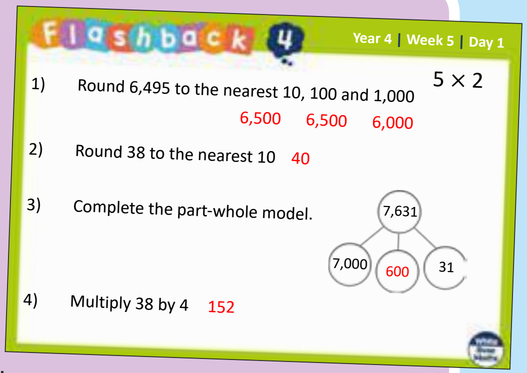
**Teaching slides** that mirror the content of our home learning videos for each step. These are fully animated and editable, so can be adapted to the needs of any class.




A **true or false** question for every small step in the scheme of learning. These can be used to support new learning or as another tool for revisiting knowledge at a later date.




**Flashback 4** starter activities to improve retention.
Q1 is from the last lesson;
Q2 is from last week;
Q3 is from 2 to 3 weeks ago;
Q4 is from last term/year.
There is also a bonus question on each one to recap topics such as telling the time, times-tables and Roman numerals.





**Topic-based CPD videos**
As part of our on-demand CPD package, our maths specialists provide helpful hints and guidance on teaching topics for every block in our schemes of learning.

## Meet the characters

Our class of characters bring the schemes to life, and will be sure to engage learners of all ages and abilities. Follow the children and their class pet, Tiny the tortoise, as they explore new mathematical concepts and ideas.

# Yearly overview

The yearly overview provides suggested timings for each block of learning, which can be adapted to suit different term dates or other requirements.

| | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 | Week 9 | Week 10 | Week 11 | Week 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Autumn | Number **Place value** | | | Number **Addition and subtraction** | | Number **Multiplication and division A** | | | Number **Fractions A** | | | |
| Spring | Number **Multiplication and division B** | | | Number **Fractions B** | | Number **Decimals and percentages** | | | Measurement **Perimeter and area** | | **Statistics** | |
| Summer | Geometry **Shape** | | | Geometry **Position and direction** | | Number **Decimals** | | | Number **Negative numbers** | Measurement **Converting units** | | Measurement **Volume** |



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Summer Block 1

# Shape

# Small steps

| | |
|---|---|
| Step 1 | Understand and use degrees |
| Step 2 | Classify angles |
| Step 3 | Estimate angles |
| Step 4 | Measure angles up to 180° |
| Step 5 | Draw lines and angles accurately |
| Step 6 | Calculate angles around a point |
| Step 7 | Calculate angles on a straight line |
| Step 8 | Lengths and angles in shapes |

# Small steps

| | |
|---|---|
| Step 9 | Regular and irregular polygons |
| Step 10 | 3-D shapes |

# Understand and use degrees

## Notes and guidance

In this small step, children recap and build on learning from previous years. They should already be familiar with the idea that an angle is a measure of turn and be able to describe angles as acute or obtuse by comparing them to a right angle.

This step introduces degrees as a unit of measure for turn, including the degree symbol. Children explore the fact that there are 360° in a full turn, and therefore 180° in half a turn, 90° in a quarter turn (or right angle) and 270° in a three-quarter turn. They use this knowledge and the language of clockwise and anticlockwise to describe turns, including in the context of compass directions and clocks.

Children may begin to recognise other common angles, such as 45° being half a right angle, but there is no requirement to measure or explore more complex angles, such as 67° or 241°, at this point, as this is covered in later steps.

## Things to look out for

- Children may confuse the terms clockwise and anticlockwise.
- Children may find it trickier to identify angles that are not shown in a standard orientation, for example a $\frac{3}{4}$ turn from north-east to north-west.

## Key questions

- What does a full/half/quarter/three-quarter turn look like?
- What does "clockwise"/"anticlockwise" mean?
- What is a right angle?

  How many right angles are there in a full turn?
- If there are 360° in a full turn, how many degrees are there in a right angle/quarter turn/half turn/three-quarter turn?
- If you are performing a full/half/quarter turn, does it matter if you turn clockwise or anticlockwise?

## Possible sentence stems

- There are ______° in a full turn, so there are ______° in a ______ turn.
- There are ______° in a right angle.
- Turning ______° ______ is the same as turning ______° ______

## National Curriculum links

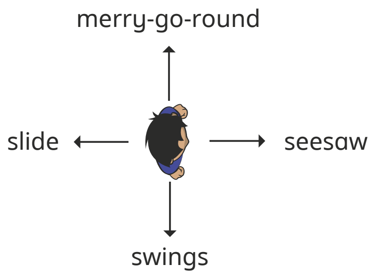
- Know angles are measured in degrees: estimate and compare acute, obtuse and reflex angles

# Understand and use degrees

## Key learning

- Amir is facing the seesaw.

  He turns 360° and is facing the seesaw again.




  Complete the sentences.

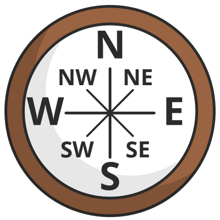
  There are 360° in a ______ turn.

  There are ______° in a half turn.

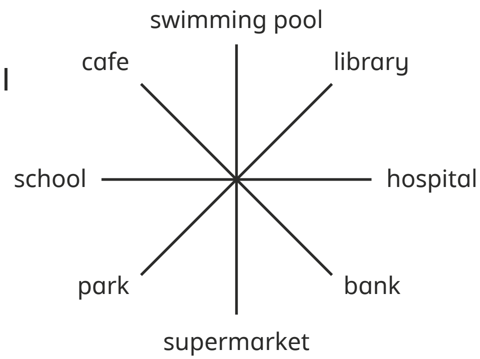
  There are ______° in a quarter turn.

  Describe some turns to a partner and work out what Amir will be facing after each turn.

- Work out the angle of each turn in degrees.
  - north to west clockwise
  - north to west anticlockwise
  - east to north clockwise
  - north-west to south-east anticlockwise




- Aisha, Scott, Huan and Dani are standing in the centre.
  - Work out what each child is facing after their turn.
    - Aisha is facing the hospital and turns 90° clockwise.
    - Scott is facing the supermarket and turns 270° anticlockwise.
    - Huan is facing the cafe and turns 180°.
    - Dani is facing the library and turns 360°.

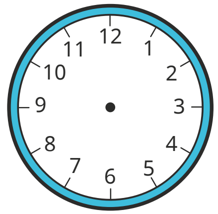



  - Explain why it does not matter whether Huan and Dani turned clockwise or anticlockwise.

- The minute hand turns from the start time to the end time.

  Use the clock to help you complete the table.

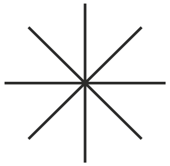
| Start time | End time | Degrees |
|---|---|---|
| 3 o'clock | quarter to 4 | |
| 4:10 pm | 4:40 pm | |
| 5:30 am | | 270° |
| | 21:05 | 90° |



# Understand and use degrees

## Reasoning and problem solving

Use the clues to label the diagram.



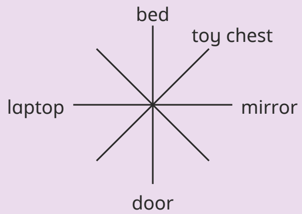
- Ron is standing in the middle of his bedroom.
- He is facing his bed.
- He turns 180° and is facing the door.
- He then makes a 90° turn clockwise and is facing his laptop.
- He turns another 90° clockwise, and then makes a $\frac{3}{4}$ turn anticlockwise. He is now facing the mirror.

Compare diagrams with a partner.

His toy chest is between the bed and the mirror.

Describe the turn from the bed to the toy chest.

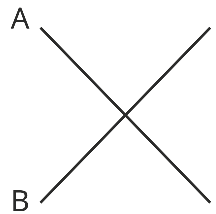
any rotation of:

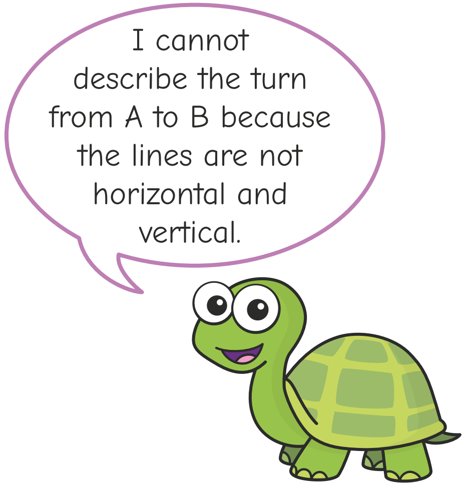



45° clockwise

or $\frac{1}{8}$ of a turn clockwise

or half of a quarter turn clockwise




Explain why Tiny is incorrect.

Describe the turn from A to B in two different ways.

$\frac{3}{4}$ turn (or 270°) turn clockwise

$\frac{1}{4}$ turn (or 90°) turn anticlockwise

# Classify angles

## Notes and guidance

In this small step, children classify angles using knowledge of right angles from the previous step. In Year 4, children classified angles as acute or obtuse based on whether an angle was less than or greater than a quarter turn (right angle). They begin by revisiting this and are also introduced to reflex angles for the first time.

It is important that children are able to visually classify an angle as acute, obtuse or reflex by comparing them to right angles and straight lines. Use of angle finders, such as the right angle, may provide support. Once secure in this, children can then begin to look at classifying angles numerically. They should be able to state, for example, that 23° is an acute angle because it is less than 90°, 134° is an obtuse angle because it is greater than 90° but less than 180°, and 210° is a reflex angle because it is greater than 180°.

As well as identifying and classifying angles, children should draw examples of each angle type.

## Things to look out for

- Children may find it more challenging to classify angles that are close to 90° or 180°.
- Children may need to turn the paper to help classify angles that are not presented horizontally or vertically.

## Key questions

- What does a right angle look like?
- What does the angle on a straight line look like?
- How many degrees are there in a right angle/on a straight line?
- Is the drawn angle less than or greater than a right angle?
- What does "acute"/"obtuse" mean?
- Can an angle be greater than 180°? What do you call an angle such as this?
- If an angle is ______ degrees, what type of angle is it?

## Possible sentence stems

- Angles less than ______° are called ______ angles.
- Angles greater than ______° but less than ______° are called ______ angles.
- Angles greater than ______° are called ______ angles.

## National Curriculum links

- Know angles are measured in degrees: estimate and compare acute, obtuse and reflex angles

# Classify angles

## Key learning

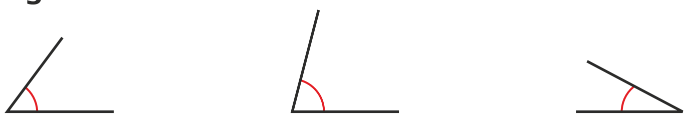
- Here is a right angle and a straight line.

How many degrees are there in a right angle?

How many degrees are there on a straight line?

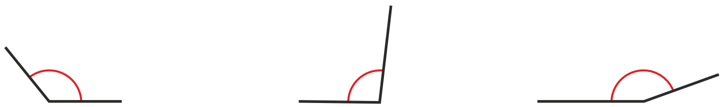
- Complete the sentences to describe the types of angles.

**acute angles**



Acute angles are less than ______°.

**obtuse angles**



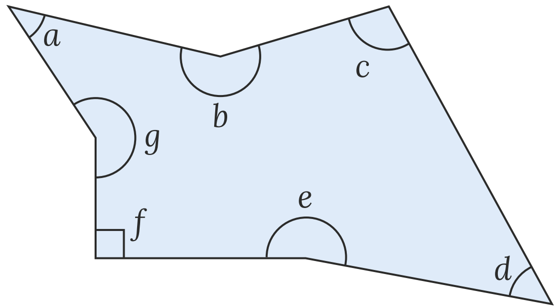
Obtuse angles are greater than ______° but less than ______°.

**reflex angles**

Reflex angles are greater than ______°.

- Draw and label two different diagrams that show each type of angle.
  - acute
  - obtuse
  - reflex

- Classify angles $a$ to $g$ as acute, obtuse, reflex or right angle.




- Sort the angles into acute, obtuse and reflex.

| | | | | |
|---|---|---|---|---|
| 23° | 123° | 91° | 359° | 99° |
| 190° | 19° | 181° | 89° | 165° |

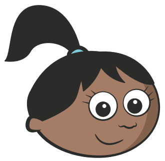
- Draw a triangle and a quadrilateral.

  For each shape, label the angles as acute, obtuse, reflex or right angle.

  Compare diagrams with a partner.

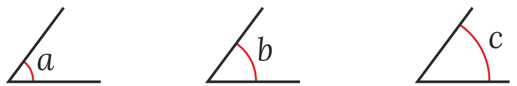
# Classify angles

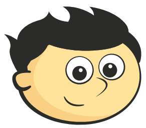
## Reasoning and problem solving



Angle $a$ is the smallest and angle $c$ is the greatest.

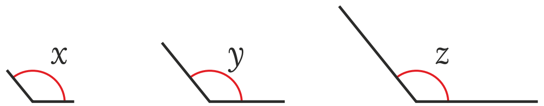
Sam



Angle $x$ is the smallest and angle $z$ is the greatest.

Jack




Do you agree with Sam and Jack?

Explain your reasoning.

No

Are the statements always true, sometimes true or never true?

Two acute angles added together make an obtuse angle.

Two obtuse angles added together make a reflex angle.

Subtracting an obtuse angle from a reflex angle leaves an acute angle.

Subtracting an acute angle from a reflex angle leaves an obtuse angle.

Draw examples to support your answers.

sometimes true

always true

sometimes true

sometimes true

# Estimate angles

## Notes and guidance

In this small step, children estimate the sizes of angles based on knowledge of what right angles and angles on a straight line look like and measure in degrees.

Children should already be able to look at an angle and identify whether it is acute, obtuse or reflex, and they now progress to estimating the size of the angle. To begin with, it is important to explore the idea of halfway between already known angles, for example 45° is half of a right angle and 135° is halfway between a right angle and a straight line. From here, children can start to estimate given angles by comparing them to these key amounts. For example 80° is greater than half a right angle but less than a right angle and is closer to 90° than 45°. As well as estimating the sizes of given angles, children start to draw angles approximately of a given size.

## Things to look out for

- Children may find angles that are not given in standard orientations more difficult to estimate.
- Children may want to find exact measurements rather than estimates, and may need support to realise that different answers are acceptable.

## Key questions

- What does a right angle/straight line look like?
- How many degrees are there in a right angle/on a straight line?
- What angle is halfway between 0° and 90°/90° and 180°?
- Is the angle acute, obtuse or reflex? How do you know?
- Is the angle closer to 0° or 90°/90° or 180°?
- Is the angle closer to 45° or 90°/90° or 135°?

## Possible sentence stems

- Angles less than ______° are called ______ angles.
- Angles greater than ______° but less than ______° are called ______ angles.
- Angles greater than ______° are called ______ angles.
- The angle is a ______ angle, so it must be …
- The angle is closer to ______ than ______, so it could be ______°.

## National Curriculum links

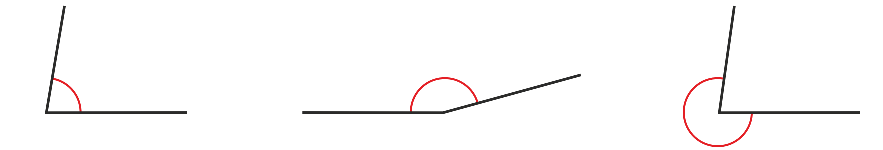
- Know angles are measured in degrees: estimate and compare acute, obtuse and reflex angles

# Estimate angles

## Key learning

- Which is the most appropriate estimate for the size of each angle?

  Explain your reasons to a partner.



| 80° or 110° | 165° or 185° | 249° or 278° |
|---|---|---|

- The diagonal lines cut the right angles in half.

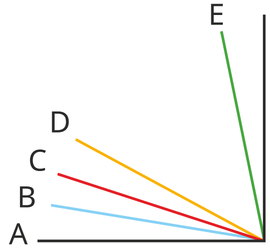
  What are the sizes of angles $a$ and $b$?


- Match each angle to an appropriate estimate of its size.

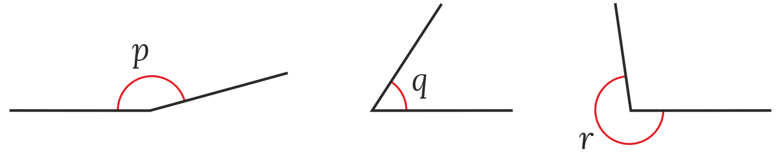

| 150° | 35° | 89° | 65° | 105° | 170° | 95° |
|---|---|---|---|---|---|---|

Compare answers with a partner.

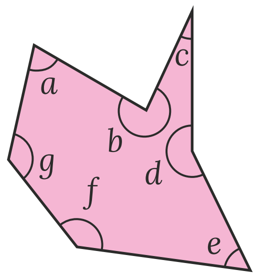
- Estimate the size of the angle formed by each line from line A.




- Estimate the sizes of the angles.




- Estimate the size of each angle in the shape.

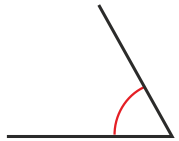



- Draw angles that are approximately of each size.

| 40° | 85° | 110° | 165° | 240° |
|---|---|---|---|---|

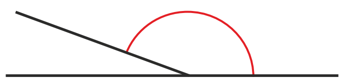
# Estimate angles

## Reasoning and problem solving




What mistake has Teddy made?

Teddy has forgotten to give the unit of measure: degrees or °.




Do you agree with Dora?

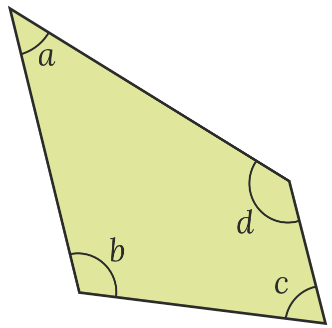
Explain your reasons.

No

Use the clues to draw an approximate diagram of the angle described.

- The angle is obtuse.
- The size of the angle is a cube number.

angle of approximately 125°




Is the statement true or false?

angle $a$ + angle $b$ > angle $c$ + angle $d$

Use estimates to explain your answer.

False

approximate sizes of angles are:

$a$ = 45°, $b$ = 110°, $c$ = 70°, $d$ = 135°

45 + 110 < 70 + 135

# Measure angles up to 180°

## Notes and guidance

In this small step, children use a protractor to measure angles up to 180°.

It is important to begin by recapping the concept of estimating angles. Children then read the sizes of angles, where a protractor is shown over the top of the angle, so they know that the protractor is already in the correct position.

Children should then be given protractors to position themselves in order to measure angles. Model the steps to successfully using a protractor: make sure that the zero line of the protractor is on one of the lines of the angle; position the centre point of the protractor on the vertex; read the correct scale to determine what size the angle is. Children count up from the zero line to get to the correct angle. By estimating the size of the angle before measuring, they are less likely to read the wrong scale.

For this step, children do not measure angles greater than 180°.

## Things to look out for

- Children may place the protractor in the incorrect place.
- Children may read the incorrect scale on the protractor.

## Key questions

- What is an angle?
- What unit do you use to measure an angle?
- What can you use to measure the size of an angle?
- How can you tell the difference between an acute angle and an obtuse angle?
- Where should you put the protractor when measuring an angle?
- Which scale will you use when reading the protractor?
- How does moving the paper help you to measure some angles?

## Possible sentence stems

- The angle is less than ______°, so it is an ______ angle.
- The angle is greater than ______°, so it is an ______ angle.
- The angle is an ______ angle, so the number of degrees must be more/less than ______

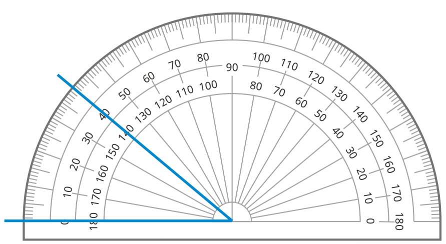
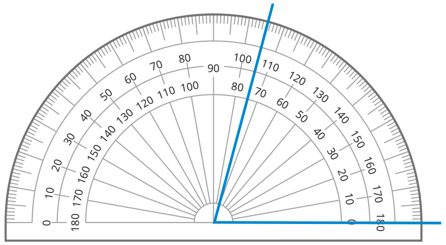
## National Curriculum links

- Draw given angles, and measure them in degrees (°)

# Measure angles up to 180°

## Key learning

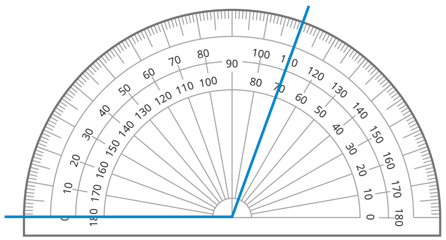
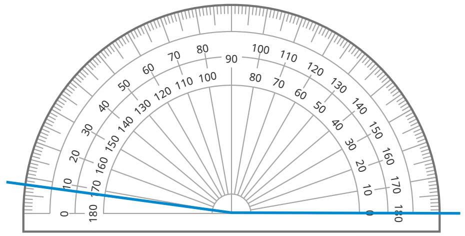
- Is each angle acute or obtuse?

  What is the size of each angle?

  What is the same and what is different about the angles?

- Is each angle acute or obtuse?

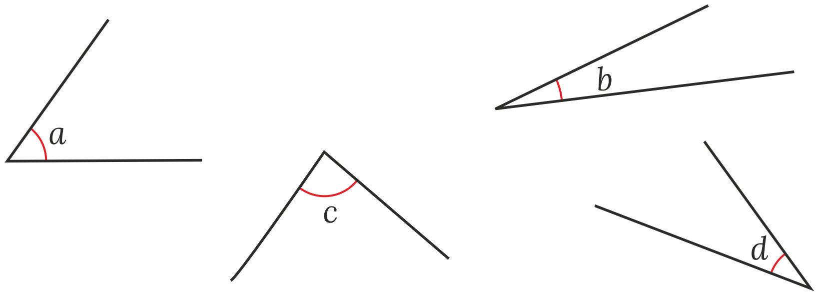



  What is the size of each angle?

  What is the same and what is different about the angles?

- Is each angle acute or obtuse?

  Estimate the size of each angle.



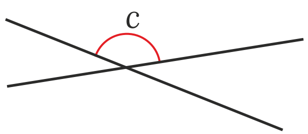

  Measure each angle with a protractor.

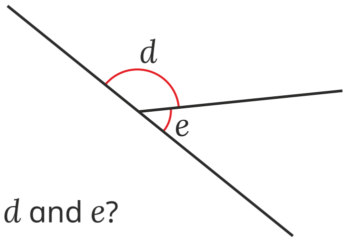
  How close were your estimates to the actual measurements?

- Is each angle acute or obtuse?

  Estimate the sizes of the angles.

  Then measure them with a protractor.

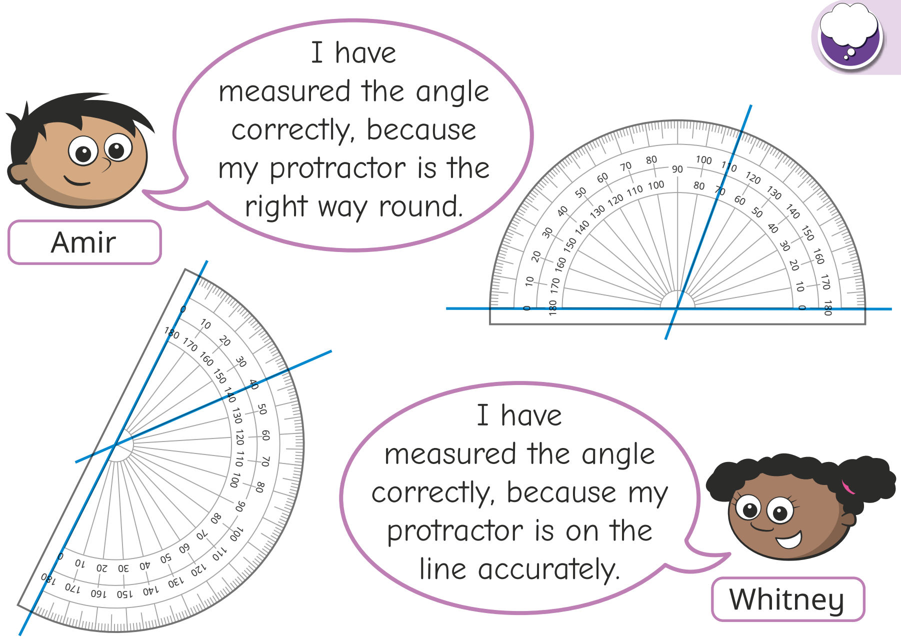





  What do you notice about angles $d$ and $e$?

# Measure angles up to 180°

## Reasoning and problem solving

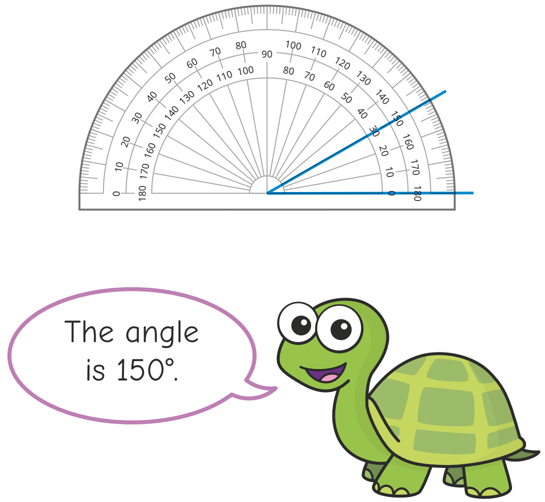



Who do you agree with?

Explain your answer.

They are both correct.

Tiny is measuring angles.




Do you agree with Tiny?

Explain your answer.

What steps for measuring an angle has Tiny done correctly?

What steps has Tiny got wrong?

No

Tiny has used the wrong scale. The angle is 30°, not 150°.

# Draw lines and angles accurately

## Notes and guidance

In this small step, children draw lines and angles accurately and use what they have learnt about shapes to construct shapes.

Children begin by drawing straight lines of given lengths, in both centimetres and millimetres. Ensure that children are measuring using the correct scale, for example centimetres, not inches.

Model how to use a protractor to draw a given angle. Instruct children to draw a straight line, then to move the protractor so that the zero line is on the line they have drawn, and the centre of the protractor is on the end of the line. They then mark the angle, remove the protractor and draw another line. Encourage children to label any angles that they draw. Once comfortable with drawing given lines and angles, they can explore drawing whole shapes accurately from a given description.

This step is a good opportunity to revisit the properties of different triangles and quadrilaterals.

### Things to look out for

- When using a ruler, children may start their line at the edge rather than at zero on the scale.
- Children may use the wrong scale on the ruler.
- Children may use the wrong scale on the protractor.

## Key questions

- What are the steps to draw a straight line of a given length with a ruler?
- Are you drawing the line in millimetres, centimetres or inches?
- How can you use a protractor to draw a given angle accurately?
- Where on the line should you place the protractor?
- Is the angle you want to draw acute or obtuse?
- Which scale on the protractor should you use? Why?
- How can you accurately draw a polygon if you know the measurements?
- What are the features of a rhombus/isosceles triangle?

## Possible sentence stems

- When drawing an angle of ______ degrees, I know it will be greater/smaller than a right angle, so I will use the inner/outer scale.

### National Curriculum links

- Draw given angles, and measure them in degrees (°)

# Draw lines and angles accurately

## Key learning

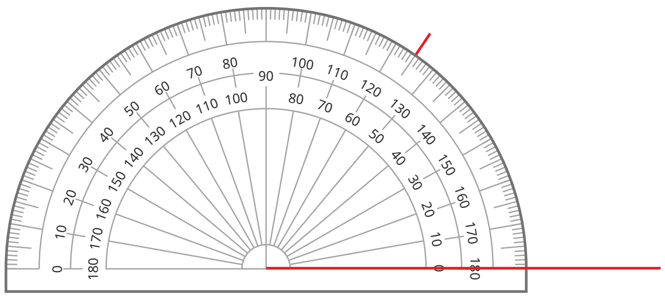
- Use a ruler to accurately draw the lines.

| 12 cm | 6.5 cm | 75 mm | 105 mm |
|---|---|---|---|

- Aisha is asked to draw an angle.

  She draws a horizontal line, then puts the protractor on the line.

  She then makes a mark.



  What size angle is Aisha drawing?

- Use a protractor to accurately draw and label the angles.

  Draw a horizontal line for each one.

| 45° | 15° | 110° | 155° |
|---|---|---|---|

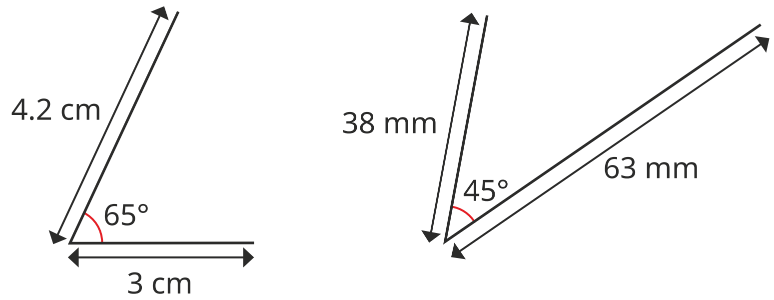
- Accurately draw and label a square that has a perimeter of 22 cm.

- Draw a straight line and label the ends A and B.

  Draw an angle of 140° from point A.

  Draw an angle of 40° from point B.

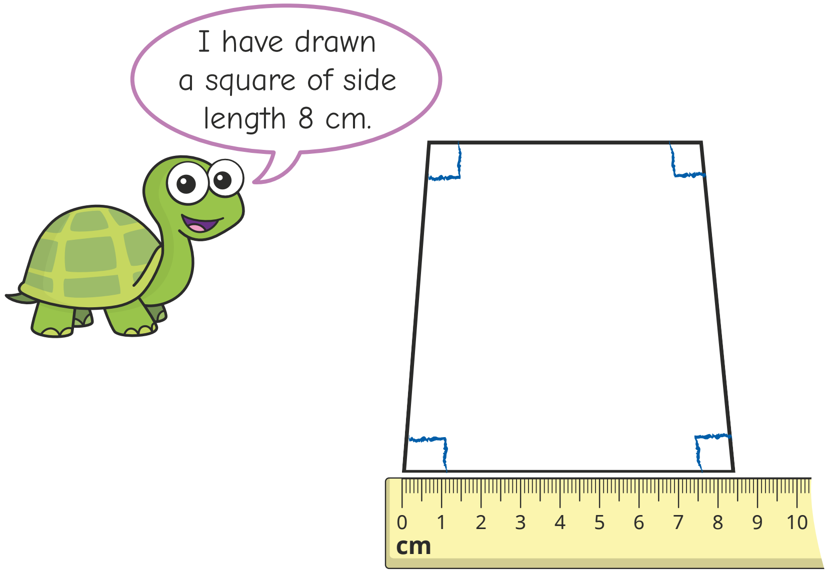
- Use a ruler and a protractor to accurately draw and label the lines and angles.




- Use a ruler and protractor to accurately draw and label:
  - an angle of 50° with the arms of the angle 50 mm long
  - an isosceles triangle that has a base of 4 cm and angles of 70°
  - a rhombus with sides of 35 mm, one pair of 50° angles and one pair of 130° angles

# Draw lines and angles accurately

## Reasoning and problem solving

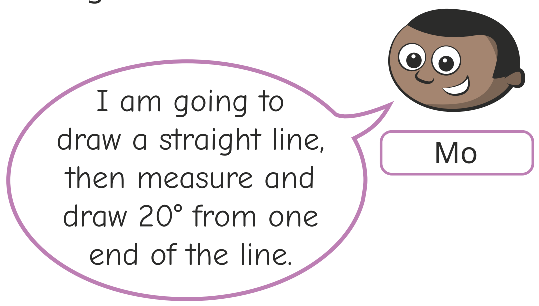


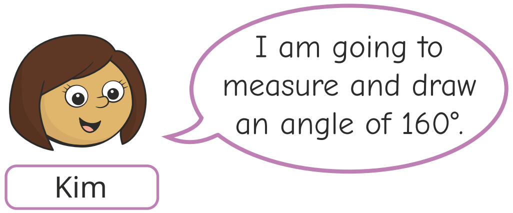

What mistakes has Tiny made?

Tiny has not drawn the side lengths or measured the angle sizes accurately.

All angles should be 90° and all lengths should be exactly 8 cm.

Mo and Kim are drawing an angle of 200°.




Talk to a partner about how both strategies will create an angle of 200°.

Use both strategies to draw an angle of 200°.

accurately drawn diagrams of 200° angles

# Calculate angles around a point

## Notes and guidance

In this small step, children move on to calculating angles based on given information, rather than always using a protractor to measure angles. When looking at drawings of angles, distinguish between those that are and are not to scale, and discuss why a protractor is or is not useful in that context.

Recap prior learning that a full turn is 360° and model this with a child turning through 360°. Children use a protractor to measure angles around a point to see that they add up to 360°. Any slight differences will be due to human error and should be discussed. Children then calculate missing angles using the knowledge that all the angles sum to 360°. They can either subtract each known angle from the total of 360°, or add the known angles first and then subtract this total from 360°. Children should also recognise that if they know that the angles around a point are equal, 360 can be divided by the number of angles to find the size of one of the angles.

## Things to look out for

- Children may use a protractor to measure a missing angle, rather than calculating from the given information.
- Children may not see or understand the notation for a right angle and exclude this from any calculations.

## Key questions

- What is a full turn?
- How many right angles are there in a full turn?
- How many degrees are there in a full turn?
- If you know three out of four angles around a point, how can you work out the fourth angle?
- Do you need to add or subtract to find the unknown angle? How do you know?
- If all the angles around a point are equal in size, how can you work out the size of each one?

## Possible sentence stems

- A full turn is ______ degrees and is made up of ______ right angles.
- Angles around a point sum to ______°.
- The missing angle is ______° subtract the total of ______°, ______° and ______°.

## National Curriculum links

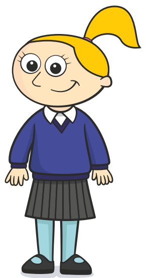
- Identify angles at a point and 1 whole turn (total 360°)

# Calculate angles around a point

## Key learning

- Eva faces in one direction.

  She then does a complete turn and ends up facing the same direction.



  - Discuss with a partner how many right angles Eva has turned.
  - Complete the sentences.

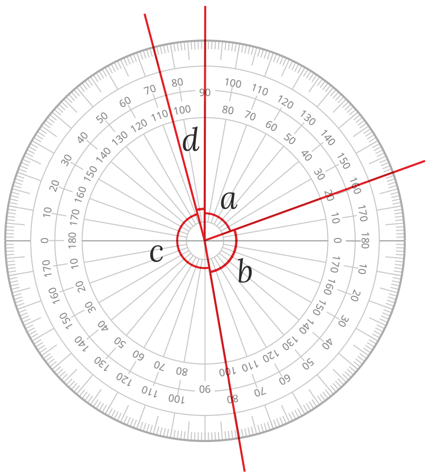
  1 complete turn = ______ right angles = ______°

  $\frac{1}{2}$ of a complete turn = ______ right angles = ______°

  $\frac{1}{\square}$ of a complete turn = 1 right angle = ______°

  $\frac{3}{4}$ of a complete turn = ______ right angles = ______°

- Measure the angles.

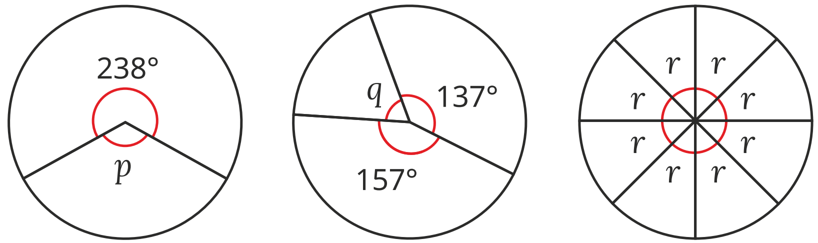



  $a$ = ______°  $b$ = ______°

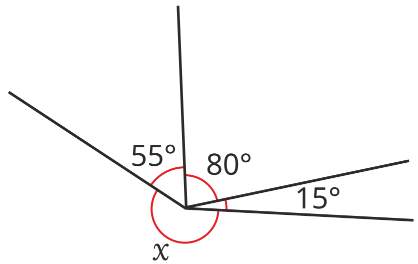
  $c$ = ______°  $d$ = ______°

  The sum of all four angles = ______°

- Work out the missing angles.




- Use the fact that angles around a point add up to 360° to work out the size of the angle marked $x$.




  Compare methods with a partner.

- There are three angles around a point.

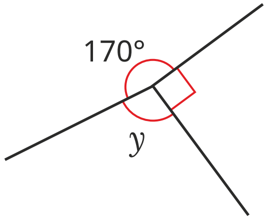
  Angle $a$ is half the size of angle $b$.

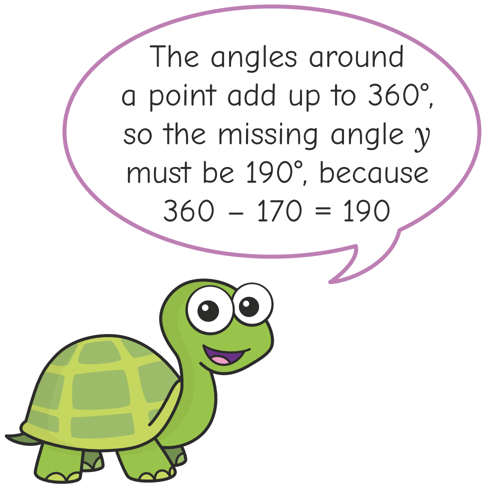
  Angle $c$ is the same size as the total of angles $a$ and $b$.

  What are the sizes of angles $a$, $b$ and $c$?

# Calculate angles around a point

## Reasoning and problem solving




Do you agree with Tiny?

Explain your answer.

No

Are the statements always true, sometimes true or never true?

If three of the angles around a point are right angles, any remaining angles will be acute.

If there are only three angles around a point, they must all be obtuse.

If there are only five equal angles around a point, they will all be acute.

If there are four angles around a point, they could all be acute.

Give reasons for your answers.

sometimes true

sometimes true

always true

never true

# Calculate angles on a straight line

## Notes and guidance

In this small step, children see that the total of the angles on a straight line is half the total of the angles around a point.

Children should recognise that a half turn is the same as a straight line, meaning that adjacent angles on a straight line sum to 180°. Looking at a protractor will reinforce this point, as children will see that the 0° to 180° line is a straight line.

Once children are secure in the understanding that both a half turn and a straight line are equal to 180°, they move on to working out unknown angles on a straight line. As with the previous step, explore both methods of calculation: the whole (180°) subtract each part; or add the parts first, then subtract from the whole.

Finally, children use division to work out equal angles knowing that the total is 180°, for example five equal angles on a straight line will all be 36°, because 180 ÷ 5 = 36

## Things to look out for

- Children may use a protractor to measure missing angles, rather than calculating from the given information.
- Children may confuse this step with the previous one and think that 360° is the whole rather than 180°.

## Key questions

- How many right angles are there in a half turn?
- How many degrees are there in a half turn?
- How can you work out a missing angle on a straight line if you know the size of the other angle/angles?
- What strategies can you use to work out missing angles?
- Do you need to add or subtract to find the unknown angle? Why?
- If there is more than one missing angle but they are equal, how can division help you to work them out?

## Possible sentence stems

- Angles on a straight line sum to ______°.
- The missing angle is ______° subtract ______°, ______° and ______°.

## National Curriculum links

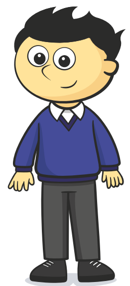
- Identify: angles at a point and 1 whole turn (total 360°); angles at a point on a straight line and half a turn (total 180°)

# Calculate angles on a straight line

## Key learning

- Jack faces in one direction.

  He then turns around to face the opposite direction.

  ▸ How many right angles has Jack turned?

  ▸ Complete the sentences.

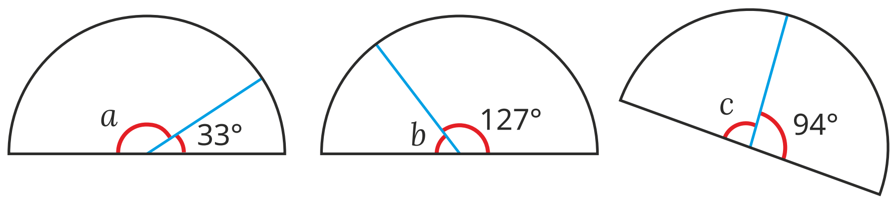
  $\frac{1}{4}$ of a complete turn = ______ right angle = ______°

  There are ______ right angles in a straight line.

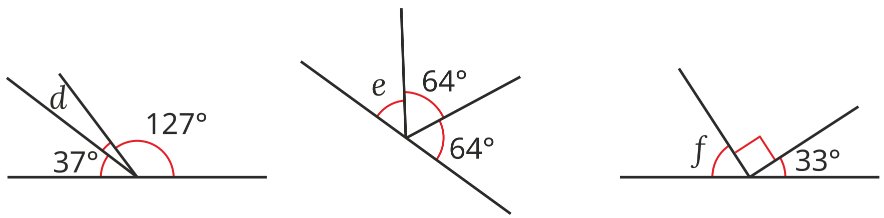
  1 half turn = ______ right angles = ______°

  There are ______° in a straight line.

- Work out the missing angles.

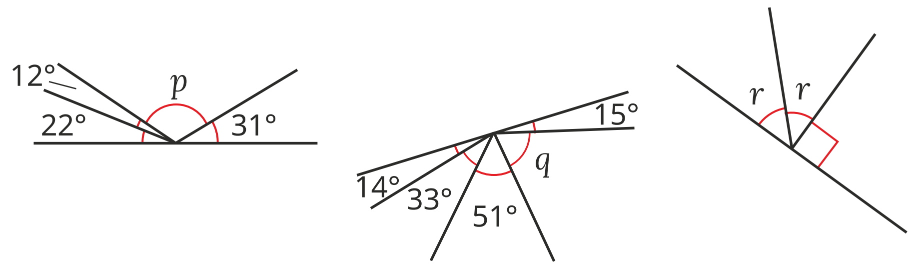



- Work out the missing angles.

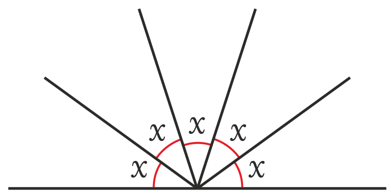



Is there more than one way to work out each angle?

- Work out the missing angles.




- The five angles are on a straight line.




Work out the size of each angle.

- There are three angles on a straight line.

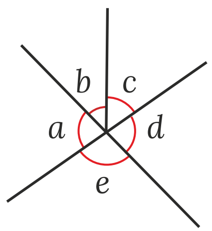
  Angle $a$ is half the size of angle $b$.

  Angle $c$ is the same size as the total of angles $a$ and $b$.

  Work out the sizes of the angles.

# Calculate angles on a straight line

## Reasoning and problem solving




$a + b + c + d + e = 360°$
$d + e = 180°$

Write some number sentences about this diagram.

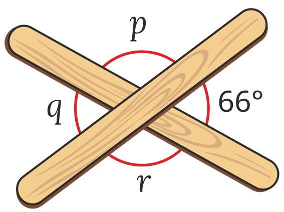
multiple possible answers, e.g.

$a + b + c = d + e$

$360° - e - d = 180°$

Two lolly sticks are on a table.

Work out the three missing angles.

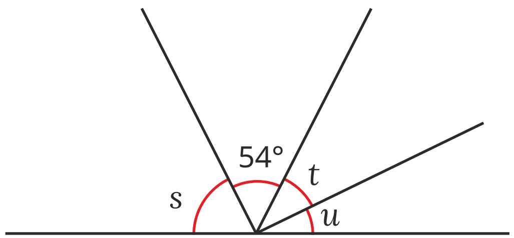



$p = 114°$

$q = 66°$

$r = 114°$

The angles are on a straight line.




- Angle $s$ is 9° greater than the size of the given angle.
- Angle $t$ is 11° greater than angle $u$.

Work out the sizes of the angles.

Create your own straight-line problem for a partner.

$s = 63°$

$t = 37°$

$u = 26°$

# Lengths and angles in shapes

## Notes and guidance

In this small step, children explore different strategies for calculating missing lengths and angles in shapes.

Start by recapping what perimeter is and how to calculate it, so that children can use this to work out missing lengths. Once children are confident at calculating the perimeter of a rectangle, move on to the perimeter of compound shapes composed of multiple rectangles. Encourage them to explore the fact that the area is multiplied by the number of rectangles used, but the same relationship is not true for the perimeter.

Using what they have learnt in previous steps, children can work out missing angles within shapes, both on a straight line and around a point. The rule that angles in a triangle sum to 180° is not covered formally until Year 6

## Things to look out for

- Children may use a ruler or a protractor to measure a length or an angle, rather than calculating from the given information.
- Children may assume that angles that look similar are equal in size.

## Key questions

- What is the perimeter of the shape?
- If two of these shapes are joined together, does the perimeter double?
- What is the perimeter of the compound shape?
- If you know the size of angle $x$ in the shape, how can you work out the sizes of other angles in the shape?
- If the perimeter of the shape is ______, what is the length of the line marked ______?

## Possible sentence stems

- Angles on a straight line sum to ______°.
- Angles around a point sum to ______°.
- If the perimeter is ______ cm and the sides I know sum to ______ cm, then the missing side is ______ cm.

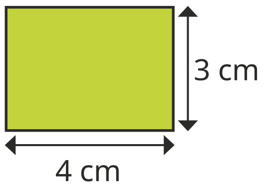
## National Curriculum links

- Identify: angles at a point and 1 whole turn (total 360°); angles at a point on a straight line and half a turn (total 180°)
- Use the properties of rectangles to deduce related facts and find missing lengths and angles

# Lengths and angles in shapes

## Key learning

- A rectangle measures 4 cm by 3 cm.

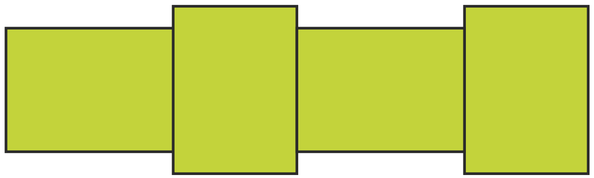



  - Calculate the area and perimeter of the rectangle.

  This compound shape is made from three of the rectangles.

  - Calculate the area and perimeter of the compound shape.
  - What do you notice about the changes in area and perimeter from the first shape to the second? Why do you think this is?

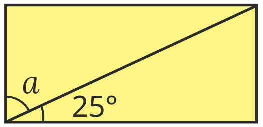
  This compound shape is made from four of the rectangles.



  - Calculate the area and perimeter of the compound shape.

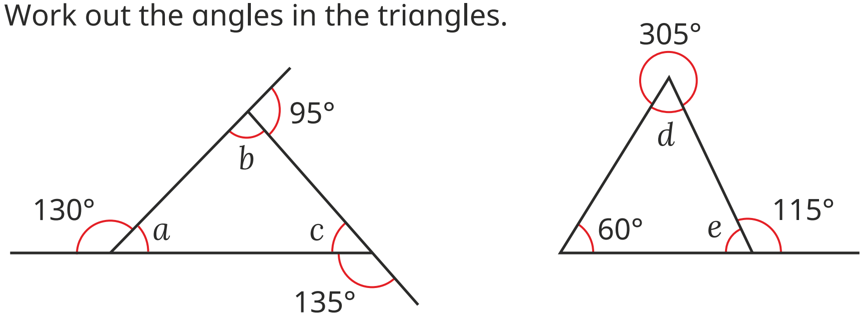
    Which was easier to work out?

- A rectangle has been split into two triangles.




  - Work out the size of angle $a$.
  - What other missing angles can you calculate in the rectangle?

- Work out the angles in the triangles.

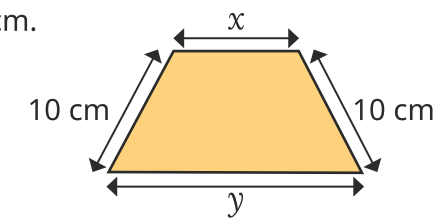



  What do you notice about the angles of each triangle?

- The perimeter of the trapezium is 44 cm.

  Side $y$ is twice the length of side $x$.

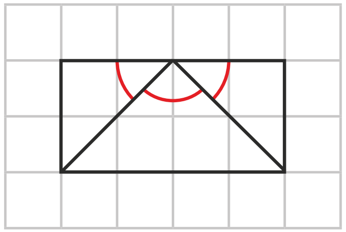
  Calculate the length of side $y$.

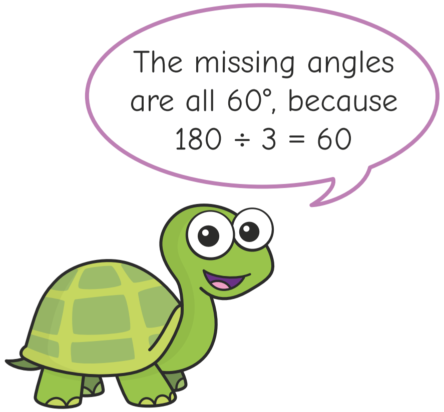


# Lengths and angles in shapes

## Reasoning and problem solving

Tiny is working out angles.



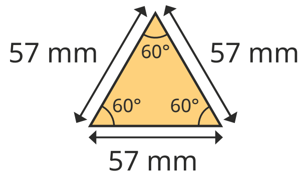



Do you agree with Tiny?

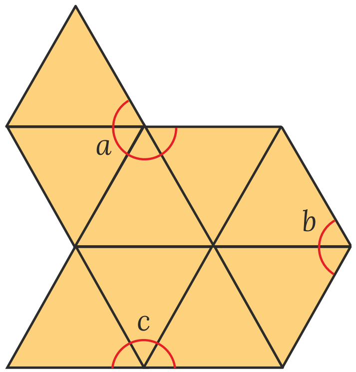
Explain your answer.

No

The lengths and interior angles of a triangular sticker are shown.




Some of these stickers are used to make this compound shape.




Work out the perimeter of the compound shape.

Work out the sizes of the angles marked with letters.

513 mm

$a$ = 240°

$b$ = 120°

$c$ = 180°

# Regular and irregular polygons

## Notes and guidance

In this small step, children explore regular and irregular polygons. It is important to discuss with children that the words “polygon” and “shape” are not interchangeable. A polygon refers to a 2-D, fully enclosed shape formed from straight lines. Show examples and non-examples of polygons to help with this understanding.

Move on to explore what a regular polygon is, allowing children to see that not only do all sides have to be the same length, but the angles must also be equal. A good example is the difference between a square and a rectangle: while the angles are all equal, the sides are not. Ensure that children understand that equal sides are indicated by hatch marks.

Once children are confident at identifying regular and irregular polygons, ask them to calculate the perimeter of regular shapes when given the length of one side. They may also explore finding the length of each side of a regular polygon when given the perimeter.

## Things to look out for

- Children may not identify polygons correctly.
- Children may think that a polygon with equal angles but different length sides, or with equal length sides and different angles, is regular.

## Key questions

- What is a polygon?
- What are the features of a polygon?
- Can a polygon have a curved side?
- How can you measure the perimeter of a polygon?
- What is a regular polygon?
- Is a shape with all equal sides always a regular polygon?
- How do you know that the shape is regular/irregular?

## Possible sentence stems

- In a regular polygon, all angles are ______ and all sides are ______
- In a regular polygon, if one side is ______ then the perimeter can be found by …

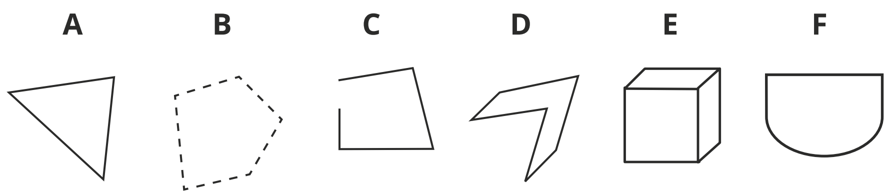
## National Curriculum links

- Distinguish between regular and irregular polygons based on reasoning about equal sides and angles

# Regular and irregular polygons

## Key learning

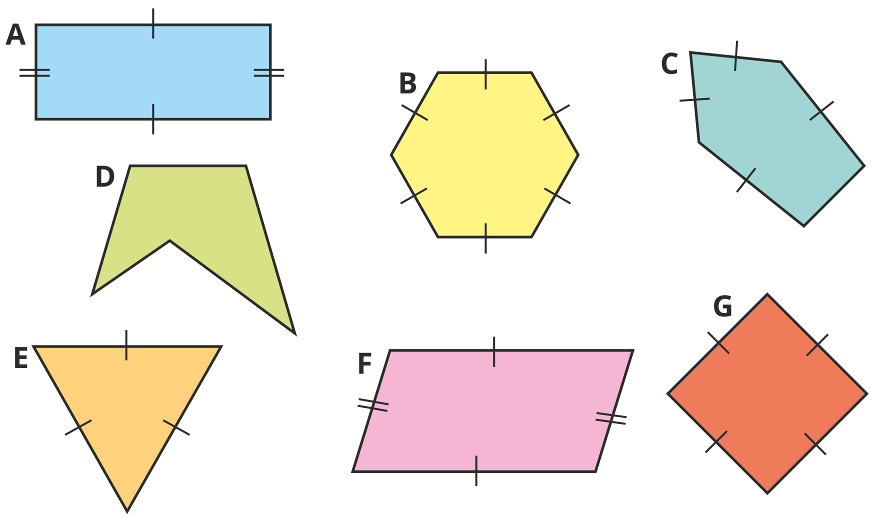
- Which of the shapes are polygons?




How do you know?

- In a regular polygon, all angles are equal and all sides are equal.

  Sort the shapes into regular and irregular polygons.




- Draw a regular polygon and an irregular polygon.

  Compare shapes with a partner.

  What is the same and what is different about your two shapes?

- Brett draws a regular triangle.

  Each side is 6 cm.

  What is the perimeter of Brett's triangle?

- Nijah draws a regular hexagon.

  Each side is 12 cm.

  What is the perimeter of Nijah's hexagon?

- Teddy draws a shape with four straight lines.

  There are four right angles in Teddy's shape.

  Is Teddy's shape regular, irregular or is it impossible to tell?

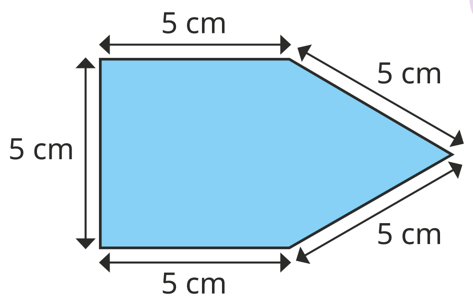
  Explain your answer.

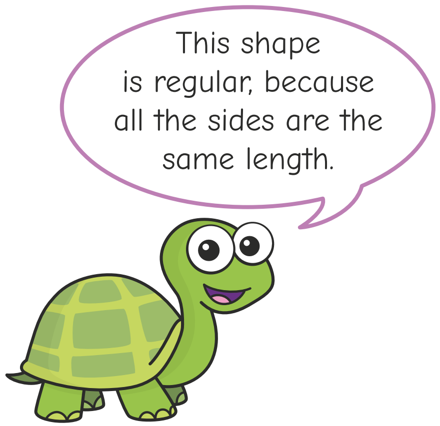
- The perimeter of a regular pentagon is 60 mm.

  What is the length of each side?

# Regular and irregular polygons

## Reasoning and problem solving




Do you agree with Tiny?

Explain your answer.

No

Are the statements always true, sometimes true or never true?

A regular polygon has equal sides, but not equal angles.

A triangle is a regular polygon.

A rhombus is a regular polygon.

In any polygon, the number of angles is the same as the number of sides.

Explain your answers.

never true

sometimes true

sometimes true

always true

# 3-D shapes

## Notes and guidance

In this small step, children start by recapping the names of 3-D shapes, and then move on to their properties. Seeing models of 3-D shapes will help to remind children of the differences between faces, edges and vertices. Identifying the 2-D shapes on the faces of the 3-D shapes allows children to compare shapes and will provide a basis for their learning of nets in Year 6

Children also look at 2-D drawings of 3-D shapes on isometric paper, identifying the 3-D shape as well as its properties. By counting the dots on each side, they can identify equal lengths that can be used to tell the difference between, for example, a cube and a cuboid.

Finally, children look at drawings of compound 3-D shapes made up of two or three simple 3-D shapes and identify which 3-D shapes were used to make the shape.

## Things to look out for

- Children may only count the faces, vertices and edges that they can see on the 2-D representation.
- Children may confuse some 3-D shapes, such as triangular-based pyramids and triangular prisms.

## Key questions

- What is the mathematical name for this 3-D shape?
- How many faces/edges/vertices are there on this 3-D shape?
- What 3-D shape is shown by this 2-D representation?
- How can you tell how many faces/edges/vertices there are on this 3-D shape when they are not all visible?
- What 2-D shapes can you see on the faces of the 3-D shape?
- What 3-D shapes is this compound shape made up of?

## Possible sentence stems

- This shape has ______ faces, ______ edges and ______ vertices.
- This shape is made up of a ______ and a ______

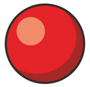
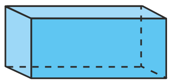
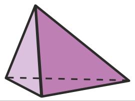
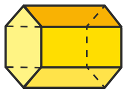
## National Curriculum links

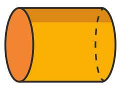
- Identify 3-D shapes, including cubes and other cuboids, from 2-D representations

# 3-D shapes

## Key learning

- Match the 3-D shapes to their names.



cuboid

triangular-based pyramid

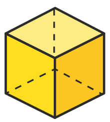
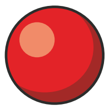
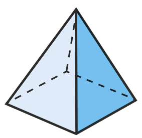
cone

sphere

hexagonal prism

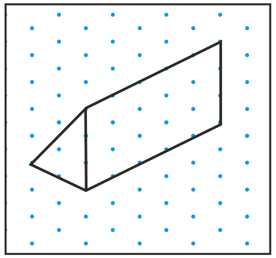
cylinder

- How many faces, edges and vertices does each shape have?

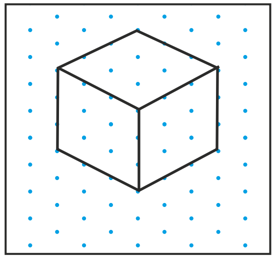




- Sam, Tommy and Ron have each drawn a 3-D shape on isometric paper.

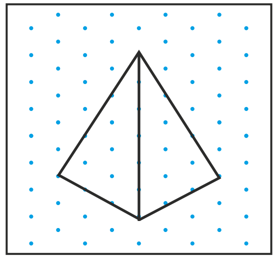
**Sam**



**Tommy**



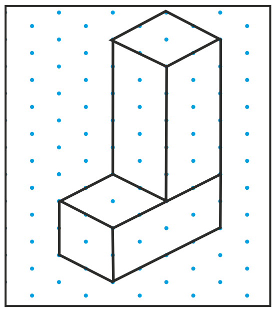
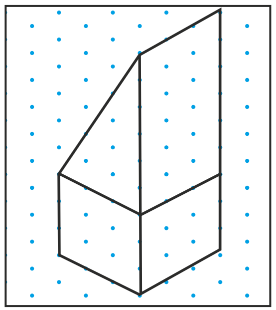
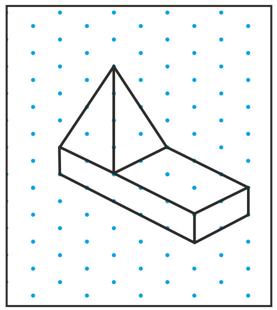
**Ron**



What 3-D shapes have they drawn? Is there more than one answer?

How many faces, edges and vertices does each shape have?

- Alex draws compound shapes made from other 3-D shapes.

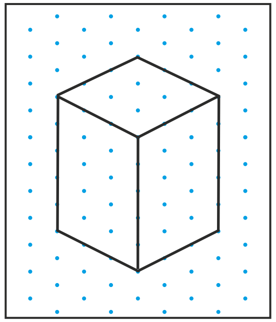
What shapes has Alex used?

How many faces are there on each of Alex's shapes?

# 3-D shapes

## Reasoning and problem solving

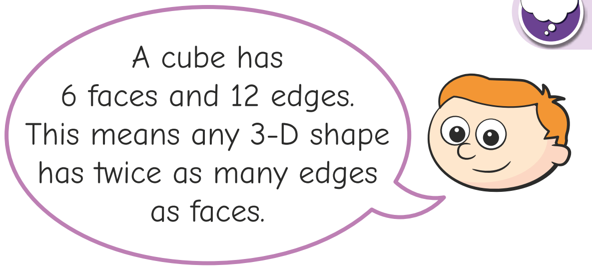
Huan has drawn this shape on isometric paper.




Do you agree with Tiny?

Explain your answer.

No

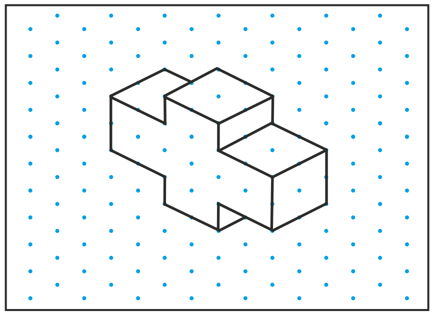



Do you agree with Ron?

Explain your answer.

No

How many faces does the shape have?



14

Summer Block 2

# Position and direction

# Small steps

| | |
|---|---|
| Step 1 | Read and plot coordinates |
| Step 2 | Problem solving with coordinates |
| Step 3 | Translation |
| Step 4 | Translation with coordinates |
| Step 5 | Lines of symmetry |
| Step 6 | Reflection in horizontal and vertical lines |

# Read and plot coordinates

## Notes and guidance

Children first saw a coordinate grid in Year 4 when they read and plotted points on a grid. They also translated points and described translations. In this small step, they recap reading and plotting coordinates on a coordinate grid. They still work only within the first quadrant (positive numbers for both coordinates), with the four-quadrant grid being taught in Year 6

Remind children what a coordinate looks like and what each number refers to. Highlight the importance of reading and plotting the $x$-value of the coordinate first. Children identify the coordinates of given points on a grid, then move on to plotting points with given coordinates. This can lead to drawing shapes on a coordinate grid with given coordinates or working out the coordinates of a shape from known information.

## Things to look out for

- Children may confuse the $x$- and $y$-values of the coordinates and read or plot them in the wrong order.
- Children may assume that the intervals on the axes always go up in 1s.

## Key questions

- What is a coordinate grid?
- What are the two axes called?
- What are coordinates?
- When reading or plotting coordinates, which axis do you look at first?
- Does it matter which way round the values of coordinates are written?
- If the point moves up/down/left/right one place, what happens to the coordinates of the point?

## Possible sentence stems

- Read the ______-axis before the ______-axis.
- The $x$-coordinate of the point is ______ and the $y$-coordinate is ______
  The point has the coordinates (______, ______).

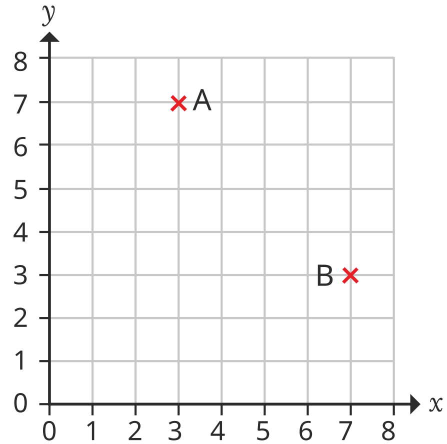
## National Curriculum links

- Identify, describe and represent the position of a shape following a reflection or translation, using the appropriate language, and know that the shape has not changed

# Read and plot coordinates

## Key learning

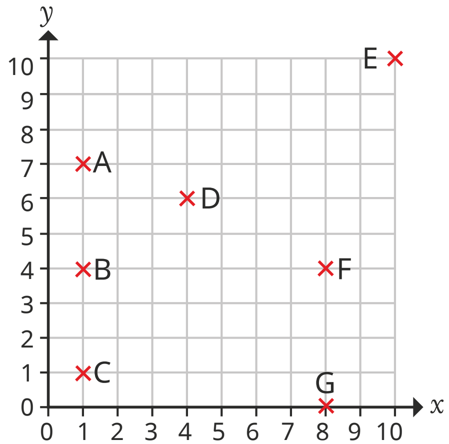
- Two points are plotted on the coordinate grid.




  - Which point has the coordinates (7, 3)?

    How do you know?
  - What are the coordinates of the other point?

- Seven points are plotted on a coordinate grid.




  - What are the coordinates of each point?
  - How many of the points have an $x$-coordinate of 1?
  - How many of the points have a $y$-coordinate of 4?
  - How many of the points have the same $x$- and $y$-coordinates?

- Plot the points on the coordinate grid.

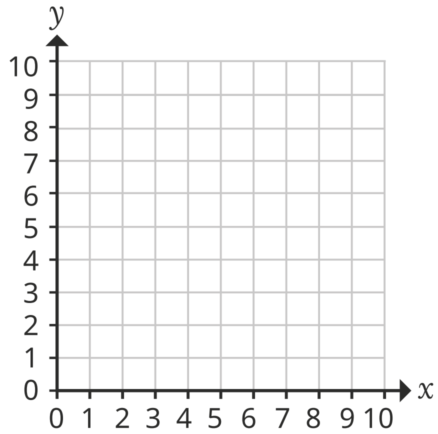
  (3, 6)

  (7, 3)

  (7, 6)

  (5, 0)

  (3, 3)




  Join the points to make a polygon.

  What polygon have you drawn?

- Nijah draws a square on a coordinate grid.

  Two of the vertices have the coordinates (1, 1) and (5, 5).

  What are the coordinates of the other two vertices?

- Scott draws a straight line on a coordinate grid.

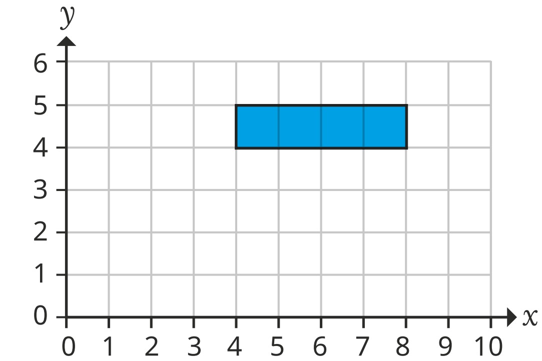
  The straight line passes through points with the coordinates (1, 4) and (1, 8).

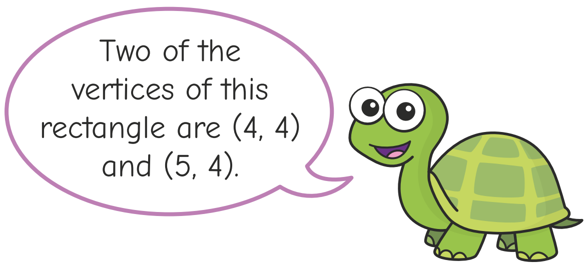
  Write the coordinates of three other points that the straight line passes through.

# Read and plot coordinates

## Reasoning and problem solving

Here is a rectangle on a coordinate grid.



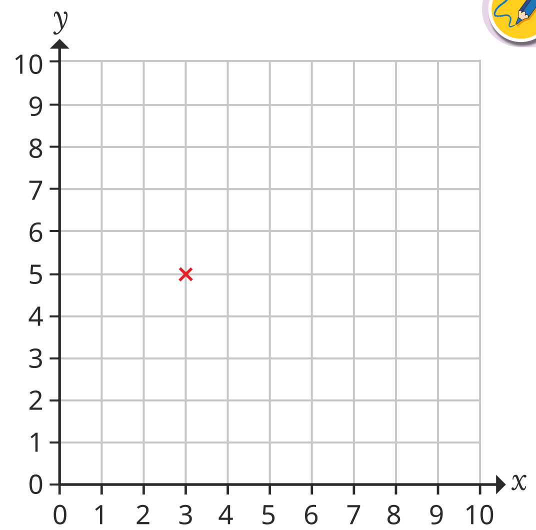



Do you agree with Tiny?

Explain your answer.

No

One vertex of a rectangle has been plotted on a coordinate grid.



The rectangle has a perimeter of 10 squares and fits on the grid.

What could the coordinates of the other three vertices of the rectangle be?

Is there more than one possible answer?

multiple possible answers, e.g.

(3, 6), (7, 6), (7, 5)

(5, 5), (5, 2), (3, 2)

(3, 8), (1, 8), (1, 5)

# Problem solving with coordinates

## Notes and guidance

In this small step, children move on from reading and plotting coordinates on a grid to solving problems involving knowledge and understanding of coordinates.

Children begin by looking at shapes on a grid where the axes are not fully labelled. By knowing the coordinates of one vertex, children can count up, down or across on the grid to work out the missing coordinates of the other vertices. They can also suggest possible coordinates for vertices based on the area or perimeter of a shape if they know the coordinates of one vertex.

Children then move on to problem solving when there are no gridlines, where they need to use the given coordinates to work out any missing coordinates and counting squares is not an option. By knowing that the coordinates of points on horizontal lines have the same $y$-coordinates and those on vertical lines have the same $x$-coordinates, children can find missing coordinates in rectilinear shapes.

## Things to look out for

- Children may confuse the $x$- and $y$-axes.
- Without a grid on which to count squares, children may find it tricky to work out missing values.
- Children may assume that all axes count up in 1s.

## Key questions

- Which axis do you look at first when writing coordinates?
- If the coordinates of this point are ______, what does that tell you about the coordinates of the points directly above/below/to the right/to the left?
- Do horizontal/vertical lines share a part of their coordinates?
- What happens to the $x$-/$y$-value of the coordinates when you move a point to the left/right/up/down by 1 square?
- If the perimeter/area of the shape is ______, what could the missing coordinates be?

## Possible sentence stems

- The ______-coordinates of points on a vertical line are equal.
- The ______-coordinates of points on a horizontal line are equal.

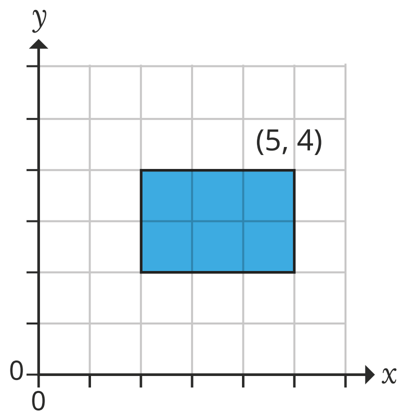
## National Curriculum links

- Identify, describe and represent the position of a shape following a reflection or translation, using the appropriate language, and know that the shape has not changed

# Problem solving with coordinates

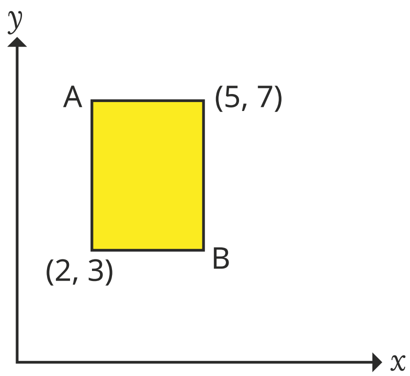
## Key learning

- A rectangle has been drawn on a coordinate grid.




How can you use the given coordinates to work out the coordinates of the other three vertices?

- A rectangle has been drawn on a coordinate grid.

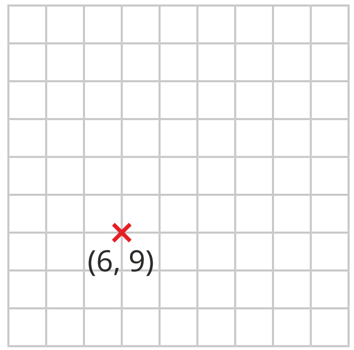



What are the coordinates of vertices A and B?

How did you work them out?

- Whitney is drawing a square on a coordinate grid.

The square has an area of 9 squares.

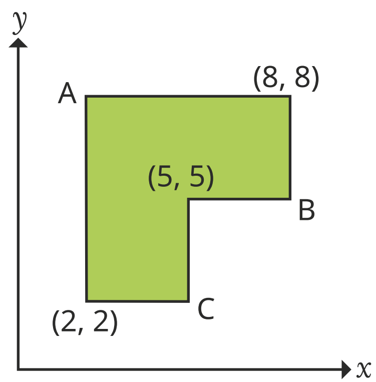



What could the coordinates of the other three vertices be?

How did you work them out?

Is there more than one possible answer?

- Work out the coordinates of points A, B and C.

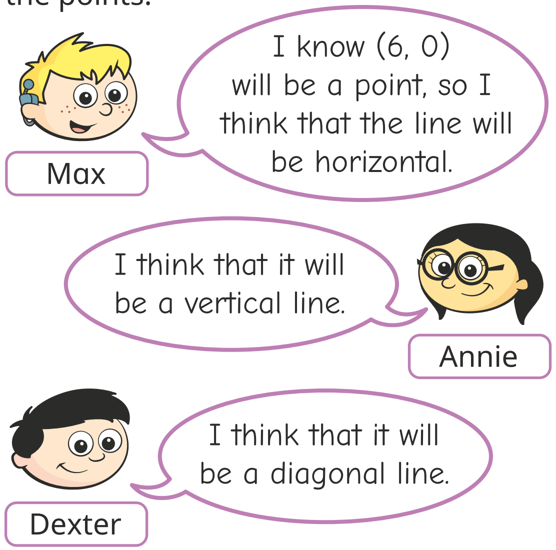


# Problem solving with coordinates

## Reasoning and problem solving

Max, Annie and Dexter are plotting points where the $x$-coordinate and the $y$-coordinate add up to 6

They will then draw a line through all the points.



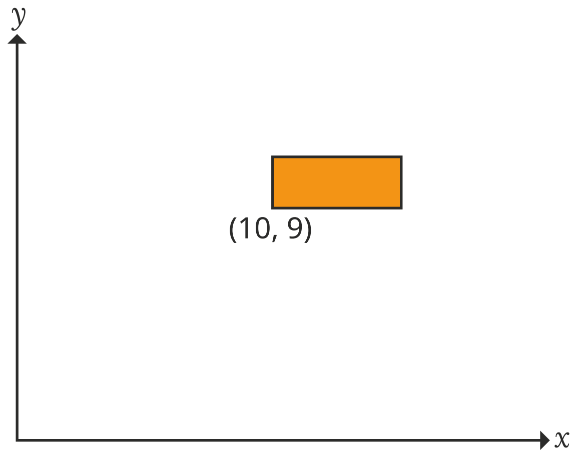

Who do you agree with?

Plot the points on a grid and draw the line to check your answer.

Dexter

diagonal straight line from (0, 6) to (6, 0)

The perimeter of the rectangle is 14 units.




What could the coordinates of the other vertices be?

How many possible answers can you find?

multiple possible answers, e.g.

(10, 10), (16, 10), (16, 9)

(10, 11), (15, 11), (15, 9)

(10, 12), (14, 12), (14, 9)

# Translation

## Notes and guidance

In Year 4, children translated shapes on a coordinate grid and described translations. This small step revisits that learning, on both a squared grid and a coordinate grid.

Children begin by translating a single point, before translating full shapes. Model translations on a grid, telling children that the point or shape moves to a different position, but remains exactly the same size and orientation. Children then translate shapes, starting with either up/down or left/right before moving on to a combination of both directions.

Show children two shapes on a grid where one is a translation of the other and ask them to describe the translation that has taken place. It is important to model this by looking at how one vertex has been translated, rather than considering the gap between the two shapes, as children can often confuse the two.

### Things to look out for

- Children may confuse left and right.
- When describing a translation, children may look at the gap between shapes rather than how the vertices have been translated.
- Children may count the square the point starts on as “1”, meaning that they do not translate by enough squares.

## Key questions

- What does it mean to translate a shape?
- How does a shape change when it is translated? How does it stay the same?
- How can you translate a shape to the left/right/up/down?
- Can you translate a shape both left/right and up/down? Does it matter which you do first?
- Does translating the shape one vertex at a time make it easier? Why/why not?
- How has the shape been translated?

## Possible sentence stems

- Shape A has been translated ______ squares to the left/right and ______ squares up/down.
- When a shape has been translated, the position of the shape ______ but the size of the shape ______

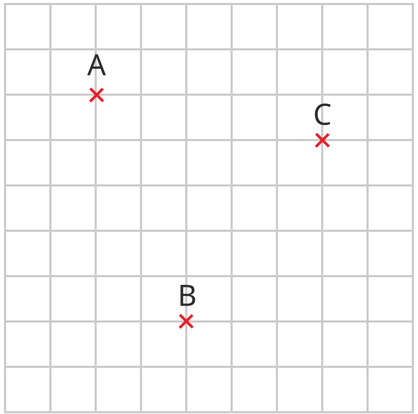
### National Curriculum links

- Identify, describe and represent the position of a shape following a reflection or translation, using the appropriate language, and know that the shape has not changed

# Translation

## Key learning

- Three points are marked on a grid.

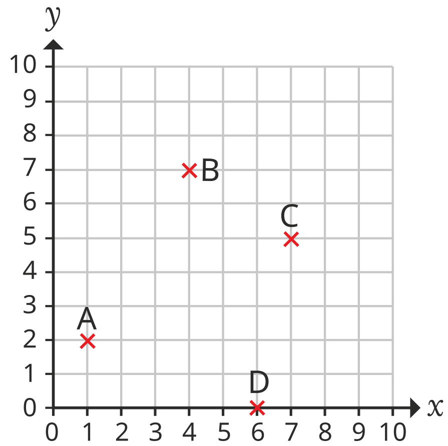



▸ Translate point A 2 squares right.

▸ Translate point B 4 squares up.

▸ Translate point C 1 square to the left and 3 squares down.

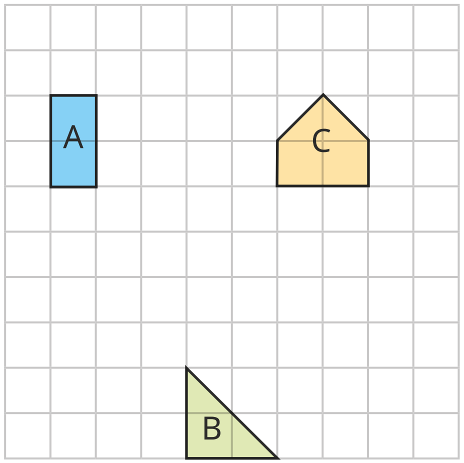
- Four points are plotted on a coordinate grid.




Describe the translations:

- A to B
- C to D
- D to A
- A to D

- Three shapes are drawn on a grid.

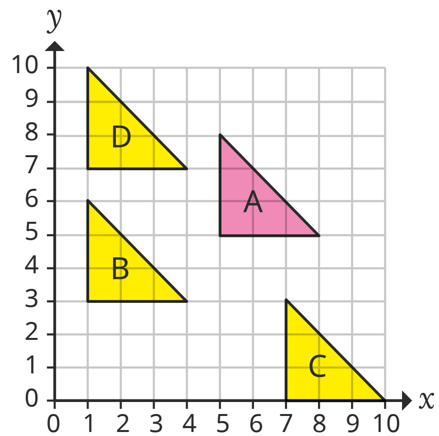



▸ Translate shape A 4 squares down.

▸ Translate shape B 3 squares left.

▸ Translate shape C 1 square to the right and 2 squares down.

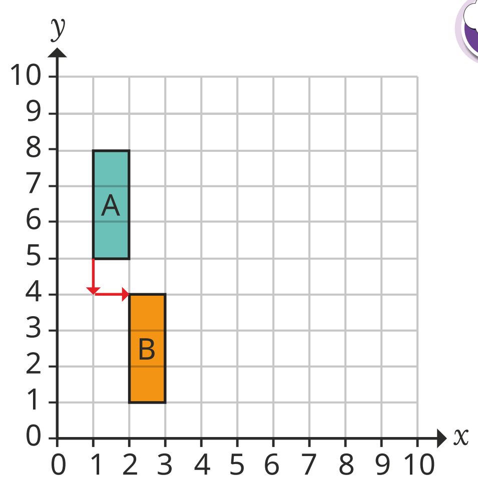
- Complete the sentence to describe the translation of shape A to shapes B, C and D.

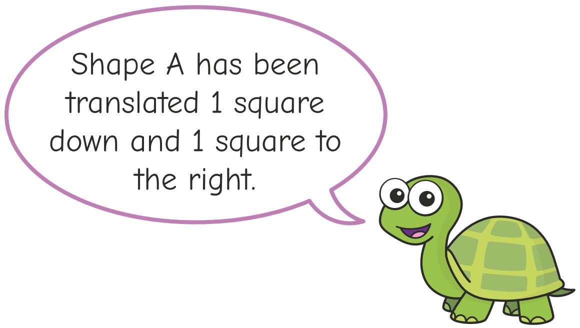



Shape A has been translated ______ squares to the left/right and ______ squares up/down.

# Translation

## Reasoning and problem solving

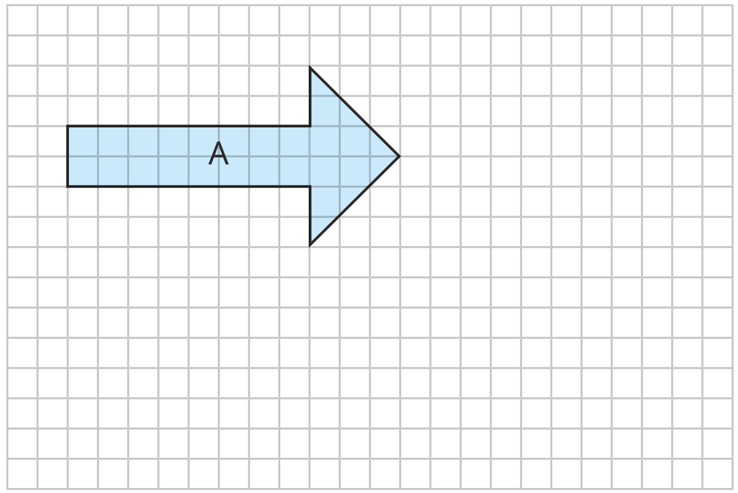



Do you agree with Tiny?

Explain your answer.

No




Dani wants to translate shape A as far to the right and as far down as possible so that it still fits on the grid.

Complete the sentence.

Shape A can translate ______ squares to the right and ______ squares down and still fit on the grid.

11 squares to the right

8 squares down

# Translation with coordinates

## Notes and guidance

This small step builds on the learning of the previous step, to now include understanding of how coordinates change when points are translated.

Begin by getting children to realise that when a point is translated to the left or right, the $y$-coordinate remains the same and the $x$-coordinate changes, and when it is translated up or down, the $x$-coordinate remains the same and the $y$-coordinate changes. They can then use this understanding to work out the new coordinates of translated points without the help of a grid. They should also be able to describe how a point has been translated to another point both with and without using a grid.

Children then move on to looking at shapes on a coordinate grid. If they know where one of the vertices is going to be translated to, they can work out the coordinates of where the other vertices will be translated to.

## Things to look out for

- Children may confuse the $x$- and $y$-axes.
- Children may find it hard to work out coordinates without the help of a grid.
- When translating a shape or point, children may count the point it is on as "1" and not translate enough spaces.

## Key questions

- If a point on a coordinate grid moves up or down, what happens to the coordinates?
- What do you notice about the $x$-/$y$-coordinate when a point is translated up/down or left/right?
- If you know how a point is translated, how can you work out what the new coordinates will be?

## Possible sentence stems

- When a point is translated up/down, the ______-coordinate stays the same and the ______-coordinate changes.
- When a point is translated left/right, the ______-coordinate stays the same and the ______-coordinate changes.
- When the point with coordinates ______ is translated ______ left/right and ______ up/down, the new coordinates are ______

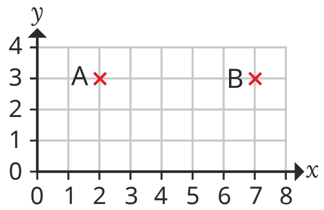
## National Curriculum links

- Identify, describe and represent the position of a shape following a reflection or translation, using the appropriate language, and know that the shape has not changed

# Translation with coordinates

## Key learning

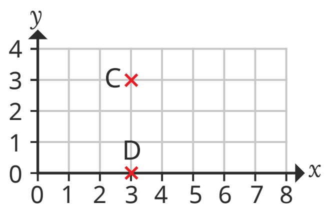
- Point A is translated to point B.




Write the coordinates of both points.

What do you notice?

Point C is translated to point D.




Write the coordinates of both points.

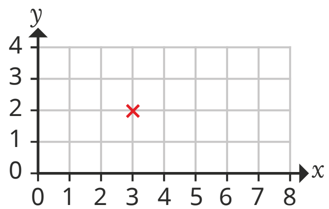
What do you notice?

- Teddy plots a point that has the coordinates (5, 4).

He translates the point so that it has the same $x$-coordinate, but a different $y$-coordinate.

Has he translated the point up/down or left/right?

- The point is translated 4 squares to the right and 2 squares down.




Write the coordinates of both points.

What do you notice?

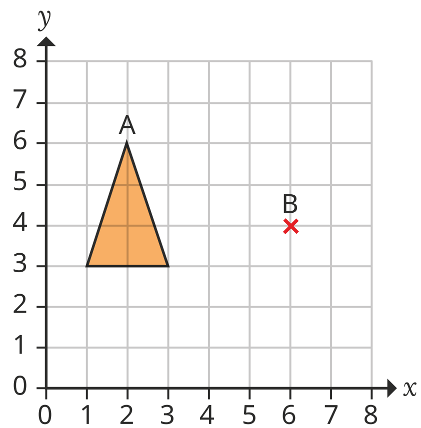
- Complete the table.

The first line has been done for you.

| Coordinates | Translation | New coordinates |
|---|---|---|
| (1, 3) | 2 right and 1 down | (3, 2) |
| (5, 2) | 3 left and 2 up | |
| (6, 7) | | (2, 5) |
| | 1 left and 1 down | (5, 5) |

- A triangle is translated so that point A translates to point B.

What are the coordinates of the other vertices of the translated triangle?



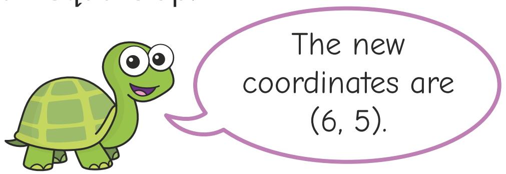

How did you work this out?

# Translation with coordinates

## Reasoning and problem solving

A point on a grid has the coordinates (5, 4).

The point is translated 1 square left and 1 square up.




Do you agree with Tiny?

Explain your answer.

No

Dora plots a point on a coordinate grid.

She translates the point 2 right.

She then translates that point 2 down.

She then translates that point 2 left.

She joins up all four points with straight lines.

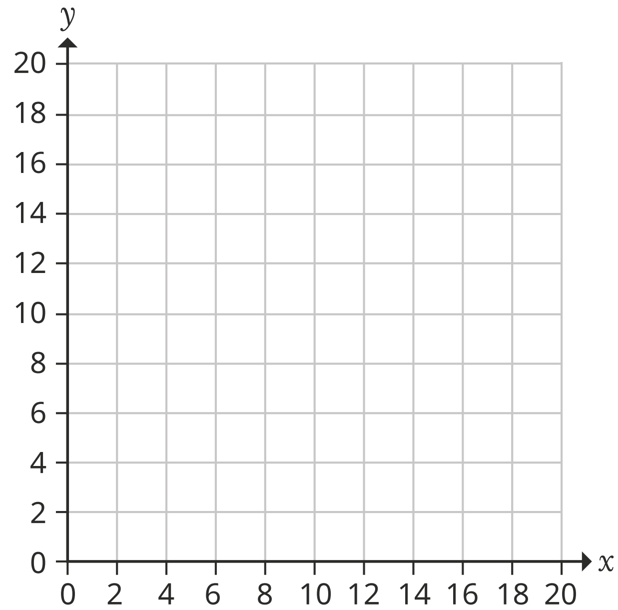
What shape has Dora drawn?

square

A rectangle is translated 2 squares left and 4 squares up.

The coordinates of three of the vertices of the translated rectangle are (6, 8), (10, 8) and (10, 14).

What are the coordinates of the vertices of the original rectangle?




(8, 4), (12, 4), (12, 10), (8, 10)

# Lines of symmetry

## Notes and guidance

Children first identified vertical lines of symmetry in shapes in Year 2. In this small step, that learning is extended to include any line of symmetry in a 2-D shape.

Begin by recapping the definition of a line of symmetry. Mirrors are a useful aid for this. Children then identify shapes on a grid that have a mirror line. Once they are confident at finding a single line in a shape (horizontal, vertical or diagonal), they move on to identifying shapes that have more than one line of symmetry.

Children can also identify lines of symmetry on shapes without the aid of the grid that they can use to check the size of both parts by counting. It is worth remembering that this is the first time that children have explored shapes with multiple lines of symmetry in different orientations, and a lot of modelling may be needed.

## Things to look out for

- Children may only look for a vertical line of symmetry.
- Children may find only one line of symmetry when there are more.
- Children may draw a line of symmetry where there is an equal amount of shape on both sides, rather than a mirror image.

## Key questions

- What does "symmetrical" mean? What is a line of symmetry?
- What does "vertical"/"horizontal"/"diagonal" mean?
- How can you show a line of symmetry on a shape?
- What will each side of a shape look like either side of a mirror line?
- Can a shape have more than one line of symmetry?
- How can grid lines help you to find lines of symmetry on a shape?
- Does using a mirror help you to find a line of symmetry?

## Possible sentence stems

- The shape has ______ lines of symmetry.
- Either side of a mirror line, the shapes are ______

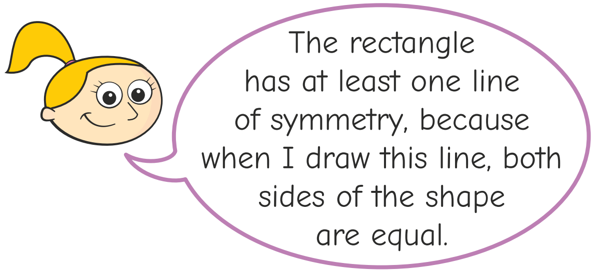
## National Curriculum links

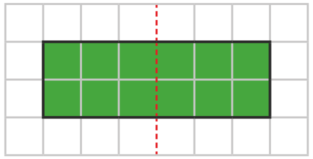
- Identify, describe and represent the position of a shape following a reflection or translation, using the appropriate language, and know that the shape has not changed

# Lines of symmetry

## Key learning

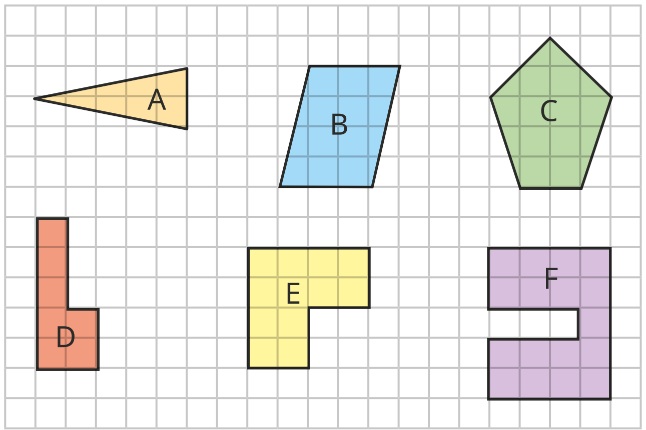
- Eva is identifying lines of symmetry on a rectangle.



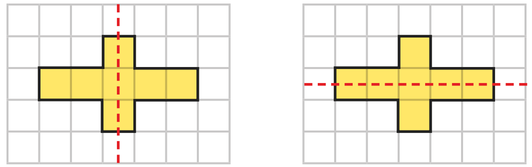
Are there any other lines of symmetry on the rectangle?

- Which of these shapes have **at least** one line of symmetry?

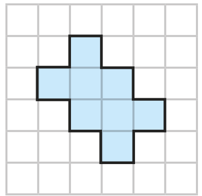



Are the lines of symmetry vertical, horizontal or diagonal?

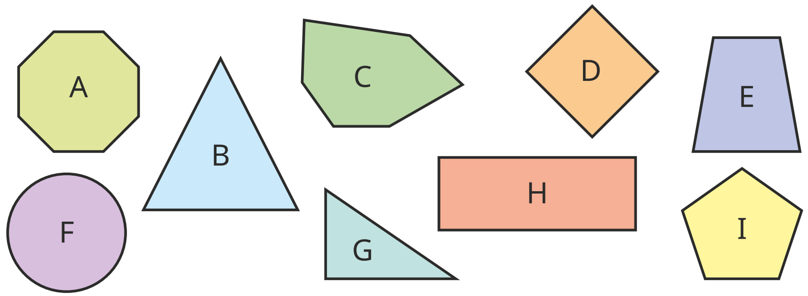
- Ron and Sam are finding lines of symmetry in the same shape.



Add lines of symmetry to this shape.



- Sort the shapes into the table.




| | 1 line of symmetry | More than 1 line of symmetry |
|---|---|---|
| Up to 4 sides | | |
| More than 4 sides | | |

# Lines of symmetry

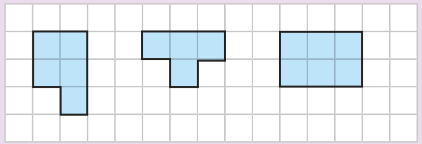
## Reasoning and problem solving

Draw three shapes on a squared grid.

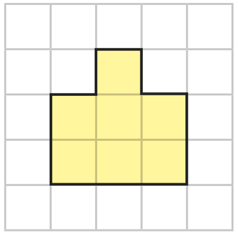
- One shape has no lines of symmetry.
- One shape has exactly one line of symmetry.
- One shape has more than one line of symmetry.

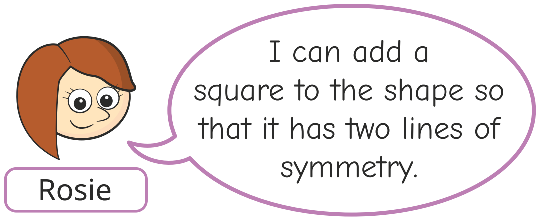
Use more than 3 squares but fewer than 7 squares for each shape.

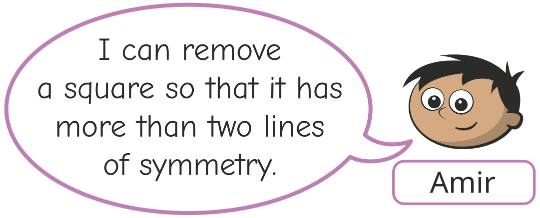
multiple possible answers, e.g.



This shape has one line of symmetry.

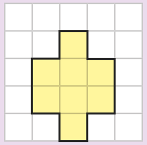




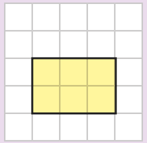




Draw the shapes that Rosie and Amir have described.

Rosie:



Amir:



# Reflection in horizontal and vertical lines

## Notes and guidance

Building on the previous step, in this small step children complete reflections for the first time.

Begin by looking at what reflection is and how it is different from translation. The use of mirrors is helpful for this, but this time children need to place the mirror on the given line rather than in the middle of the shape. As well as using squared paper, model reflecting a shape on a coordinate grid where the mirror line is a line parallel to one of the axes, reflecting one vertex of the shape at a time.

For added challenge, children can reflect shapes where the grid is not shown and they have to work out the new coordinates of the shape by considering how far away from the mirror line each coordinate is, rather than counting squares.

## Things to look out for

- Children may translate a shape, rather than reflect it.
- Children may find that shapes that do not touch the mirror line are harder to reflect than those that do.
- Children may copy the shape, rather than reflecting it to face the opposite way.

## Key questions

- What is reflection?
- What does a shape look like when it has been reflected?
- How can using a mirror help you to reflect shapes?
- How could reflecting one vertex of a shape at a time help?
- If the coordinates of vertex A are ______, what are the coordinates of the corresponding vertex when it has been reflected?
- How is reflection different from translation?

## Possible sentence stems

- Vertex A is ______ squares away from the mirror line, so the corresponding vertex needs to be ______ squares away from the mirror line.
- The coordinates of the vertices of the reflected shape will be …

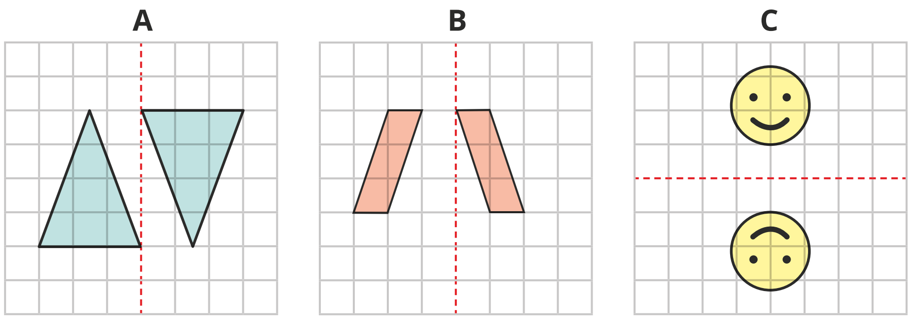
## National Curriculum links

- Identify, describe and represent the position of a shape following a reflection or translation, using the appropriate language, and know that the shape has not changed

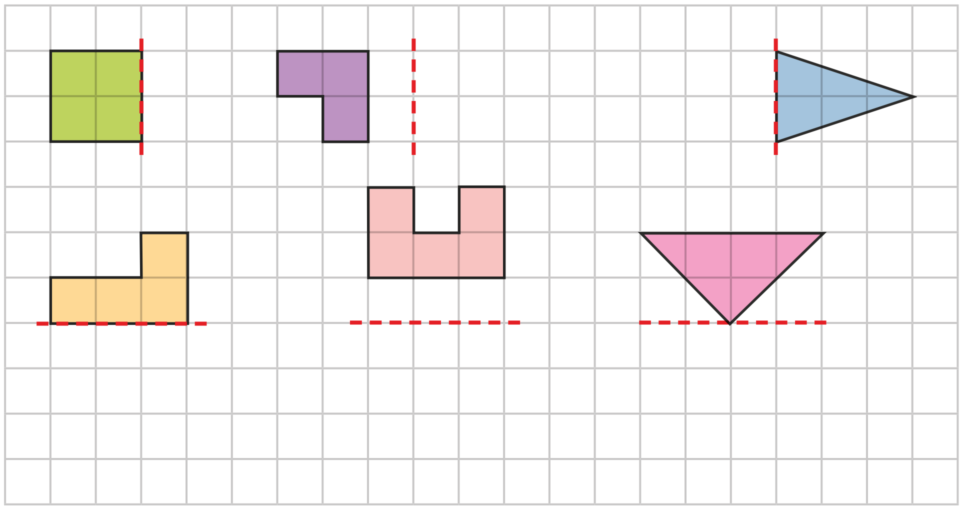
# Reflection in horizontal and vertical lines

## Key learning

- Which diagrams show a reflection in the given mirror line?

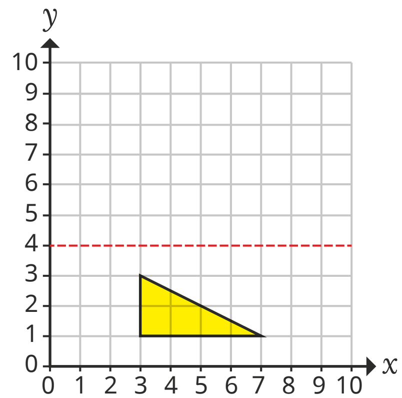



- Reflect each shape in its mirror line.

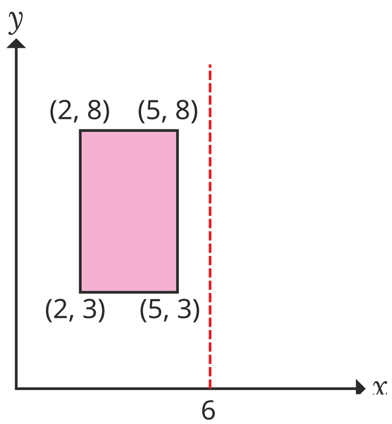


- Reflect the triangle in the mirror line.

  Write the coordinates of the vertices of the reflected triangle.



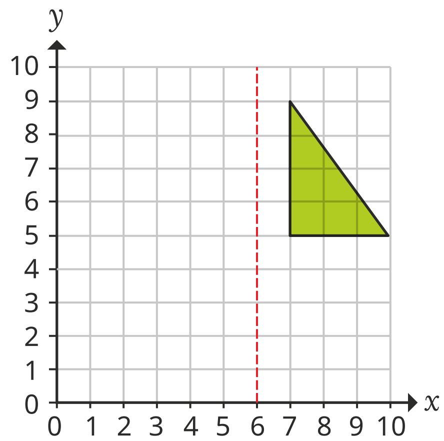

- The rectangle is reflected in the mirror line.



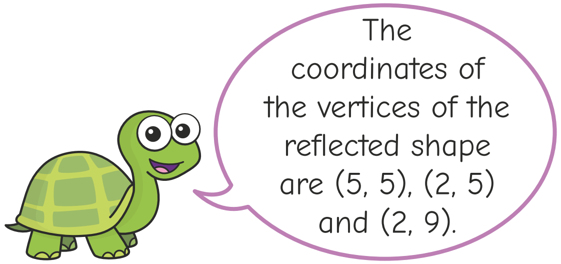

What are the coordinates of the vertices of the reflected rectangle?

# Reflection in horizontal and vertical lines

## Reasoning and problem solving




Tiny reflects the shape in the mirror line.

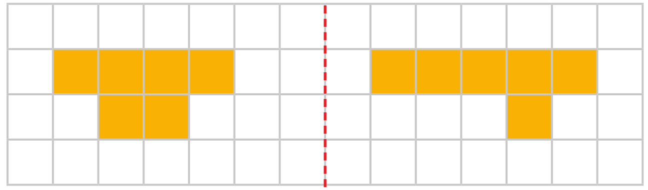


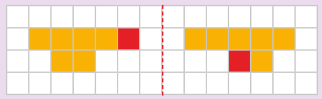

Do you agree with Tiny?

Explain your answer.

No

Shade two more squares to make the reflection correct.



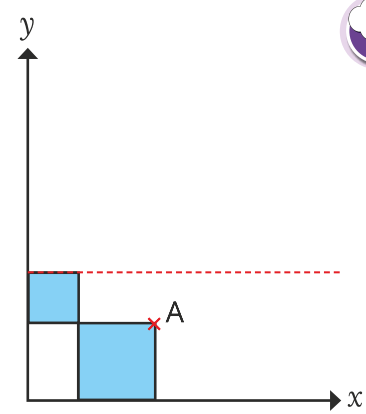


The area of the small square is 4 squares.

The area of the large square is 9 squares.

Both squares are reflected in the mirror line.

What are the new coordinates of vertex A?




(5, 7)

Summer Block 3

# Decimals

# Small steps

| | |
|---|---|
| Step 1 | Use known facts to add and subtract decimals within 1 |
| Step 2 | Complements to 1 |
| Step 3 | Add and subtract decimals across 1 |
| Step 4 | Add decimals with the same number of decimal places |
| Step 5 | Subtract decimals with the same number of decimal places |
| Step 6 | Add decimals with different numbers of decimal places |
| Step 7 | Subtract decimals with different numbers of decimal places |
| Step 8 | Efficient strategies for adding and subtracting decimals |

# Small steps

# Use known facts to add and subtract decimals within 1

## Notes and guidance

In this small step, children add and subtract decimals within 1 whole using known facts. They will move on to using a formal method to add and subtract decimals later in this block.

Through unitising, children are able to make connections between whole numbers and decimals. For example, 7 ones + 9 ones = 16 ones, therefore 7 hundredths + 9 hundredths = 16 hundredths. Ensure that children have a good understanding of place value, as a common error is to ignore the place value of decimals, leading to incorrect calculations such as 0.48 + 0.3 = 0.51. Using a stem sentence allows children to recognise that the unit they are adding or subtracting must be the same, so in this example 48 hundredths + 30 hundredths = 78 hundredths. Hundred squares and place value charts are useful representations to support children when adding and subtracting decimals within 1 whole.

## Things to look out for

- Children may add digits together irrespective of which place value column they are in, e.g. 0.45 + 0.3 = 0.48
- Children may rely on using formal written methods to add/subtract decimals within 1 instead of using known facts.

## Key questions

- How can you use the hundred square to help you with the addition/subtraction?
- What whole number calculation can you compare this calculation to?
- How can you convert between tenths and hundredths?
- Which known facts can help you with this calculation?
- What is 1 hundredth more than your number?
- What is 2 tenths less than your number?

## Possible sentence stems

- ______ tenths = ______ hundredths
- ______ ones + ______ ones = ______ ones,
  so ______ tenths + ______ tenths = ______ tenths
- ______ hundredths − ______ hundredths = ______ hundredths

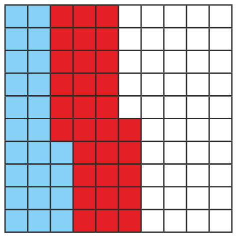
## National Curriculum links

- Recognise and use thousandths and relate them to tenths, hundredths and decimal equivalents
- Solve problems involving number up to 3 decimal places

# Use known facts to add and subtract decimals within 1

## Key learning

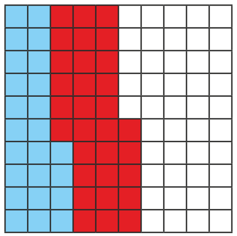
- Complete the sentences.
  - Each square in this hundred square represents 1 whole.



______ ones + ______ ones = ______ ones

______ + ______ = ______

  - Each square in this hundred square represents one-hundredth of the whole.



______ hundredths + ______ hundredths = ______ hundredths

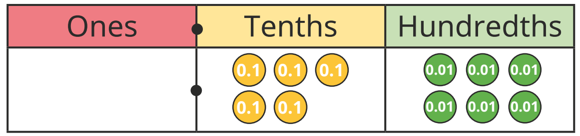
______ + ______ = ______

What is the same and what is different about the hundred squares?

- Use a hundred square to work out the calculations.

0.72 + 0.13 | 0.16 + 0.08 | 0.28 + 0.49 | 0.62 + 0.19

- Here is a number.




  - What is 3 tenths less than this number?
  - What is 0.02 more than this number?

- Max uses known facts to complete the subtraction.

86 – 24 = 62, so 0.86 – 0.24 = 0.62

Use known facts to work out the calculations.

  - 0.89 – 0.41
  - £0.45 – £0.27
  - 37 hundredths more than 14 hundredths
  - 72 hundredths – 19 hundredths

- Mo and Dora are working out 0.76 – 0.3

**Mo** 0.76 – 0.3 = 0.73

**Dora** 0.76 – 0.3 = 0.46

Who is correct?

How do you know?

# Use known facts to add and subtract decimals within 1

## Reasoning and problem solving

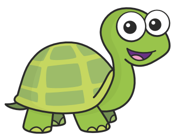
Is the statement true or false?

21 hundredths – 10 hundredths
= 0.21 – 0.1

Explain your answer.

True

Tiny is working out 0.57 + 0.4



57 + 4 = 61
So 0.57 + 0.4 = 0.61

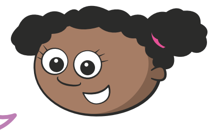
What mistake has Tiny made?

What is the correct answer?

0.97

Whitney is working out 0.4 – 0.07

I cannot work out 0.4 – 0.07, because 7 is greater than 4



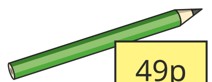
Do you agree with Whitney?

Explain your answer.

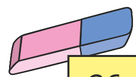
No

Brett has £0.89

He buys a pencil and a rubber.



49p



26p

How much money does Brett have left?

Give your answer in pounds and pence.

£0.14

# Complements to 1

## Notes and guidance

In this small step, children find complements to 1 for numbers with up to 3 decimal places.

It is important for children to see the links with number bonds to 10, 100 and 1,000, and it may be useful to revise these first. The use of ten frames and hundred squares can support children to see the number bonds to 10 and 100 and the corresponding number bonds to 1 for numbers with 1 or 2 decimal places respectively. The number bonds to 1,000 and corresponding 3-decimal place bonds to 1 can be more challenging, but children should be encouraged to apply the same principles as for numbers with fewer decimal places.

## Things to look out for

- When finding a complement to 1, children may assume that they need to find the bond to 10 in each place value column, for example 0.365 + 0.745 = 1
- Children may try to use a formal written method to find complements to 1 instead of using known number bonds.

## Key questions

- What number bonds can you use to help you?
- What is the missing number in 64 + ______ = 100?
  How does this help you to work out the missing number in 0.64 + ______ = 1?
- What do you need to add to ______ to make 10/100/1,000?
  So what do you need to add to ______ to make 1?
- What is the same and what is different about finding complements to 10/100/1,000 and complements to 1?

## Possible sentence stems

- 1 = ______ tenths = ______ hundredths = ______ thousandths
- ______ ones + ______ ones = 10 ones,
  so ______ tenths + ______ tenths = 10 tenths = 1
- ______ hundredths/thousandths + ______ hundredths/thousandths = 1

## National Curriculum links

- Recognise and use thousandths and relate them to tenths, hundredths and decimal equivalents
- Solve problems involving number up to 3 decimal places

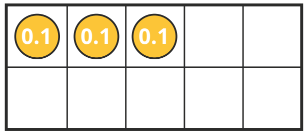
# Complements to 1

## Key learning

- Each square in the ten frame represents 1 tenth.

  The ten frame represents 1 whole.

  Complete the statements.

  3 tenths + ______ tenths = 10 tenths

  10 tenths = 1 whole

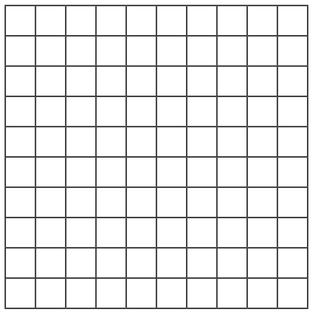
  ___ . ___ + ___ . ___ = 1

  Use a ten frame to complete the calculations.

  ▸ 0.8 + ______ = 1
  ▸ 1 = ______ + 0.4
  ▸ 0.1 + ______ = 1
  ▸ 1 = 0.5 + ______

- Each square in the hundred square represents 1 hundredth of the whole.

  Use the hundred square to complete the calculations.

  ▸ 0.55 + ______ = 1
  ▸ 1 = 0.32 + ______
  ▸ 0.11 + 0.5 + ______ = 1

- Jack is working out 0.763 + ______ = 1

  | |
  |---|
  | 763 ones + 237 ones = 1,000 ones, |
  | so 763 thousandths + 237 thousandths = 1,000 thousandths. |
  | 0.763 + 0.237 = 1 |

  Use Jack's method to complete the calculations.

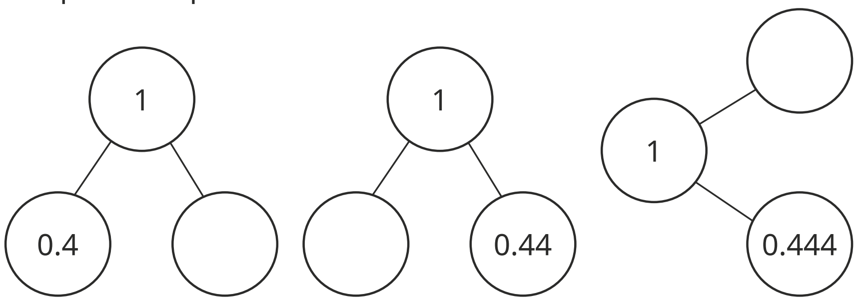
  ▸ 0.356 + ______ = 1
  ▸ 1 = 0.873 + ______
  ▸ ______ + 0.456 = 1
  ▸ 1 = ______ + 0.048

- Complete the calculations.

  ▸ 0.3 + ______ = 1 ▸ 0.35 + ______ = 1 ▸ 0.399 + ______ = 1

  What is the same and what is different?

- Complete the part-whole models.

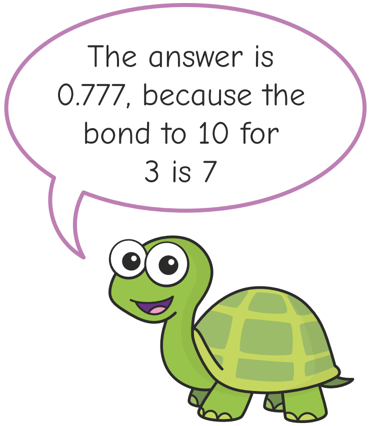
  
  

# Complements to 1

## Reasoning and problem solving

Tiny is working out the missing number.

| | | |
|---|---|---|
| 0.333 + | ☐ | = 1 |



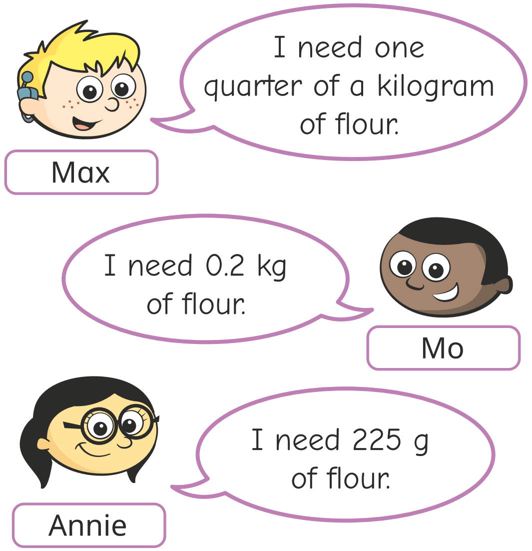

Explain why Tiny is incorrect.

What is the missing number?

0.667

Max, Mo and Annie are baking.

They have 1 kg of flour between them.




What is the mass of the flour that will be left over?

Give your answer in kilograms.

Compare methods with a partner.

0.325 kg

# Add and subtract decimals across 1

## Notes and guidance

In this small step, children add and subtract decimals that cross 1

For some numbers, using known facts is again a useful strategy, for example 6 + 7 = 13, so 0.6 + 0.7 = 1.3. Children can also use their experience from the previous step of finding complements to 1, using the "make 1" strategy to help them add and subtract. This requires a secure understanding of flexible partitioning, which allows them to partition decimals into appropriate numbers. For example, when calculating 0.64 + 0.45, children can use their knowledge of finding complements to 1: 0.64 + 0.36 = 1, therefore 0.45 should be partitioned into 0.36 and 0.09, leading to 0.64 + 0.36 = 1 and 1 + 0.09 = 1.09. Part-whole models or other diagrams can be used to support this. Similarly, when subtracting decimals, encourage children to subtract to get to 1 first, then subtract the remaining decimal.

## Things to look out for

- Children may make place value errors, for example using 6 + 7 = 13 to deduce 0.6 + 0.7 = 0.13
- Children may make errors with complements to 1 by looking at columns individually, for example thinking that adding 0.38 to 0.72 makes 1

## Key questions

- How could partitioning one of the numbers help you?
- How do you decide which number to partition?
- How could you partition this number to help find a complement to 1? What number is left?
- How can you use your number bond knowledge to help you?
- What is the same and what is different about crossing 1 when adding and subtracting decimals?

## Possible sentence stems

- _______ can be partitioned into _______ and _______
- The first number is _______ away from 1

  The second number can be partitioned into _______ and _______

  The total is 1 + _______ = _______
- I can subtract _______ to get to 1 and then subtract _______ from 1

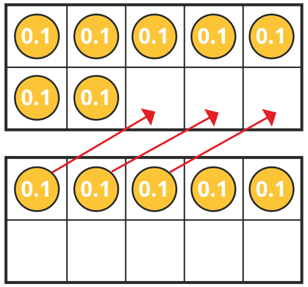
## National Curriculum links

- Recognise and use thousandths and relate them to tenths, hundredths and decimal equivalents
- Solve problems involving number up to 3 decimal places

# Add and subtract decimals across 1

## Key learning

- Huan is using ten frames to work out 0.7 + 0.5

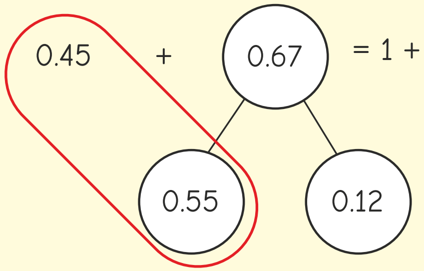



0.7 + 0.3 = 1
1 + 0.2 = 1.2
0.7 + 0.5 = 1.2

Use Huan's method to work out the additions.

| | | | |
|---|---|---|---|
| 0.8 + 0.6 | 0.2 + 0.9 | 0.4 + 0.9 | 0.8 + 0.9 |

- Dani is finding a complement to 1 to work out 0.45 + 0.67




= 1 + 0.12 = 1.12

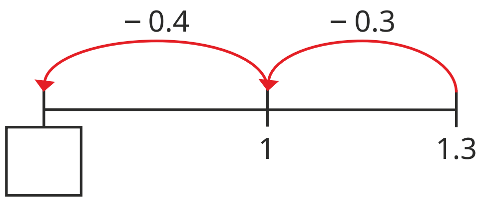
Use Dani's method to work out the additions.

| | | | |
|---|---|---|---|
| 0.74 + 0.78 | 0.74 + 0.42 | 0.57 + 0.65 | 0.81 + 0.46 |

- Scott is using a number line to subtract decimals crossing 1

He is working out 1.3 – 0.7

Complete Scott's workings.

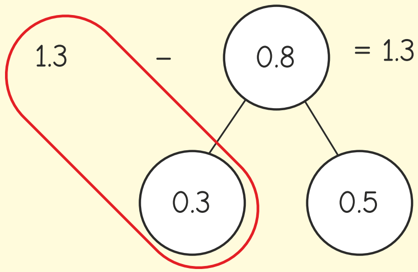



1.3 – 0.3 = 1
1 – 0.4 = ______

Use Scott's method to work out the subtractions.

| | | | |
|---|---|---|---|
| 1.3 – 0.4 | 1.5 – 0.9 | 1.6 – 0.8 | 1.2 – 0.5 |

- Kim uses partitioning to work out 1.3 – 0.8




= 1.3 – 0.3 – 0.5 = 1 – 0.5
= 0.5

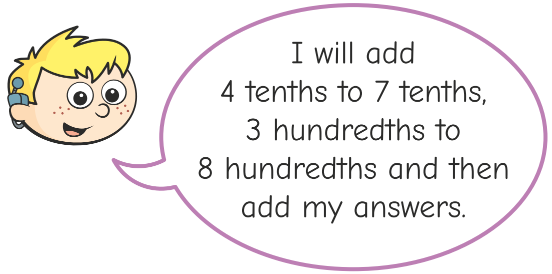
Use Kim's method to work out the subtractions.

| | | |
|---|---|---|
| 1.1 – 0.4 | 1.24 – 0.59 | 1.36 – 0.48 |

# Add and subtract decimals across 1

## Reasoning and problem solving

Max is working out 0.78 + 0.43

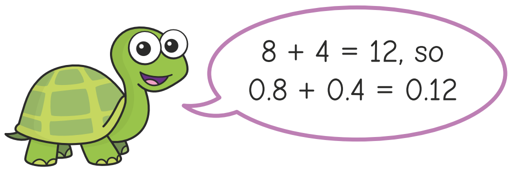



Will Max's method work?

How do you know?

Yes

Tiny is working out 0.8 + 0.4

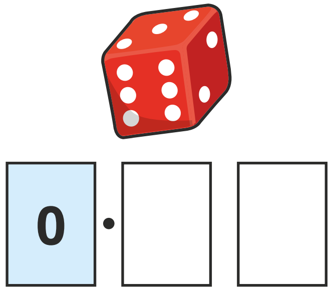



What mistake has Tiny made?

What is the correct answer?

1.2

You need a partner and a 6-sided dice for this game.




Take turns to roll the dice twice and create a decimal number less than 1 using the digits you rolled.

Repeat to create a second number.

Add your two numbers together.

Repeat until you have each added four numbers.

The winner is the person whose total is the closest to 1.5 **without** going above 1.5

Compare strategies as a class.

# Add decimals with the same number of decimal places

## Notes and guidance

In this small step, children add decimal numbers with the same number of decimal places, using the formal written method for the first time.

Children begin by looking at calculations with no exchanges before moving on to calculations that involve exchanges and numbers with up to 3 decimal places. Place value charts and counters are extremely helpful in ensuring that children understand the value of each digit and when an exchange is needed. When there are 10 or more in a place value column, children can physically exchange, for example, 10 tenths for 1 whole. They could also compare using column methods for integers and decimals, for example comparing 46 + 38 with 4.6 + 3.8

Children also perform decimal calculations with money, converting amounts in pence to pounds if necessary.

## Things to look out for

- Children may not line up the columns correctly, particularly if the calculation involves zero as a placeholder.
- Children may position the decimal point incorrectly.
- Children may forget to add the exchanged digit.

## Key questions

- How can you represent this calculation using a place value chart?
- What happens when there are 10 or more counters in a place value column? What is the same and what is different in the formal written method?
- Why is the position of the decimal point important?
- Why is it important to line up the columns?
- Will this addition involve an exchange? How do you know?

## Possible sentence stems

- ______ ones + ______ ones = ones,

  so ______ tenths + ______ tenths = ______ tenths
- The greatest number I can have in any column is ______

  If the total is greater than ______, I need to make an ______

## National Curriculum links

- Recognise and use thousandths and relate them to tenths, hundredths and decimal equivalents
- Solve problems involving number up to 3 decimal places

# Add decimals with the same number of decimal places

## Key learning

- Use the place value chart and the column method to work out 3.42 + 4.14

| Ones | Tenths | Hundredths |
|---|---|---|
| 1 1 1 | 0.1 0.1 0.1 0.1 | 0.01 0.01 |
| 1 1 1 1 | 0.1 | 0.01 0.01 0.01 0.01 |

| | | | |
|---|---|---|---|
| | 3 | • 4 | 2 |
| + | 4 | • 1 | 4 |
| | | • | |

Use place value charts and the column method to work out the additions.

| 5.2 + 3.6 | 4.13 + 2.45 | 3.146 + 1.513 | 4.054 + 3.624 |
|---|---|---|---|

- Use the place value chart and the column method to add 2.83 and 4.41

| Ones | Tenths | Hundredths |
|---|---|---|
| 1 1 | 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 | 0.01 0.01 0.01 |
| 1 1 1 1 | 0.1 0.1 0.1 0.1 | 0.01 |

| | | | |
|---|---|---|---|
| | 2 | • 8 | 3 |
| + | 4 | • 4 | 1 |
| | | • | |

Use place value charts and the column method to work out the additions.

| 4.7 + 3.6 | 3.29 + 4.65 | 8.714 + 2.613 | 15.86 + 13.48 |
|---|---|---|---|

- Use the column method to work out the additions.

| | | | |
|---|---|---|---|
| | 4 | • 4 | 2 |
| + | 3 | • 5 | 3 |
| | | • | |

| | | | |
|---|---|---|---|
| | 4 | • 5 | 5 |
| + | 3 | • 0 | 7 |
| | | • | |

| | | | | |
|---|---|---|---|---|
| | 4 | • 6 | 0 | 2 |
| + | 3 | • 9 | 4 | 9 |
| | | • | | |

- Filip buys a hat and a scarf.


£4.85


£9.15

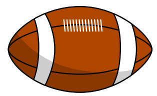
How much does it cost him altogether?

- Aisha buys three of these items.


£4.45


£5.59


£3.99

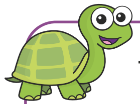

£4.05

What is the most she could pay?

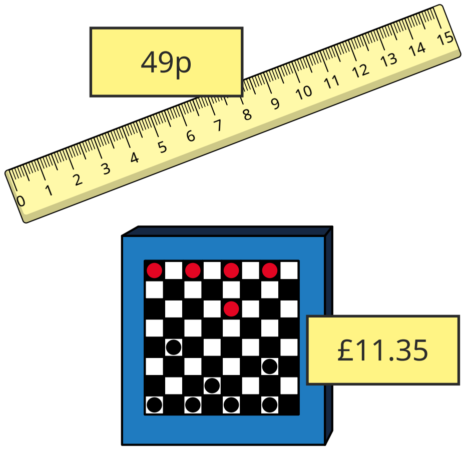
What is the least she could pay?

# Add decimals with the same number of decimal places

## Reasoning and problem solving



Tiny is working out the total cost of a ruler and a game.




| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | 1 | 1 · | 3 | 5 | |
| | + | 4 | 9 · | | | |
| | | 6 | 0 · | 3 | 5 | |
| | | 1 | | | | |

Explain Tiny's mistake.

Tiny has put the price of the ruler in the wrong columns.

49p = £0.49

Use the digit cards to complete the column addition.

You may use each digit only once in each addition.

| | | | | |
|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | | · | | | |
| | + | · | | | |
| | | · | | | |
| | | | | | |

What is the greatest possible sum?

What is the smallest possible sum?

Is there more than one way of creating each total?

greatest: 18.39

smallest: 1.59

# Subtract decimals with the same number of decimal places

## Notes and guidance

In this small step, children subtract numbers with the same number of decimal places, using the formal written method for the first time.

As with addition, children first look at calculations with no exchanges, before moving on to calculations that involve exchanges and numbers up to 3 decimal places. Place value charts and counters continue to support understanding of the value of each digit and when an exchange is needed. Again, children should look at the formal and practical methods alongside each other to begin with. When an exchange is needed, children can physically exchange, for example, 1 one for 10 tenths. They could also compare using column methods for integers and decimals, for example comparing 76 – 28 with 7.6 – 2.8

Give children opportunities to apply subtraction to real-life contexts, for example using measures and money.

## Things to look out for

- Children may not line up the columns correctly, particularly when zero is used as a placeholder.
- When subtracting using the column method, children may just find the difference between the digits, rather than making an exchange when necessary, for example 4.5 – 3.8 = 1.3

## Key questions

- What are ______ ones/tenths/hundredths subtract ______ ones/tenths/hundredths?
- Will you need to make an exchange in this subtraction? How do you know?
- What can you exchange 1 one/tenth/hundredth for?
- Why is the position of the decimal point important?
- What does zero in a place value column mean? How does this affect a subtraction?

## Possible sentence stems

- ______ ones/tenths subtract ______ ones/tenths is equal to ______ ones/tenths.
- I need to make an exchange because …
- I need to exchange 1 ______ for 10 ______

## National Curriculum links

- Recognise and use thousandths and relate them to tenths, hundredths and decimal equivalents
- Solve problems involving number up to 3 decimal places

# Subtract decimals with the same number of decimal places

## Key learning

- Use the place value chart and the column method to work out 4.23 – 2.12

| Ones | Tenths | Hundredths |
|---|---|---|
| 1 1 1 1 | 0.1 0.1 | 0.01 0.01 0.01 |

| | | | |
|---|---|---|---|
| | 4 | • 2 | 3 |
| – | 2 | • 1 | 2 |
| | | • | |

Did you need to make any exchanges?

- Use the place value chart and the column method to work out 6.35 – 4.83

Will you need to make any exchanges?

| Ones | Tenths | Hundredths |
|---|---|---|
| 1 1 1 1 1 1 | 0.1 0.1 0.1 | 0.01 0.01 0.01 0.01 0.01 |

| | | | |
|---|---|---|---|
| | 6 | • 3 | 5 |
| – | 4 | • 8 | 3 |
| | | • | |

Use a place value chart and a column method to work out the subtractions.

| 5.7 – 2.4 | 8.56 – 3.37 | 8.313 – 2.614 | 13.24 – 12.06 |
|---|---|---|---|

- Use the column method to work out the subtractions.

| | | |
|---|---|---|
| | 6 | • 4 |
| – | 3 | • 8 |
| | | • |

| | | | | |
|---|---|---|---|---|
| | 7 | 3 | • 0 | 4 |
| – | 3 | 9 | • 1 | 2 |
| | | | • | |

| | | | |
|---|---|---|---|
| | 5 | • 0 | 5 |
| – | 2 | • 1 | 5 |
| | | • | |

| | | | | |
|---|---|---|---|---|
| | 2 | 4 | • 6 | 3 |
| – | 1 | 7 | • 8 | 1 |
| | | | • | |

- Tom has £12.45

  He buys a football for £6.99

  How much money does he have left?

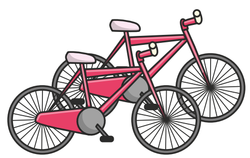
  Compare methods with a partner.

- Annie and Amir are doing a sponsored bike ride.

  Annie cycles 8.47 miles.

  Amir cycles 5.95 miles.

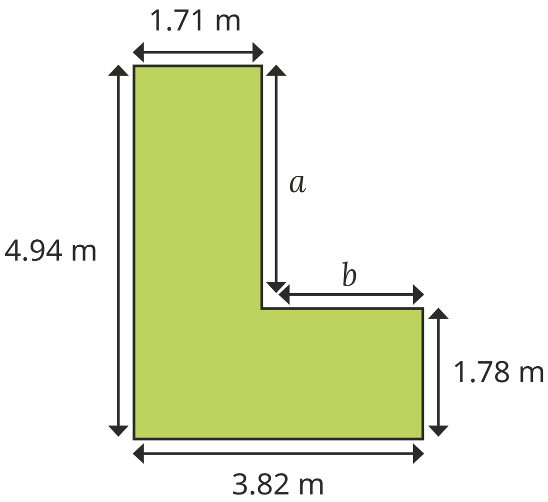
  How much further does Annie cycle than Amir?



# Subtract decimals with the same number of decimal places

## Reasoning and problem solving

Work out the lengths of sides $a$ and $b$.




What is the perimeter of the hexagon?

$a$ = 3.16 m

$b$ = 2.11 m

17.52 m

Dexter and Nijah have some money.

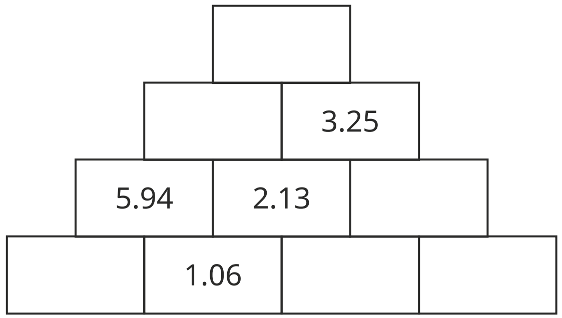
Dexter has £3.45 more than Nijah.

They have £12.45 altogether.

How much money does Nijah have?

£4.50

In the number pyramid, each number is the sum of the two numbers below it.




Complete the number pyramid.

11.32

8.07

1.12

4.88 1.07 0.05

# Add decimals with different numbers of decimal places

## Notes and guidance

In this small step, children extend their knowledge of adding decimal numbers to include numbers with a different number of decimal places.

Emphasise the importance of lining up the decimal point in order to ensure that digits with the same place value are also aligned. A place value chart is a useful representation to reinforce this, as children can see the value of each digit in the correct place value column. Children could be encouraged to "fill" empty columns with trailing zeros to promote an understanding of using the zero as a placeholder and making it easier to see how the numbers line up.

Children could also use estimation to think about whether their answers are sensible.

As in previous steps, it may be useful to begin with examples that do not require an exchange, so that children can focus on the new learning of adding numbers with a different number of decimal places.

## Things to look out for

- Children may not line up digits correctly.
- Children may put trailing zeros in the wrong place, for example writing 8.6 as 8.06 instead of 8.60

## Key questions

- How can you show this addition on a place value chart?
- What happens when there are 10 or more counters in a place value column?
- Why is the position of the decimal point important?
- Why is it important to line up the columns?
- Will this addition involve an exchange? How do you know?
- What could you add to the spaces that do not contain a digit, to help you?

## Possible sentence stems

- When adding two decimal numbers, I need to keep the ______ in line.
- ______ tenths + ______ tenths = ______ tenths, so I do/do not need to make an exchange.

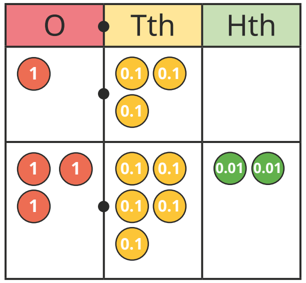
## National Curriculum links

- Recognise and use thousandths and relate them to tenths, hundredths and decimal equivalents
- Solve problems involving number up to 3 decimal places

# Add decimals with different numbers of decimal places

## Key learning

- Use the place value chart and column method to work out 1.3 + 3.52

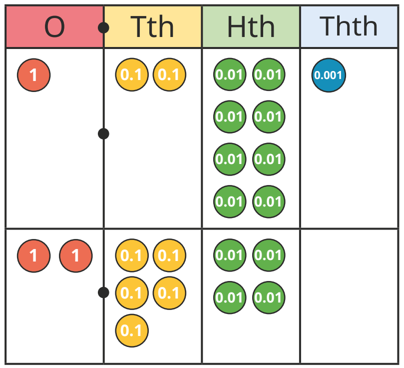


| | | | | | |
|---|---|---|---|---|---|
| | | 1 · | 3 | | |
| | + | 3 · | 5 | 2 | |
| | | · | | | |
| | | | | | |

Work out the additions.

▸ 5.7 + 3.16 ▸ 2.017 + 3.5 ▸ 4.61 + 3.372

- Use the place value chart and column method to work out 1.281 + 2.54



| | | | | | | |
|---|---|---|---|---|---|---|
| | | 1 · | 2 | 8 | 1 | |
| | + | 2 · | 5 | 4 | | |
| | | · | | | | |
| | | | | | | |

Work out the additions.

▸ 4.7 + 3.56 ▸ 2.8 + 1.317 ▸ 3.595 + 4.62

- Use the column method to work out the additions.

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 4 · | 7 | 5 | 3 | |
| | + | 3 · | 1 | 7 | | |
| | | · | | | | |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 2 · | 6 | 8 | | |
| | + | 1 · | 4 | 0 | 6 | |
| | | · | | | | |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 5 · | 6 | 8 | | |
| | + | 2 · | 3 | 3 | 2 | |
| | | · | | | | |
| | | | | | | |

- Complete the bar model.

| | |
|---|---|
| | |
| 4.35 | 12.7 |

- Sam is cycling in a race.

  She has cycled 3.145 km and has 4.1 km left to cycle.

  What is the total distance of the race?

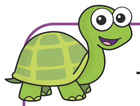
- Work out the additions.

| | |
|---|---|
| 8.7 m + 5.29 m | 0.63 litres + 0.8 litres |
| 6.3 kg + 2.75 kg | 5.173 km + 4.08 km |

# Add decimals with different numbers of decimal places



## Reasoning and problem solving



Tiny is working out
4.144 + 1.4

What mistake has Tiny made?

What is the correct answer?

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | 4 · | 1 | 4 | 4 | |
| | + | | | 1 · | 4 | |
| | | 4 · | 1 | 5 | 8 | |
| | | | | | | |

5.544

Find a solution to the addition with:

- no exchanges
- 1 exchange
- 2 exchanges

☐ . ☐ ☐ + ☐ . ☐ ☐ ☐ = 3.678

multiple possible answers, e.g.
1.15 + 2.528 2.28 + 1.398 2.79 + 0.888

Write the additions in the correct columns in the table.

9.99 + 0.1 9.99 + 1
9.99 + 0.001 9.99 + 0.01

| No exchange | Exchange in ones column | Exchange in tenths column | Exchange in hundredths column | Exchange in thousandths column |
|---|---|---|---|---|
| | | | | |

Some additions may go in more than one column.

Add two more additions to each column, where the numbers have a different number of decimal places.

no exchange: 9.99 + 0.001

ones column: 9.99 + 1,
9.99 + 0.1, 9.99 + 0.01

tenths column:
9.99 + 0.1, 9.99 + 0.01

hundredths column:
9.99 + 0.01

# Subtract decimals with different numbers of decimal places

## Notes and guidance

In this small step, children extend their knowledge of subtracting decimal numbers to include numbers with a different number of decimal places.

It is important that children continue to practise lining up the decimal point carefully and ensure that each digit is in the correct column. A place value chart could be used to reinforce this. In the column method, show children how to "fill" empty columns with zeros, which will support them when exchanges are required. They need to be secure with the fact that, for example, 6 and 6.0 have the same numerical value, as do 4.7 and 4.70 and so on.

Children need a good understanding of column subtraction from previous steps, knowing when to make an exchange – particularly when zeros are involved.

## Things to look out for

- Children may not line up digits correctly.
- In calculations such as 7.6 – 2.38, children may subtract where there are pairs of numbers but just write the last digit, giving the answer of 5.38, instead of writing 7.60 – 2.38 and making an exchange.
- Children may struggle when multiple exchanges are required, for example 13 – 2.532

## Key questions

- How should the digits be lined up in a column subtraction?
- How do you show that there is nothing in a place value column?
- Do you need to make an exchange? How do you know?
- How do you make an exchange if there is a zero in the column that you want to make the exchange from?
- Is the column subtraction method the most efficient method to use in this example?

## Possible sentence stems

- When subtracting two decimal numbers, I need to keep the ______ in line.
- If I need to subtract hundredths and there is no digit in the hundredths column, I can put in a ______ and then make an ______

## National Curriculum links

- Recognise and use thousandths and relate them to tenths, hundredths and decimal equivalents
- Solve problems involving number up to 3 decimal places

# Subtract decimals with different numbers of decimal places

## Key learning

- Alex is using a place value chart and column subtraction to work out 4.54 – 1.4

| O | Tth | Hth |
|---|---|---|
| 1 1 1 1 | 0.1 0.1 0.1 0.1 0.1 | 0.01 0.01 0.01 0.01 |

| | | | | |
|---|---|---|---|---|
| | 4 | • 5 | 4 | |
| – | 1 | • 4 | | |
| | 3 | • 1 | 4 | |

Use place value charts and the column method to work out the subtractions.

| 2.65 – 1.4 | 5.42 – 1.3 | 7.326 – 4.01 | 8.72 – 4.1 |
|---|---|---|---|

- Teddy is using a place value chart and column subtraction to subtract 4.23 from 6.5

| O | Tth | Hth |
|---|---|---|
| 1 1 1 1 1 1 | 0.1 0.1 0.1 0.1 0.1 | |

| | | | | |
|---|---|---|---|---|
| | 6 | • 5 | 0 | |
| – | 4 | • 2 | 3 | |
| | | • | | |

Why can Teddy write 6.5 as 6.50?

Complete the calculation using place value counters to help you.

- Use the column method to work out the subtractions.

| | | | | |
|---|---|---|---|---|
| | 4 | • 7 | 5 | |
| – | 3 | • 1 | 2 | 3 |
| | | • | | |

| | | | |
|---|---|---|---|
| | 5 | • 3 | |
| – | 2 | • 0 | 7 |
| | | • | |

| | | | |
|---|---|---|---|
| | 6 | • 0 | 6 |
| – | 3 | • 7 | |
| | | • | |

| | | | | |
|---|---|---|---|---|
| | 8 | • 7 | | |
| – | 2 | • 0 | 6 | 8 |
| | | • | | |

- Eva buys a bag of apples costing £4.27

  She pays with a £10 note.

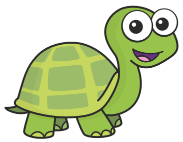
  How much change does she get?

- Work out the subtractions.
  - 5,000 g – 3,200 g = ______ g
  - 450 cm – 255 cm = ______ cm
  - 550 ml – 60 ml = ______ ml
  - 5 kg – 3.2 kg = ______ kg
  - 4.5 m – 2.55 m = ______ m
  - 0.55 l – 0.06 l = ______ l

# Subtract decimals with different numbers of decimal places

## Reasoning and problem solving

Tiny is working out 4.9 − 3.84



| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | | 4 • | 9 | | |
| | − | 3 • | 8 | 4 | |
| | | 1 • | 1 | 4 | |
| | | | | | |

What mistake has Tiny made?

Work out the correct answer.

1.06

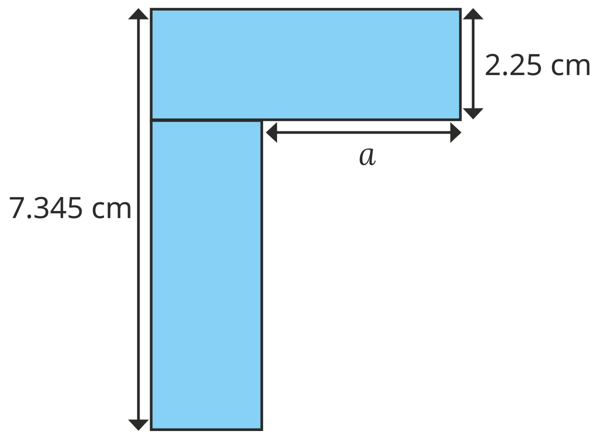
Rosie, Mo and Dora each have some money.

- Rosie has £1.63 more than Mo.
- Dora has £4 more than Rosie.
- Dora has £7.60

How much money do they have altogether?

£13.17

The shape is made of two identical rectangles.




Find the length of the part marked $a$.

2.845 cm

# Efficient strategies for adding and subtracting decimals

## Notes and guidance

In this small step, children explore a range of different calculation strategies to solve addition and subtraction problems, making decisions about which strategy would be the most effective for each problem.

Encourage children to consider the question carefully rather than automatically choosing the same option every time. They can experiment by solving the same calculation in a number of ways and considering which way was the most efficient and why. In particular, discuss when mental strategies are more appropriate than written, for example when compensation can be used, such that adding 9.99 can be simplified to add 10 and then subtract 0.01. Number lines are useful to support this approach.

## Things to look out for

- Children may automatically use formal written methods, even when they are less efficient.
- Children may not transfer strategies used with integers to decimals without explicit teaching.
- When working mentally, children may make place value errors.

## Key questions

- Do you need to make an exchange?
- What methods could you use?
  Which is most efficient for this calculation?
- When would you use a mental method?
- When would you use an informal jotting such as a number line?
- When would a formal method be more efficient?
- What integer is 9.9 close to?
  How can this help with the calculation?
- How could partitioning help with this calculation?

## Possible sentence stems

- ______ is close to ______, so I can change the calculation to ______
- I will work this out using ______ because …

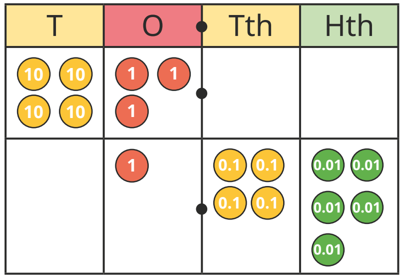
## National Curriculum links

- Solve problems involving number up to 3 decimal places

# Efficient strategies for adding and subtracting decimals

## Key learning

- Dani uses a place value chart and a written method to work out 43 + 1.45




| | | | | | | |
|---|---|---|---|---|---|---|
| | | 4 | 3 • | | | |
| | + | | 1 • | 4 | 5 | |
| | | 4 | 4 • | 4 | 5 | |
| | | | | | | |

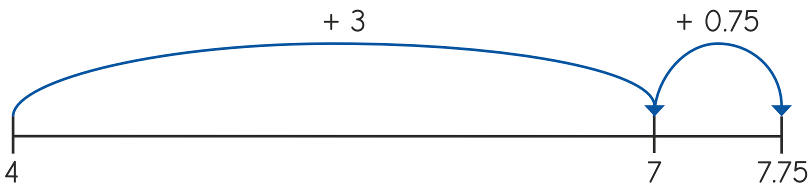
Could Dani have worked the answer out using a mental method?

Which of these calculations could you work out mentally?

For which calculations would you use a written method?

- 8.2 + 3.1
- 6.9 + 0.45
- 9.8 – 4
- 90.8 – 0.45
- 18.02 + 34.19
- 6.7 + 0.25
- 9.8 – 4.56
- 9.8 – 0.4

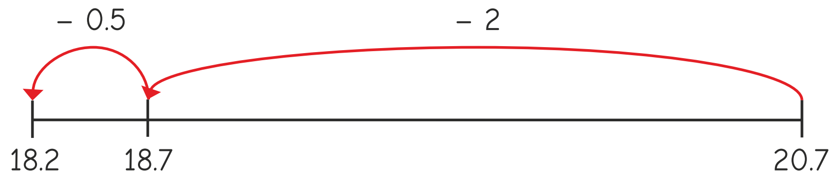
- Whitney uses a number line to work out 4 + 3.75




Use Whitney's method to work out the additions.

- 7 + 0.65
- 4 + 3.2
- 12 + 4.63
- 19 + 8.784

- Brett is counting back along a number line to work out 20.7 – 2.5




Use Brett's method to work out the subtractions.

- 16.8 – 2.5
- 12.9 – 4.3
- 14.6 – 8.05
- 15.75 – 8.32

- Work out 8.4 + 3.42 using:
  - a mental method
  - a number line
  - the column method.

Which method do you think is best?

Would this be the best method to work out 8.4 – 3.42?

Explain your answer.

- Use your preferred method to work out the calculations.

| | | | |
|---|---|---|---|
| 43 – 2.14 + 0.86 | 23 + 4.105 | 19 – 0.25 | 19 – 17.37 |

Compare methods with a partner.

# Efficient strategies for adding and subtracting decimals

## Reasoning and problem solving

For each calculation, decide if you would use a mental method, an informal jotting or the formal written method.

| | | |
|---|---|---|
| 57.9 + 4.8 | 12.8 + 5.4 | 5.6 + 2.1 |
| 9.5 – 4.3 | 8.6 – 7.7 | 3.25 – 1.37 |

| Mental method | Informal jotting | Formal written method |
|---|---|---|
| | | |

Explain your choices.

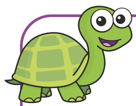
Add one more calculation to each column.

Discuss as a class.

Work out the missing digits.

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 3 | 1 | . □ | 0 | |
| | – | | □ | . 3 | 7 | |
| | | 2 | 9 | . 6 | 3 | |

31.00 – 1.37



Tiny is working out 63.7 – 9.9

$$63.7 - 9.9 = 63.7 - 10 - 0.1$$
$$= 53.7 - 0.1$$
$$= 53.6$$

What mistake has Tiny made?

How could you work out the change from £20 when you spend £6.99?

Tiny should have subtracted 10 and then **added** 0.1

# Decimal sequences

## Notes and guidance

In this small step, children combine their knowledge of number sequences and decimals to explore decimal sequences.

Given a range of sequences, children look for patterns and use and find simple rules that involve adding or subtracting a decimal each time. It is important to note that they are not expected to generate algebraic expressions at this stage. Children should, however, use the language associated with sequences such as “term” and “rule”. They should make predictions about the next term or subsequent terms in a sequence or, given different terms in a sequence, work backwards to find previous terms. Number lines are useful for representing sequences.

This step supports children’s understanding of counting in decimals, particularly across an integer, and prepares them for further study of sequences in Year 6

## Things to look out for

- Children may make errors when crossing an integer boundary, for example 0.3, 0.6, 0.9, 0.12
- When looking for terms earlier in a sequence, children may use the operation for the rule instead of the inverse operation, for example adding when they need to subtract.

## Key questions

- Are the terms increasing or decreasing in value?
- Are the terms increasing or decreasing by the same amount each time? If so, by how much?
- What will the next term in the sequence be?
- What will the ______ term in the sequence be?
- How can you tell if you need to make an exchange?
- How can you work out the previous term in a sequence? Does it make a difference if the sequence is increasing or decreasing?

## Possible sentence stems

- Each term is ______ than the previous term.

  The difference between the terms is ______

  As the sequence is increasing/decreasing, I need to add/subtract ______ to work out the next term.

## National Curriculum links

- Read, write, order and compare numbers with up to 3 decimal places
- Solve problems involving number up to 3 decimal places

# Decimal sequences

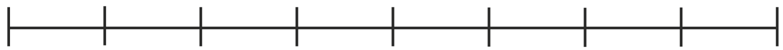
## Key learning

- Complete the sequence.

| 1st term | 2nd term | 3rd term | 4th term | 5th term |
|---|---|---|---|---|
| 1.21 | 1.32 | 1.43 | | |

- Complete the number lines.

2.4 2.6 2.8



4.67 4.69 4.71

- Write the rule for each sequence.
  - 3.4, 3.6, 3.8, 4
  - 3.4, 3.2, 3, 2.8
  - 3.4, 3.42, 3.44, 3.46
  - 3.4, 3.38, 3.36, 3.34

  Work out the next term in each sequence.

- Use the rule to find the missing terms in the sequences.
  - Rule: add 0.3

    0.4, ______, ______, ______, ______
  - Rule: add 0.25

    ______, ______, 3.75, ______, ______
  - Rule: subtract 1.1

    ______, ______, ______, 7.8, ______

- A library charges a £1.50 fine if a book is not returned on the due date, and 15p per day for every day after that.

  Use the sequence to work out the fine for a book that is one week overdue.

  £1.50, £1.65, ______, ______, ______, ______, ______

- The 1st term of a sequence is 0.7 and the 3rd term is 1

  What is the 2nd term of the sequence?

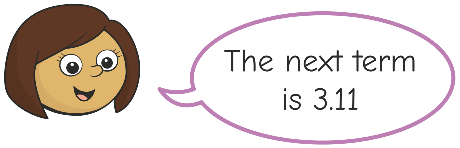
  What is the 5th term?

# Decimal sequences

## Reasoning and problem solving

Here is a sequence.

3.5, 3.7, 3.9 …



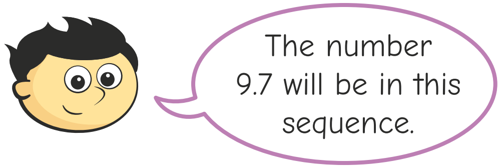

Explain why Kim is wrong.

What is the next term?

4.1

Here is a sequence.

9.48, 9.52, 9.56, 9.6 …




Do you agree with Jack?

Explain your answer.

No

| | |
|---|---|
| 0.83 | 0.78 |
| 0.93 | 0.88 |

Put the cards in order to make a sequence.

What is the rule?

Could there be a different sequence and a different rule?

0.78, 0.83, 0.88, 0.93

rule: add 0.05

0.93, 0.88, 0.83, 0.78

rule: subtract 0.05

Huan and Alex are writing number sequences starting at zero.

- Huan's rule is + 0.9
- Alex's rule is + 1.2

What is the first number they will both write?

What other numbers will they both write?

3.6

7.2, 10.8 …

all multiples of 3.6

# Multiply by 10, 100 and 1,000

## Notes and guidance

In this small step, children learn to multiply decimals by 10, 100 and 1,000

Children multiplied integers by 10 and 100 in Year 4 and moved on to multiply by 1,000 in the Autumn term of Year 5. Despite this experience, they may still make the mistake of over-generalising and simply "adding zeros". Concrete resources and stem sentences can be used to enable children to make accurate generalisations about what happens to the digits in a number when they multiply by 10, 100 or 1,000. Representations such as place value charts allow children to physically move plain counters to the left and recognise that all digits move, for example, 1 place to the left when multiplying by 10. They can also use a Gattegno chart to recognise that multiplying by 10 and "10 times the size" is the same.

## Things to look out for

- Children may assume that they add a zero to the original number when multiplying by 10
- Children may "move the decimal point" instead of recognising that it is the digits that increase in value when multiplying by 10, 100 and 1,000

## Key questions

- What is the value of each digit in the number?
- How many places to the left do the counters move when you multiply by 10/100/1,000?
- Where would the digits move to if you multiplied the number by 10/100/1,000?
- How many times greater than ______ is ______?
- If you multiply a number by 10 and then multiply the answer by 10, how many times greater than the original number is your final answer?

## Possible sentence stems

- To multiply by 10/100/1,000, I move all the digits ______ places to the left.
- 10 times greater than ______ is ______
- Multiplying by 100/1,000 is the same as multiplying by 10 ______ times.

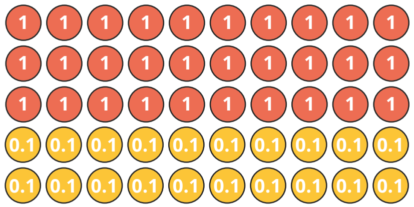
## National Curriculum links

- Multiply and divide whole numbers and those involving decimals by 10, 100 and 1,000

# Multiply by 10, 100 and 1,000

## Key learning

- The place value counters show 3.2 multiplied by 10

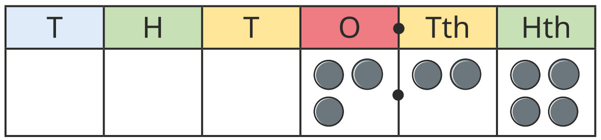



  - Can you make any exchanges?
  - Complete the sentences.

    _______ multiplied by 10 is equal to _______

    _______ is 10 times the size of _______

- Use the place value chart to multiply 3.24 by 10, 100 and 1,000




  Complete the sentence.

  When you multiply by _______, you move the counters _______ places to the left.

- Use a place value chart to multiply the decimals by 10, 100 and 1,000

  | 4.24 | 2.401 | 4.21 |
  |---|---|---|

- Mo is using a Gattegno chart to work out 4.9 × 10

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1,000 | 2,000 | 3,000 | 4,000 | 5,000 | 6,000 | 7,000 | 8,000 | 9,000 |
| 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 |
| 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
| 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |

  4 × 10 = 40
  0.9 × 10 = 9
  So 4.9 × 10 = 49

  Use the Gattegno chart to work out the multiplications.

  - 0.6 × 10
    0.6 × 100
    0.6 × 1,000
  - 2.4 × 10
    2.4 × 100
    2.4 × 1,000
  - 1.35 × 10
    1.35 × 100
    1.35 × 1,000

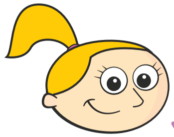
  What patterns do you notice?

- Multiply each number by 10, 100 and 1,000

  | 3.14 | 0.13 | 0.033 |
  |---|---|---|

# Multiply by 10, 100 and 1,000

## Reasoning and problem solving

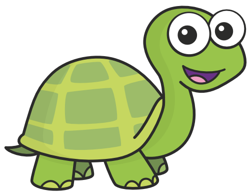



Do you agree with Eva?

Explain your answer.

Yes

Tiny is multiplying by 10




What mistake has Tiny made?

What is the correct answer?

31.04

Without calculating, write <, > or = to make the statements correct.

$4.732 \times 100$ ◯ $47.32 \times 10$

$10 \times 13.82$ ◯ $1{,}000 \times 1.382$

$0.723 \times 10 \times 10$ ◯ $100 \times 0.723$

$1{,}000 \times 3.81$ ◯ $30.81 \times 100$

Explain your reasoning.

=

<

=

>

Scott has £4.87

Tom has 10 times as much money as Scott.

How much more money does Tom have than Scott?

£43.83

# Divide by 10, 100 and 1,000

## Notes and guidance

In this small step, children explore dividing integers and decimal numbers by 10, 100 and 1,000. This builds on their learning from Year 4, where they learned to divide 1- and 2-digit numbers by 10

Children should begin to recognise the links with multiplying by 10, 100 and 1,000 and notice the inverse relationship. Concrete resources and stem sentences can be used to enable children to make accurate generalisations about what happens to the digits in a number when they divide by 10, 100 or 1,000. A place value chart allows children to physically move counters to the right and recognise that all of the digits move, for example, 2 places to the right when dividing by 100. Children can also use a Gattegno chart to recognise that dividing by 10 and "one-tenth of the size" is the same.

### Things to look out for

- Children may make errors with zero placeholders, for example 30.4 ÷ 10 = 3.4
- Children may mix up the rules for multiplication and division.
- Children may "move the decimal point" instead of recognising that it is the digits that decrease in value when dividing by 10, 100 and 1,000

## Key questions

- What is the value of each digit in the number?
- If you divide by 10/100/1,000, how many places to the right do the counters move?
- Where would the digits move to if you divided the number by 10/100/1,000?
- How many times smaller is ______ than ______?
- If you divide a number by 10 and then divide the answer by 10, how many times smaller than the original number is your final answer?

## Possible sentence stems

- To divide by 10/100/1,000, I move all the digits ______ places to the right.
- ______ is one-tenth the size of ______
- Dividing by 100/1,000 is the same as dividing by 10 ______ times.

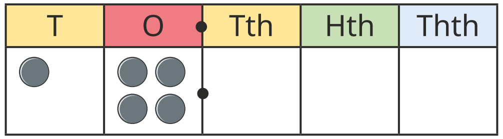
### National Curriculum links

- Multiply and divide whole numbers and those involving decimals by 10, 100 and 1,000

# Divide by 10, 100 and 1,000

## Key learning

- Use the place value chart to divide 14 by 10, 100 and 1,000




Complete the sentence.

When you divide by ______, you move the counters ______ places to the right.

- Use a place value chart and counters to divide the numbers by 10, 100 and 1,000

| 4 | 15 | 301 |
|---|---|---|

- Use the place value chart to complete the divisions.

| H | T | O | Tth | Hth | Thth |
|---|---|---|---|---|---|
| | 2 | 7 | | | |
| | | | | | |
| | | | | | |
| | | | | | |

27 ÷ 10 = ______

27 ÷ 100 = ______

27 ÷ 1,000 = ______

- Filip is using a Gattegno chart to work out 5.8 ÷ 10

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 |
| 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
| 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
| 0.001 | 0.002 | 0.003 | 0.004 | 0.005 | 0.006 | 0.007 | 0.008 | 0.009 |

5 ÷ 10 = 0.5
0.8 ÷ 10 = 0.08
5.8 ÷ 10 = 0.58
0.58 is one-tenth the size of 5.8

Use the Gattegno chart to work out the divisions.

- 42 ÷ 10
  42 ÷ 100
  42 ÷ 1,000
- 713 ÷ 10
  713 ÷ 100
  713 ÷ 1,000
- 102 ÷ 10
  102 ÷ 100
  102 ÷ 1,000

What patterns do you notice?

- There are 100 pence in £1

Use this fact to convert the amounts from pence to pounds.

- 210p = £ ______
- 132p = £ ______
- 2,456p = £ ______

# Divide by 10, 100 and 1,000

## Reasoning and problem solving

Amir is working out 4.08 ÷ 10

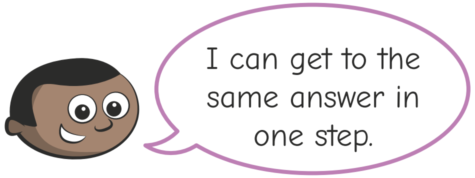

What mistake has Amir made?

What is the correct answer?

0.408

Mo divides 72 by 1,000

He then multiplies the answer by 10




Explain Mo's method.

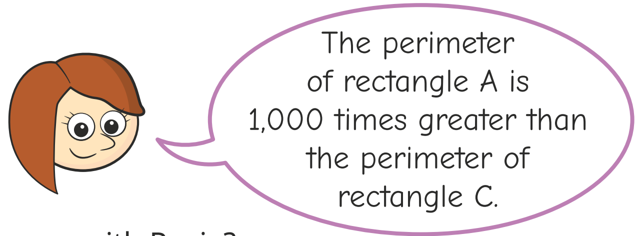
Mo can divide by 100 to get the same answer.

Here are three rectangles.


The sides of rectangle B are 10 times greater than rectangle A.

The sides of rectangle C are one-hundredth the size of rectangle B.

Work out the side lengths of rectangles B and C.




Do you agree with Rosie?

Explain your answer.

B: 14 m and 9 m

C: 0.14 m and 0.09 m

No

# Multiply and divide decimals – missing values

## Notes and guidance

In this small step, children apply their knowledge of multiplying and dividing by 10, 100 and 1,000 to work out missing values.

Through the use of concrete resources and stem sentences in the two previous steps, children have generalised what happens to the digits in a number when they multiply and divide by 10, 100 or 1,000. They now use these generalisations to support them to find missing values in calculations. Gattegno charts can be used to recognise how many rows a counter has moved up or down, allowing children to work out if the number is 10, 100 or 1,000 times greater or smaller. A place value chart allows them to physically move counters to the left or right to work out if the number is 10, 100 or 1,000 times greater or smaller. Children should recognise the inverse relationship between multiplying and dividing by 10, 100 and 1,000 and use this to find the missing values.

## Things to look out for

- Children may mix up multiplication and division and move counters or digits in the wrong direction.
- Children may make errors with numbers that include zero as a placeholder, especially within numbers such as 3.04

## Key questions

- What is the value of each digit?
- How many times smaller is ______ than ______?
- How many times greater is ______ than ______?
- How have the values of the digits changed?
- Has the number been multiplied or divided? How do you know?
- In which direction have the digits moved? How many places have the digits moved? What does this tell you?

## Possible sentence stems

- The digits have moved ______ places to the left/right, so the number has been ______ by ______
- The digits have moved ______ places to the left/right, so the number is ______ times greater/smaller.

## National Curriculum links

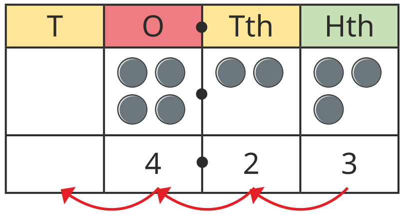
- Multiply and divide whole numbers and those involving decimals by 10, 100 and 1,000

# Multiply and divide decimals – missing values

## Key learning

- Use the place value chart to work out the missing value.

  4.23 × _______ = 42.3




- Use a place value chart and counters to work out the missing values.
  - 3.45 × _______ = 34.5
  - 84 ÷ _______ = 0.84
  - 4.56 ÷ _______ = 0.456
  - 1.03 × _______ = 103

- Mo divides a number by 100 and ends up with 0.52

| H | T | O | Tth | Hth | Thth |
|---|---|---|---|---|---|
| | | | | | |
| | | 0 | 5 | 2 | |

  What number did Mo start with?

- Work out the missing numbers.
  - _______ ÷ 10 = 4.9
  - _______ × 10 = 0.45
  - 1,000 × _______ = 273
  - _______ ÷ 100 = 2.103

- Dexter uses a Gattegno chart to work out the missing value in the calculation 4.82 × _______ = 482

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1,000 | 2,000 | 3,000 | 4,000 | 5,000 | 6,000 | 7,000 | 8,000 | 9,000 |
| 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 |
| 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
| 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
| 0.001 | 0.002 | 0.003 | 0.004 | 0.005 | 0.006 | 0.007 | 0.008 | 0.009 |

  - Complete the sentences.

    Each counter moves up _______ rows to get to 482

    482 is _______ times the size of 4.82

    4.82 × _______ = 482
  - Use the Gattegno chart to work out the missing values.

    3.4 × _______ = 34

    _______ ÷ 10 = 64.5

    _______ × 5.62 = 5,620

    4.6 ÷ _______ = 0.046

    1,000 × _______ = 345

    _______ ÷ 100 = 3.02

- Complete the calculations.
  - _______ ÷ 10 = 1.93 ÷ 100
  - 34.2 ÷ _______ = 0.342 × _______

# Multiply and divide decimals – missing values

## Reasoning and problem solving

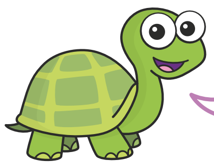
Is the statement true or false?

420 ÷ 100 = 0.042 × 100

Explain your answer.

True

| | |
|---|---|
| ☐ | ÷ 100 = 0.594 |



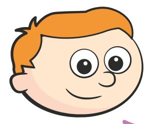
I can multiply 0.594 by 100 to find the missing value.

Do you agree with Tiny?

Explain your answer.

Yes

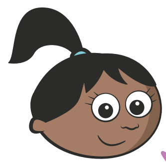
Ron thinks of a number.



I multiplied my number by 10 and then divided it by 1,000. I ended up with 0.034

What number was Ron thinking of?

3.4



I started with the same number as Ron and ended up with 340

What did Sam do to her number?

multiplied by 100

Summer Block 4

# Negative numbers

# Small steps

| | |
|---|---|
| Step 1 | Understand negative numbers |
| Step 2 | Count through zero in 1s |
| Step 3 | Count through zero in multiples |
| Step 4 | Compare and order negative numbers |
| Step 5 | Find the difference |

# Understand negative numbers

## Notes and guidance

In this small step, children are introduced to negative numbers for the first time. The focus of this step is exploring negative numbers in real-life contexts, including temperatures, distances above and below sea level and floors in a building that go underground.

In this first step, only vertical representations are used to develop understanding of the concept. Draw attention to the fact that negative numbers can be seen as a reflection of the positive numbers. This will help to avoid the common misconception of counting 3, 2, 1, 0, −10, −9, −8 …

Careful attention should be paid to language choices and children should be encouraged to say, for example, −3 as "negative three" rather than "minus three", so that they see negative numbers as numbers rather than operations.

At this stage, children do not need to calculate using negative numbers.

## Things to look out for

- As children are often shown scales from positive 10 to negative 10, they may count incorrectly across zero, for example 3, 2, 1, 0, −10, −9, −8 etc.
- Children may only look at the digit and think that, for example, −7 is greater than −2

## Key questions

- What are negative numbers? How do you write them?
- As the temperature gets warmer/colder, do the numbers get greater or smaller?
- If zero degrees Celsius is freezing point, how do you write temperatures that are colder than freezing?
- Is −5 colder or warmer than −2? Which temperature is closer to freezing point (zero degrees Celsius)?
- If the ground floor is zero and the first floor is 1, what number represents the basement?
- Which of these floors are above/below the ground floor, −3 and 3?
- If 5 m represents 5 metres above sea level, how do you write 5 metres below sea level?

## Possible sentence stems

- Numbers greater than zero are called ______ numbers.
- Numbers less than zero are called ______ numbers.

## National Curriculum links

- Interpret negative numbers in context, count forwards and backwards with positive and negative whole numbers, including through zero

# Understand negative numbers

## Key learning

- Mr Rose is in the lift of a building.

  He is on the ground floor.

  ▶ What number represents the ground floor?

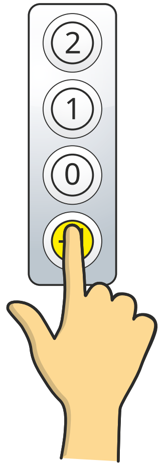
  Mr Rose wants to go to a shop on the floor above him.

  ▶ What number button does he need to press?

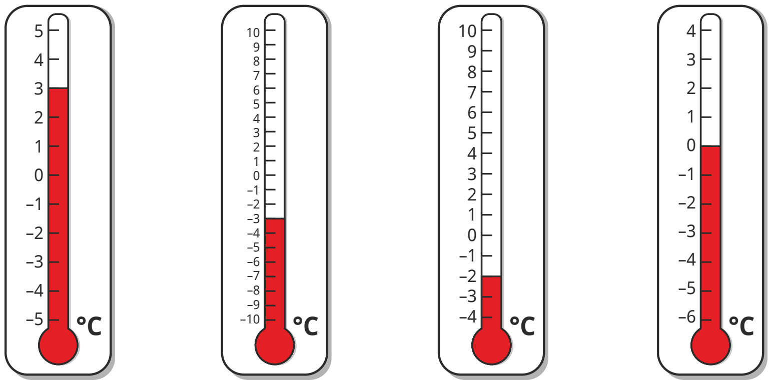
  Mr Rose's car is parked in the car park on the floor below ground level.

  His hand is covering the button.

  ▶ What number will this be?



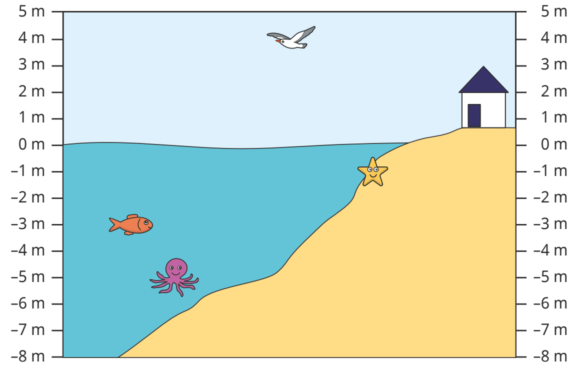

- The thermometers show the temperatures in four cities measured in degrees Celsius (°C).



Paris Oslo London Berlin

What temperatures are shown on the thermometers?

- The diagram shows distances above and below sea level.




  ▶ At what height is the bird flying?

  ▶ Which creature is at a deeper level, the starfish, fish or octopus?

  ▶ How many metres below the surface of the water is the fish?

- The table shows the temperatures at different times of the day.

| Time | Temperature |
|---|---|
| 5 am | −4 °C |
| 12 noon | 1 °C |
| 6 pm | −1 °C |

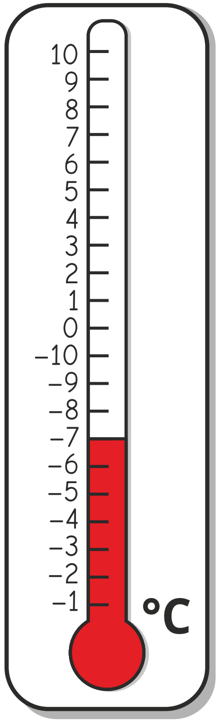
Use the clues to work out the temperature at each time.

- At 9 am, the temperature was 1 degree warmer than at 5 am.
- At 4 pm, it was colder than at 12 noon but warmer than at 6 pm.
- At 11 pm, it was 1 degree colder than at 5 am.

# Understand negative numbers

## Reasoning and problem solving

Tiny has labelled the thermometer incorrectly.

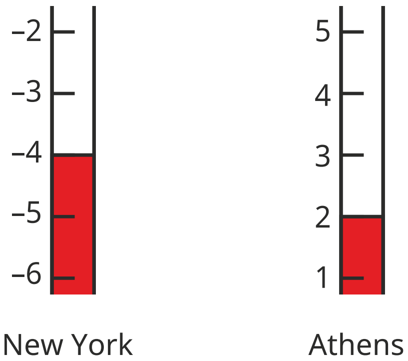



What mistake has Tiny made?

What temperature is shown?

−4 °C

The thermometers show the temperatures in New York and Athens.




The temperature in Rome is warmer than in New York, but colder than in Athens.

What could the temperature in Rome be?

−3 °C, −2 °C, −1 °C, 0 °C or 1 °C

# Count through zero in 1s

## Notes and guidance

In this small step, children become more fluent with negative numbers and explore counting both forwards and backwards through zero in 1s. Counting in other multiples through zero will be covered in the next step.

Alongside the vertical representations used in the previous step, children now see horizontal number lines. This will help to reinforce the reflective nature of positive and negative numbers. Use of horizontal number lines provides an opportunity to revisit and develop skills in labelling and identifying numbers on a number line covered in earlier blocks.

Once confident with counting both forwards and backwards through zero on a number line, children then apply these skills to solving problems involving change in temperature.

## Things to look out for

- Children may forget to include zero in a count, for example 3, 2, 1, −1, −2 , −3
- Children may not see the reflective nature of negative numbers and count after zero with the negative partner of the first positive number, for example 3, 2, 1, 0, −3, −2, −1

## Key questions

- What is a negative number? How do you write negative numbers?
- What is the next number in this count: 3, 2, 1?
- What is the number after that?
- Are the numbers counting forwards or backwards?
- What is the sequence counting forwards/backwards in?
- What number comes before/after ______ when counting forwards/backwards in 1s?

## Possible sentence stems

- Numbers less than zero are called ______ numbers.
- I know the numbers are counting forwards/backwards because …
- The number before/after ______ when counting forwards/backwards in 1s is ______

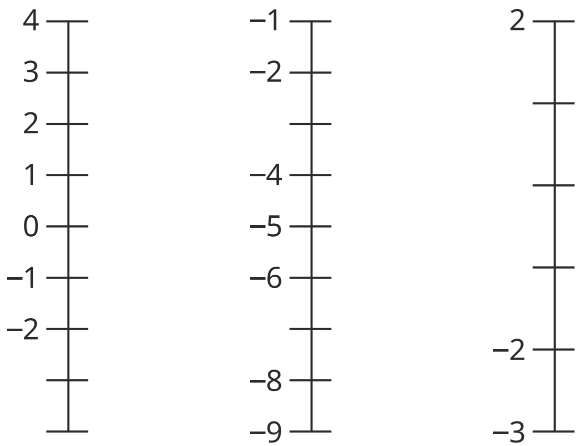
## National Curriculum links

- Interpret negative numbers in context, count forwards and backwards with positive and negative whole numbers, including through zero

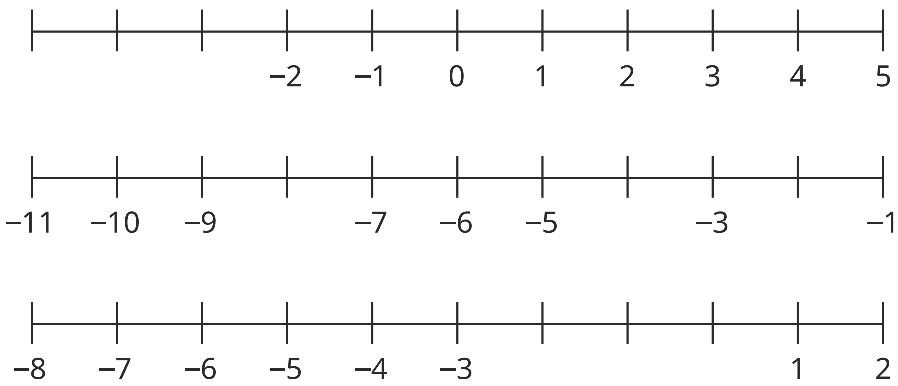
# Count through zero in 1s

## Key learning

- Work out the missing numbers.

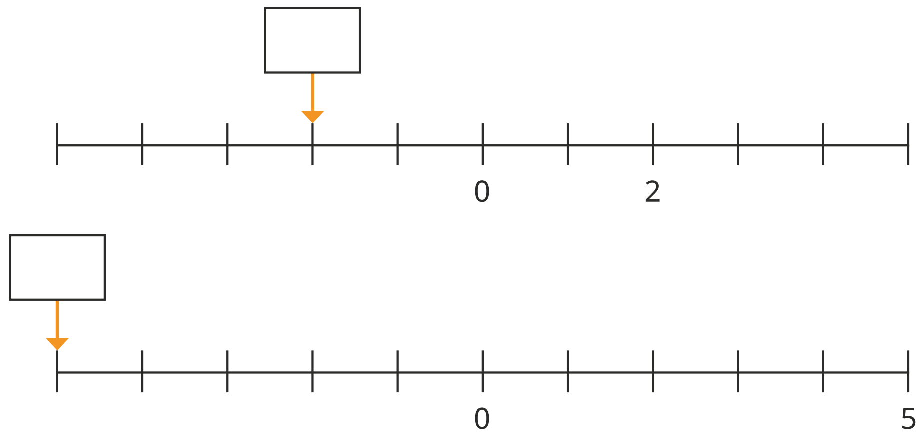



- Complete the number lines.




- What are the next three numbers in each sequence?
  - ▶ −20, −19, −18, −17, ______, ______, ______
  - ▶ 5, 4, 3, 2, ______, ______, ______
  - ▶ −6, −5, −4, −3, ______, ______, ______

- What numbers are the arrows pointing to?




What do you notice?

- The temperature in Halifax is 2 °C.

  The temperature in Manchester is 5 degrees colder.

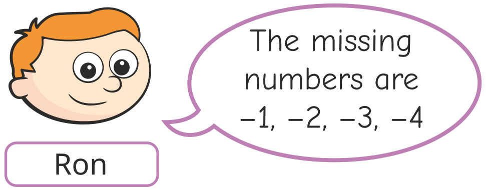
  What is the temperature in Manchester?

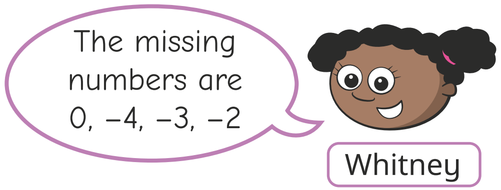
# Count through zero in 1s

## Reasoning and problem solving

Ron and Whitney are completing this counting sequence.

4, 3, 2, 1, ______, ______, ______, ______



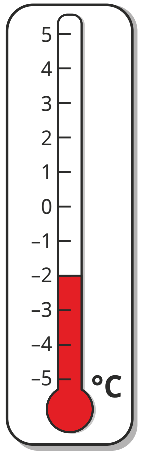




What mistake has each child made?

Complete the counting sequence correctly.

0, −1, −2, −3

The thermometer shows the temperature in Helsinki on Monday.




On Tuesday, the temperature was 5 degrees warmer than on Monday.

On Wednesday, the temperature was 7 degrees colder than on Tuesday.

What was the temperature on Wednesday?

Compare methods with a partner.

−4 °C

# Count through zero in multiples

## Notes and guidance

In this small step, children continue to practise counting both forwards and backwards through zero, but now in multiples other than 1s.

Initially, the focus is on counting where zero is included in the count, which leads to a reflective pattern, for example −6, −4, −2, 0, 2, 4, 6. Once children are confident with this, they explore counting through zero that does not follow this pattern, for example 8, 5, 2, −1, −4, −7. Encourage children to explore how partitioning of the multiple can support counting through zero. For example, when counting back in 5s from 3, they can use the fact that 5 can be partitioned into 3 and 2. This will allow them to first jump to zero and then from zero to reach −2

Number lines, both vertical and horizontal, continue to be a key representation in supporting this understanding.

## Things to look out for

- In counts that include zero, children may forget to include it.
- Children may just reflect a given sequence rather than counting through zero, for example −8, −5, −2, 2, 5, 8
- When counting through zero, children may continue the count from zero, for example 5, 3, 1, 0, −2, −4, −6

## Key questions

- What is the next number in this count: 6, 4, 2?
  What is the number after that?
- Are the numbers counting forwards or backwards?
- What is the sequence counting forwards/backwards in?
- What number comes before/after ______ when counting forwards/backwards in ______s?
- How does partitioning the multiple help when counting through zero?

## Possible sentence stems

- The sequence is counting in ______s.
- The number before/after ______ when counting forwards/backwards in ______s is ______
- I can partition ______ into ______ and ______ to help count through zero.

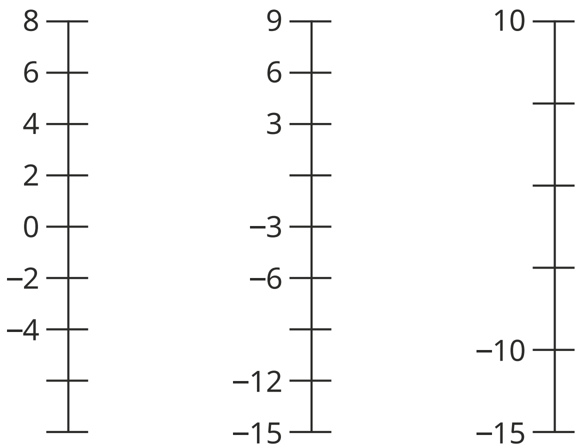
## National Curriculum links

- Interpret negative numbers in context, count forwards and backwards with positive and negative whole numbers, including through zero

# Count through zero in multiples

## Key learning

- Work out the missing numbers.



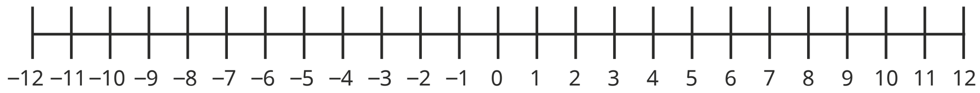

- Complete the sequences.
  - −16, −12, −8, ____, ____, ____
  - −5, −10, −15, ____, ____, ____
  - −9, −6, −3, ____, ____, ____
  - 18, 12, 6, ____, ____, ____

- The temperature at 3 pm is 4 °C.

  The temperature drops by 2 degrees every hour.

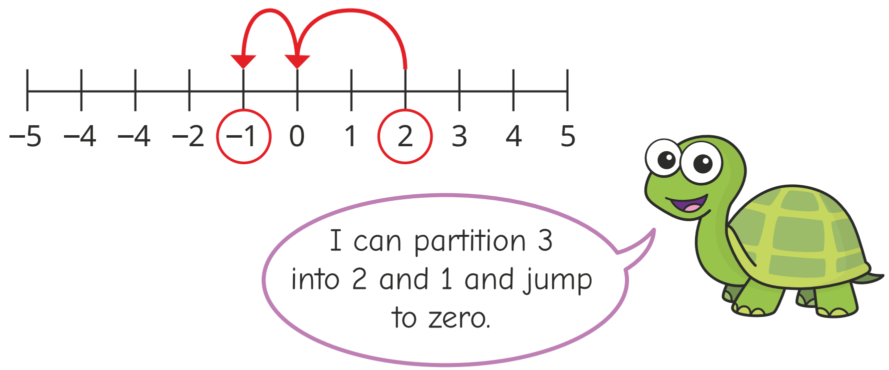
  What will the temperature be at 7 pm?

- Use the number line to complete the sequences.




  - 5, 3, 1, ____, ____, ____
  - 7, 4, 1, ____, ____, ____
  - −9, −7, −5, ____, ____, ____
  - −9, −5, −1, ____, ____, ____

- Tiny is counting backwards in 3s from 2




Use Tiny's method to find the next number in these counts.

- counting back in 4s from 2
- counting back in 5s from 3
- counting back in 4s from 3
- counting forwards in 5s from −3

# Count through zero in multiples

## Reasoning and problem solving

Starting at sea level, a diver descends 5 m every minute for 3 minutes.

The diver then ascends 3 m every minute until they reach the surface.

How many minutes does it take the diver to reach the surface?

5 minutes

Here are five numbers from a counting pattern.

| | | | | |
|---|---|---|---|---|
| 5 | −15 | −3 | 1 | −11 |

The numbers are not in the correct order.

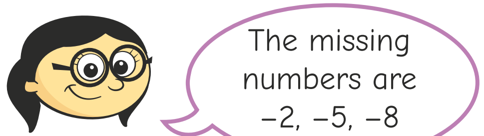
A sixth card is missing to complete the counting pattern.

What is the missing number?

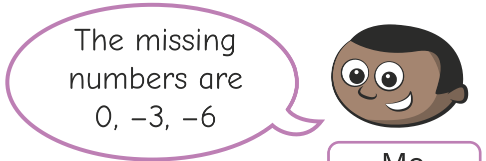
−7

Annie and Mo are completing the counting sequence.

8, 5, 2, ____, ____, ____




Annie




Mo

What mistake has each child made?

Complete the counting sequence correctly.

−1, −4, −7

# Compare and order negative numbers

## Notes and guidance

In this small step, children compare and order integers that include negative numbers.

A common misconception is to apply the abstract "rules" of positive numbers to negative numbers. For example, children may believe that because 10 is greater than 3, then −10 must be greater than −3. Number lines are a key representation to help address this misconception. By comparing positive numbers and reflecting on their positions on a number line, children can begin to generalise that greater numbers lie to the right on a number line. Therefore, because −3 lies to the right of −10, it is greater. It can also be helpful to discuss real-life contexts to support this understanding. For example, children may be comfortable with the fact that, for example, −5 degrees is colder than −1 degree and can then apply this to show that −5 < −1

Once children are confident with comparing two numbers, they can begin to order groups of integers that include both positive and negative numbers.

## Things to look out for

- Directly applying knowledge of comparing and ordering positive numbers can lead children to think that, for example, −7 > −3

## Key questions

- Where is the number ______ on the number line?
- How can you use a number line to compare numbers?
- When comparing numbers on a number line, are the greater/smaller numbers on the right or the left?
- Are negative numbers greater or less than positive numbers?
- What temperature is warmer/colder, ______ or ______? So which number is greater?
- How do you know that −8 is less than −3?

## Possible sentence stems

- Greater numbers are to the ______ of smaller numbers on a number line.
- Positive numbers are ______ than negative numbers.
- Ascending/descending order means ordering from ______ to ______

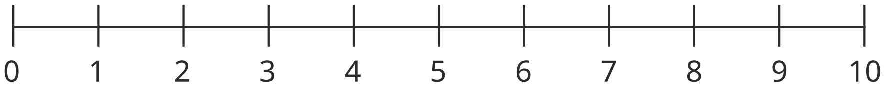
## National Curriculum links

- Interpret negative numbers in context, count forwards and backwards with positive and negative whole numbers, including through zero

# Compare and order negative numbers

## Key learning

- Use the number line to help compare the numbers.

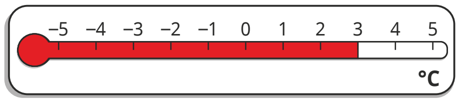


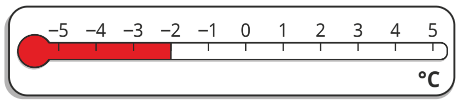

6 ◯ 3 7 ◯ 9 2 ◯ 0

Complete the sentence.

Numbers to the left on the number line are ______ than numbers to the right.

- Use the correct word to complete each sentence.



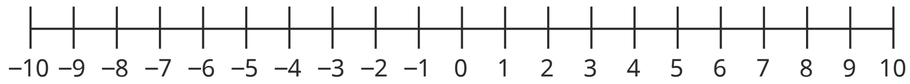

- warmer colder

  3 degrees is ______ than –2 degrees.

- less greater

  –2 degrees is ______ than 3 degrees.

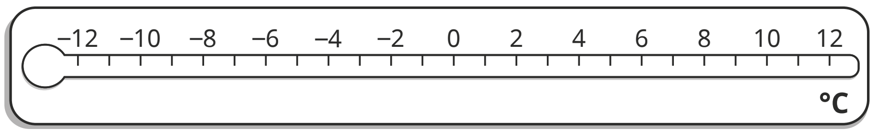
- Use the number line to help compare the numbers.




6 ◯ –3 –8 ◯ –4

5 ◯ –7 0 ◯ –5

- Write the temperatures in order, starting with the coldest.




- 9 °C, 0 °C, 3 °C
- –9 °C, 0 °C, –3 °C
- 8 °C, –1 °C, –3 °C

- Write the numbers in ascending order.

| | | | | | |
|---|---|---|---|---|---|
| –2 | 0 | 7 | –7 | 22 | 4 |

- Write the numbers in descending order.

| | | | | | |
|---|---|---|---|---|---|
| –41 | 104 | –1 | 14 | –14 | 4 |

# Compare and order negative numbers

## Reasoning and problem solving

Tiny is comparing numbers.


Draw a number line and label the positions of the numbers.

Explain why Tiny is incorrect.

Drawing of number line showing that −1 is greater than −4 as it is further to the right

Fill in the missing number.

| | | |
|---|---|---|
| −3 < | | < 2 |

Find all the possible answers.

−2, −1, 0, 1

Amir is on floor 4 of a building.

He gets in a lift and goes down 7 floors.

Rosie is on floor −5 of the building.

She gets in a lift and goes up 3 floors.

Who is on the lower floor now?

Amir

Here are the temperatures in three cities on Monday.

| Vancouver | Edinburgh | Stockholm |
|---|---|---|
| −7 °C | 1 °C | −3 °C |

On Tuesday, the temperature in:

- Vancouver is 4 degrees warmer
- Stockholm is 3 degrees warmer
- Edinburgh is 3 degrees colder.

Order the temperatures for Tuesday, starting with the warmest.

Stockholm 0 °C

Edinburgh −2 °C

Vancouver −3 °C

# Find the difference

## Notes and guidance

In this small step, children look at finding the difference between positive and negative numbers.

As with previous steps, vertical and horizontal number lines are a key representation in supporting this understanding. To begin with, children count either forwards or backwards in 1s through zero, seeing that the difference is the number of jumps between the two numbers. They then look at more efficient strategies by jumping to and from zero and adding the two jumps together to find the difference. For example, to find the difference between −4 and 3, they can jump 3 from 3 to 0 and then 4 from 0 to −4. The difference is 3 + 4 = 7

Contextual problems, such as finding the difference between temperatures or distances above and below ground, are very common, so this step is key for working with negative numbers.

## Things to look out for

- When using number lines, children may count the numbers rather than the jumps, resulting in a difference that is 1 greater than it should be.
- Children may rely on always counting individual jumps rather than using the more efficient strategy of jumping to and from zero.

## Key questions

- Where is the number ______ on the number line?
- How can you use a number line to find the difference between two numbers?
- How many jumps are there from ______ to ______?
- Does it matter if you count forwards or backwards?
- How far away from zero is ______?
- If the jump from ______ to zero is ______ and the jump from zero to ______ is ______, what is the overall difference?

## Possible sentence stems

- There are ______ jumps from ______ to ______, so the difference is ______
- The distance from ______ to zero is ______

  The distance from zero to ______ is ______

  So the difference between ______ and ______ is ______

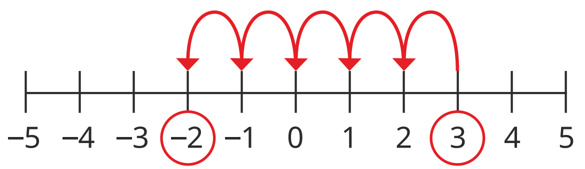
## National Curriculum links

- Interpret negative numbers in context, count forwards and backwards with positive and negative whole numbers, including through zero

# Find the difference

## Key learning

- Max is finding the difference between 3 and −2

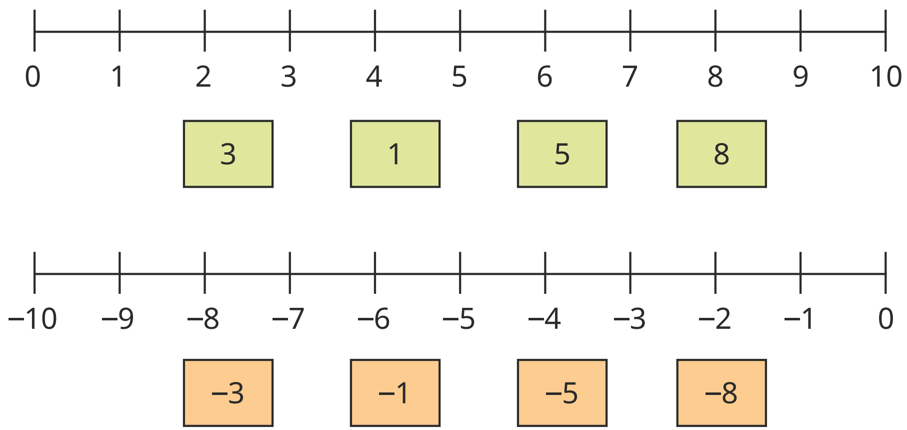



The difference between 3 and −2 is 5

Use Max's method to find the differences between the pairs of numbers.

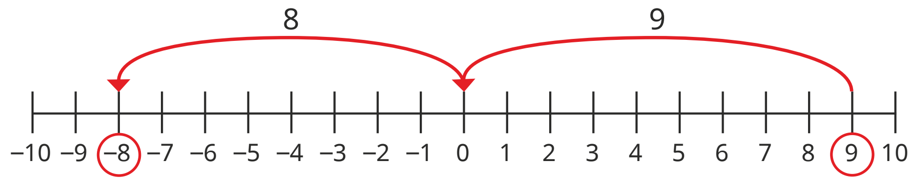
▸ −1 and 2 ▸ 2 and −5 ▸ −2 and 5 ▸ 3 and −3

- Count the number of jumps from zero to each number.




What do you notice?

- Eva is finding the difference between 9 and −8




9 + 8 = 17, so the difference between 9 and −8 is 17

Use Eva's method to find the differences between the pairs of numbers.

▸ −5 and 7 ▸ 8 and −4 ▸ −1 and 9 ▸ 6 and −6

- The temperature in London is 8 °C.

  The temperature in Moscow is −7 °C.

  How much warmer is the temperature in London than in Moscow?

- Find the differences between the pairs of numbers.

  ▸ −32 and 65 ▸ −48 and 45 ▸ 132 and −224

- Mrs Fisher parks her car on level −3

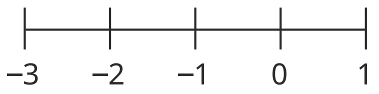
  Her flat is on level 18

  How many floors does she have to go up to get to her flat?

# Find the difference

## Reasoning and problem solving

Kim is finding the difference between −3 and 1




The difference is 5

What mistake has Kim made?

What is the difference between −3 and 1?

4

The table shows the highest and lowest temperatures recorded on a day in two cities.

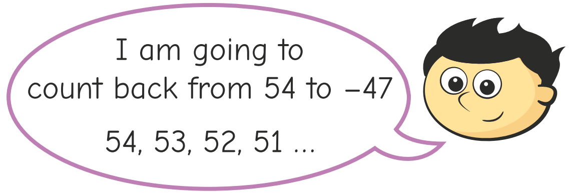
| City | Highest temperature | Lowest temperature |
|---|---|---|
| Oslo | 4 °C | −6 °C |
| Helsinki | 3 °C | −9 °C |

Which city has the greater difference in its daily temperature?

Compare methods with a partner.

Helsinki

Jack is finding the difference between −47 and 54




Explain a more efficient method for Jack to find the difference.

What is the difference?

101

The temperature at 9 am is −5 °C.

At 1 pm, the temperature is 9 degrees warmer.

At 9 pm, the temperature has dropped 3 degrees since 1 pm.

What is the difference between the temperatures at 9 am and 9 pm?

6 degrees

Summer Block 5

# Converting units

# Small steps

| | |
|---|---|
| Step 1 | Kilograms and kilometres |
| Step 2 | Millimetres and millilitres |
| Step 3 | Convert units of length |
| Step 4 | Convert between metric and imperial units |
| Step 5 | Convert units of time |
| Step 6 | Calculate with timetables |

# Kilograms and kilometres

## Notes and guidance

Children first encountered kilograms in Year 3 and kilometres in Year 4. This small step revisits both of these units of measure and their relationships to grams and metres, respectively.

Begin by discussing what units of measure are and how different units of measure are used for different purposes. Remind children of what kilograms and kilometres are, discussing examples of when each would be used. Then explain that the prefix "kilo-" always means one thousand, so 1,000 grams is equivalent to 1 kilogram and 1,000 metres is equivalent to 1 kilometre. Bar models and double number lines are useful representations for showing the conversions. Make links to multiplying and dividing integers and decimals by 1,000, covered earlier in the year.

Children should also be confident with conversions of simple fractions such as $\frac{1}{2}$ kg = 500 g and $\frac{3}{4}$ km = 750 m.

## Things to look out for

- Children may perform the wrong operation, for example multiplying instead of dividing.
- Children may confuse "kilo-" with "centi-" and use the factor of 100 instead of 1,000

## Key questions

- What are units of measure?
- What might you measure using kilograms/kilometres?
- What is the same about kilograms and kilometres? What is different?
- What does the prefix "kilo-" mean?
- How many grams are there in ______ kilograms?
- How can you convert from kilometres to metres? What is the same and what is different about converting from metres to kilometres?

## Possible sentence stems

- 1 kilometre = ______ m,
  so ______ kilometres = ______ × 1,000 m = ______ m
- ______ g = 1 kg, so ______ g = ______ ÷ 1,000 = ______ kg

## National Curriculum links

- Convert between different units of metric measure [for example, kilometre and metre; centimetre and metre; centimetre and millimetre; gram and kilogram; litre and millilitre]

# Kilograms and kilometres

## Key learning

- Complete the bar models.

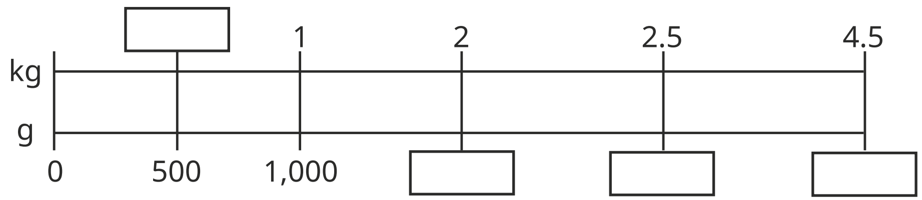
| 1 km | 1 km |
|---|---|
| m | m |

2 km = ______ m

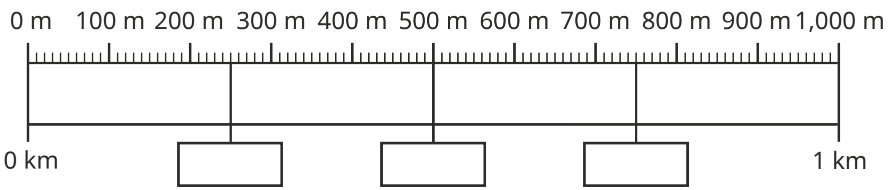
| 1,000 g | 1,000 g | 1,000 g | 1,000 g |
|---|---|---|---|
| kg | kg | kg | kg |

4,000 g = ______ kg

- Find the missing values on the double number line.




- Use the double number line to help you complete the sentences.




  - 1 km is equivalent to ______ m.
  - $\frac{1}{4}$ km is equivalent to ______ m.
  - $\frac{1}{2}$ km is equivalent to ______ m.
  - $\frac{3}{4}$ km is equivalent to ______ m.

- Write <, > or = to compare the measurements.

  5 kg ◯ 4,500 g  12 kg ◯ 12,000 g

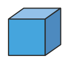
  3.7 km ◯ 370 m  37,000 m ◯ 3.7 km

- Fill in the missing numbers.
  - $\frac{1}{10}$ kg = ______ g
  - $\frac{3}{10}$ km = ______ m
  - 7 kg + $\frac{1}{4}$ kg = ______ g
  - 12 km + ______ km = 12,500 m

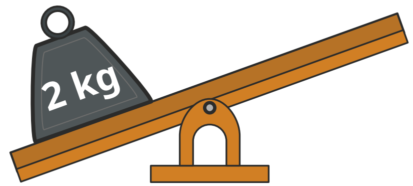
- Eva walks 1,750 m to the bus stop.

  She then rides on the bus for 5.2 km.

  How far has she travelled in total?

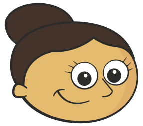
- Each cube has a mass of 250 g. 

  How many cubes must be added to balance the scales?



# Kilograms and kilometres

## Reasoning and problem solving




10 km = 10 × 1,000
= 10,000 m and
0 km = 0 × 1,000
= 0 m

Do you agree with Dora?

Explain your answer.

Yes

Dani bakes a cake that has a mass of 2.4 kg.

She cuts it into eight equal pieces.

She eats a piece and gives a piece to each of her two friends.

What is the mass of the remaining cake in grams?

1,500 g

Mr Lee buys 2,500 g of potatoes and 2,000 g of carrots.

78p per kg

£1.46 per kg

He pays with a £5 note.

How much change does he get?

13p

Mo and Nijah are both doing a sponsored run.

They are each given 25p for every 100 m that they run.

- Mo runs 5.7 km.
- Nijah runs 6,300 m.

How much more money does Nijah raise than Mo?

Compare methods with a partner.

£1.50

# Millimetres and millilitres

## Notes and guidance

Children first encountered millimetres and millilitres as units of measure in Year 3. In this small step, they convert between millimetres and metres and between millilitres and litres for the first time.

As in the previous step, begin by reminding children what these units of measure are and what they are likely to be used for. Then discuss the prefix "milli-", explaining that it means one thousandth. Model conversions by multiplying amounts given in litres and metres by 1,000 and dividing amounts given in millimetres and millilitres by 1,000. The use of bar models and double number lines will help children's understanding of these conversions.

Children then move on to converting amounts given in litres and metres, including decimals and fractions. Finally, they use this understanding to solve problems that require conversions between these units of measure.

## Things to look out for

- Children may perform the wrong operation, for example multiplying instead of dividing.
- Children may confuse the different prefixes "kilo-", "milli-" and "centi-".

## Key questions

- What might you measure in metres/litres?
- What might you measure in millimetres/millilitres?
- What does the prefix "milli-" mean?
- What is the same and what is different about the prefixes "milli-" and "kilo-"?
- How can you convert from litres/metres to millilitres/millimetres?
- How many litres are equivalent to ______ millilitres?
- Which is the greatest length, 1 mm, 1 km or 1 m?
- What unit of measure would you use for measuring ______?

## Possible sentence stems

- To convert from litres to millilitres, I ______ by 1,000
- To convert from millimetres to metres, I ______ by 1,000

## National Curriculum links

- Convert between different units of metric measure [for example, kilometre and metre; centimetre and metre; centimetre and millimetre; gram and kilogram; litre and millilitre]

# Millimetres and millilitres

## Key learning

- Use the bar models to complete the conversions.

| 1,000 ml | 1,000 ml | 1,000 ml | 1,000 ml |
|---|---|---|---|
| l | l | l | l |

4,000 ml = ______ l

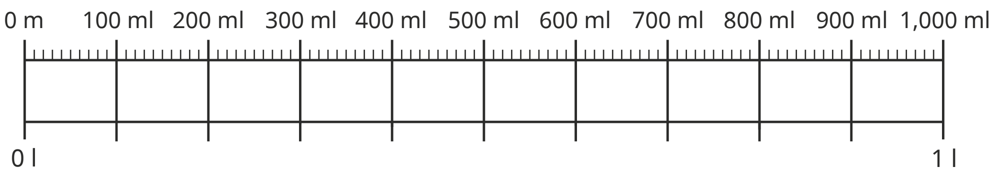
| 1 m | 1 m | 1 m | 1 m | 1 m | 1 m |
|---|---|---|---|---|---|
| mm | mm | mm | mm | mm | mm |

6 m = ______ mm

| 1 l | 1 l | 1 l | |
|---|---|---|---|
| ml | ml | ml | |

$2\frac{1}{2}$ l = ______ ml

- Use the double number line to complete the conversions.




▶ 1 l = ______ ml
▶ 200 ml = $\frac{\square}{\square}$ l
▶ ______ ml = 0.4 l
▶ $\frac{1}{10}$ l = ______ ml
▶ ______ . ______ l = 700 ml

- Use the fact to help you complete the conversions.

1,000 mm = 1 m

▶ 5,000 mm = ______ m
▶ 500 mm = ______ m
▶ 50,000 mm = ______ m
▶ 5,500 mm = ______ m

- Write <, > or = to compare the measurements.

2 l ◯ 1,500 ml
60 l ◯ 6,000 ml
2.8 m ◯ 280 mm
3,700 m ◯ 3.7 mm

- Fill in the missing numbers.

▶ $\frac{1}{1000}$ m = ______ mm
▶ 2 l + ______ ml = 2,500 ml
▶ $\frac{1}{100}$ m = ______ mm
▶ 3 l + $\frac{1}{4}$ l = ______ ml
▶ $\frac{1}{10}$ m = ______ mm
▶ 3 l + ______ l = 3,400 ml

- Brett has a 2 litre jug of juice.

He pours 350 ml of juice into each of three cups.

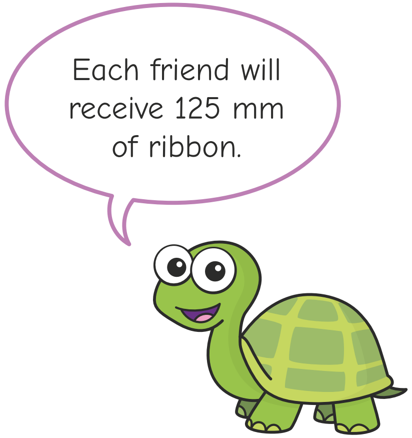
How much juice is left in the jug?

# Millimetres and millilitres

## Reasoning and problem solving

5 m of ribbon is shared equally between four friends.

| 5 m | | | |
|---|---|---|---|
| mm | mm | mm | mm |



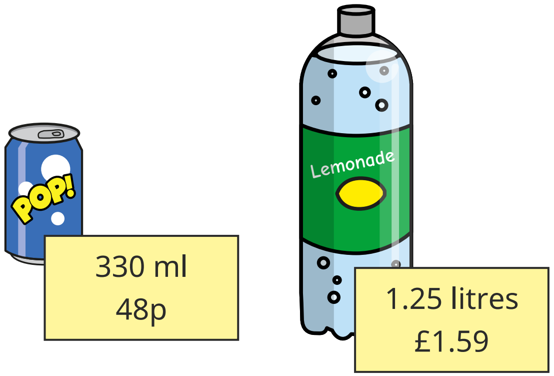

Do you agree with Tiny?

Explain your answer.

No

There are not 100 mm in 1 m.

Lemonade is sold in cans and bottles.




Alex buys 5 cans and 3 bottles.

She sells the lemonade in 100 ml glasses to raise money for charity.

She sells all the lemonade.

How many glasses does she sell?

Alex charges 50p per glass.

How much profit does she make?

54

£19.83

# Convert units of length

## Notes and guidance

In this small step, children build on their learning in the previous two steps to convert the units of metric lengths – millimetres, centimetres and metres.

Recap what types of things would be measured by each unit of measure, and when each one would be inappropriate, for example measuring the playground in millimetres or measuring a pencil sharpener in metres. Measuring and drawing lines of specific lengths in centimetres and millimetres help with children's understanding of these measures.

Model how to convert between these units. Begin by discussing the difference between milli- and centi-, meaning that they multiply a length given in metres by 100 to convert it to centimetres, and by 1,000 to convert it to millimetres. Then use division to convert the other way. When children are confident with integer values, they can move on to converting fractional and decimal lengths in metres.

## Things to look out for

- Children may confuse when to multiply or divide and/or when to use 10, 100 or 1,000
- Children may confuse the units of measure or omit them from their answers.

## Key questions

- What units of length do you know?
- What objects would you measure with millimetres/centimetres/metres?
- Which unit of measure would you use to measure ______?
- How many mm/cm are there in ______ cm/m?
- How can you convert from mm/cm/m to mm/cm/m?
- When do you need to divide/multiply by 10/100/1,000?

## Possible sentence stems

- There are ______ mm in ______ cm.
- There are ______ mm in ______ m.
- There are ______ cm in ______ m.
- To convert between mm/cm/m and mm/cm/m, I ______ by ______

## National Curriculum links

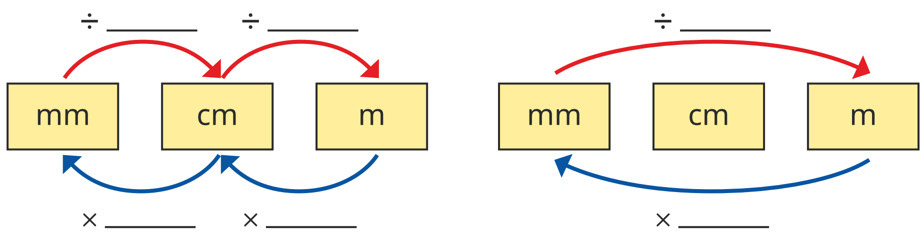
- Convert between different units of metric measure [for example, kilometre and metre; centimetre and metre; centimetre and millimetre; gram and kilogram; litre and millilitre]

# Convert units of length

## Key learning

- There are 10 mm in 1 cm and 100 cm in 1 m.

  Use this to help you complete the conversion diagrams.




- Fill in the missing numbers in the conversions.
  - 10 mm = ______ cm
  - ______ cm = 1 m
  - 55 mm = ______ cm
  - 300 mm = ______ cm = ______ m
  - ______ mm = 98 cm = ______ m
  - 2 cm = ______ mm
  - ______ m = 300 cm
  - ______ m = 670 cm
  - 5 m = ______ cm
  - 5.6 m = ______ cm

- Measure each line.

  Write the lengths in both centimetres and millimetres.

- Here are the heights of four children.

| Esther | Scott | Aisha | Filip |
|---|---|---|---|
| 1.3 m | 124 cm | 1.32 m | 141 cm |

  Put the children in height order, starting with the shortest.

  Write their heights in millimetres.

- Write <, > or = to compare the measurements.

  55 mm ◯ 6 cm

  100 m ◯ 1 cm

  6.8 cm ◯ 7 mm

  0.25 m ◯ 300 mm

- Line A is 6 centimetres long.

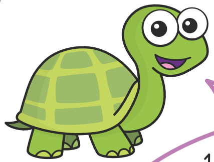
  Line B is 54 millimetres longer than line A.

  Line C is $\frac{2}{3}$ of line B.

  Draw lines A, B and C.

# Convert units of length

## Reasoning and problem solving



$\frac{1}{2}$ a metre is 500 cm.
That means that $\frac{1}{2}$ a metre is 5,000 mm because to convert between cm and mm, I multiply by 10

Is Tiny correct?

Explain your answer.

No

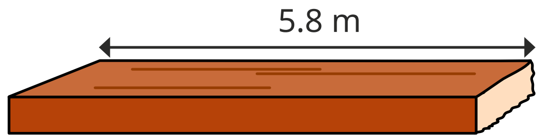
Dexter has a pencil that is 9.5 cm long.

He uses it every day for a week, and it is now 6.9 cm long.

How many millimetres shorter is his pencil now than it was a week ago?

26 mm

A plank of wood is 5.8 metres long.




Two lengths are cut from the wood.

| 175 cm | $3\frac{4}{5}$ m |
|---|---|

What length of the plank is left?

25 cm or 0.25 m

A 10p coin is 2 mm thick.

Rosie makes a pile of 10p coins worth £1.30

What is the height of the pile of coins in centimetres?


2.6 cm

# Convert between metric and imperial units

## Notes and guidance

In this small step, children are introduced to imperial units of measure and learn to convert between metric and imperial units.

Begin by having a conversation about different units of measure, asking children to name as many as they can. Sort children's suggestions into metric and imperial units. Explain that the metric and imperial systems are different ways of measuring the same type of thing and it can depend on where you are as to which you use, for example road signs in England are in miles, but in France they are in kilometres.

Model exchanging between the units covered in this step: inches and centimetres, kilograms and pounds, and pints and millilitres. It is important to explain the term "approximately" in this context and that the conversions given are not exact. Explain the meaning of "≈" as "approximately equal to".

When children are confident converting between units, they can solve problems that include both metric and imperial measures.

## Things to look out for

- Children may confuse ≈ and =.
- Children may forget to include units of measure in their answers.

## Key questions

- What different types of units of measure do you know?
- How can you sort the units of measure into groups?
- What is the difference between imperial and metric units of measure?
- What does "approximately equal to" mean? What symbol is used to mean "approximately equal to"?
- How can you convert from cm/kg/ml to inches/lb/pints?
- How can you convert from inches/lb/pints to cm/kg/ml?

## Possible sentence stems

- 1 kg is approximately equal to ______ lb, so ______ kg is approximately equal to ______ × ______ = ______ lb.
- 1 pint is approximately equal to ______ ml, so ______ pints is approximately equal to ______ × ______ = ______ ml.
- 1 inch is approximately equal to ______ cm, so ______ cm is approximately equal to ______ ÷ ______ = ______ inches.

## National Curriculum links

- Understand and use approximate equivalences between metric units and common imperial units such as inches, pounds and pints

# Convert between metric and imperial units

## Key learning

- 1 inch is approximately equal to 2.5 cm.

  1 inch ≈ 2.5 cm

  Use this fact to complete the conversions.

  - 2 inches ≈ _______ cm
  - 20 inches ≈ _______ cm
  - _______ inches ≈ 7.5 cm
  - _______ inches ≈ 12.5 cm

- The area of the rectangle is 50 $cm^2$


  What is the approximate perimeter of the rectangle in inches?

- 1 kilogram is approximately equal to 2.2 pounds.

  1 kg ≈ 2.2 lb

  Use this fact to complete the conversions.

  - _______ kg ≈ 4.4 lb
  - _______ kg ≈ 22 lb
  - 4 kg ≈ _______ lb
  - 100 kg ≈ _______ lb

- Apples are sold in 2 kg bags.

  Huan buys 4 bags of apples.

  He uses 2.6 lb of the apples.

  What is the approximate mass of Huan's remaining apples in pounds?

- Use the fact to complete the conversions.

  1 pint ≈ 568 ml

  - 2 pints ≈ _______ ml
  - $\frac{1}{2}$ pint ≈ _______ ml
  - _______ pints ≈ 56.8 ml
  - _______ pints ≈ 5,680 ml

- There are 8 pints in a gallon.

  A class is given 2 gallons of lemonade.

  They drink 3 litres of lemonade in total.

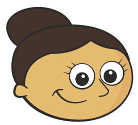
  About how many millilitres of lemonade do they have left?

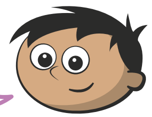
| 1 gallon | 1 gallon |
|---|---|
| pints | pints |
| ml | ml |

_______ ml

# Convert between metric and imperial units

## Reasoning and problem solving

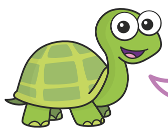



Who was heavier when they were born, Dora or Amir?

Explain your answer.

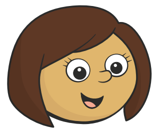
Dora




Is Tiny correct?

Explain your answer.

No




Approximately how many litres of milk are delivered to Kim's house each week?

Kim uses about 200 ml of milk every day on her cereal.

Approximately how many pints of milk does Kim use for her cereal in a week?

approximately 6.8 litres

approximately $2\frac{1}{2}$ pints

# Convert units of time

## Notes and guidance

Children have encountered units of time and converted between them in previous years. In this small step, they revisit and extend this learning and solve problems involving units of time.

Ask children to name as many different units for measuring time as they can. Encourage them to think of longer units such as days, weeks, months and years as well as smaller units such as seconds, minutes and hours.

Model the different conversions, many of which, such as days in a week and minutes in an hour, will be familiar from previous learning and everyday experience, but others, such as days in a year or days in different months, may need recapping.

Double number lines are a useful representation to support many of the conversions. Once children are confident converting between different units of time, they can solve problems that involve different units.

## Things to look out for

- Children may be confused when converting measures that involve division (for example, days to weeks) if there is a remainder.
- Children may think that time conversions behave like decimals, for example 0.25 minutes = 25 seconds.

## Key questions

- What units of measure do we use for time?
- How can you put the units of measure for time in order from shortest to longest?
- How many seconds/minutes/hours are there in ______ minutes/hours/days?
- How can you convert from ______ to ______?
- When using division to convert times, what happens if there is a remainder?

## Possible sentence stems

- There are ______ seconds/minutes in a minute/hour, so in ______ minutes/hours there are ______ × ______ = ______ seconds/minutes.
- There are ______ hours in a day, so in ______ hours there are ______ ÷ ______ = ______ full days and ______ hours.
- To convert ______ into ______, I ______ by ______

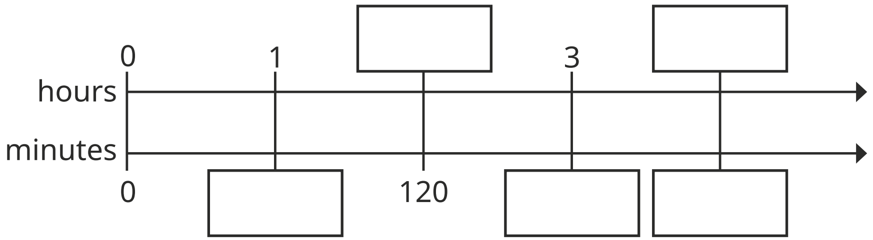
## National Curriculum links

- Solve problems involving converting between units of time

# Convert units of time

## Key learning

- Complete the double number line.




Use the double number line to help work out the conversions.

- ▸ 5 hours = ______ minutes
- ▸ ______ hours = 600 minutes
- ▸ $\frac{1}{2}$ hour = ______ minutes
- ▸ ______ hours = 150 minutes

- There are 60 seconds in a minute.
  - ▸ How many seconds are there in 5 minutes?
  - ▸ How many minutes are equivalent to 630 seconds?

- Sam is boiling an egg.

  She wants to boil it for $4\frac{1}{2}$ minutes, but she accidentally boils it for an extra 45 seconds.

  How many seconds does she boil the egg for?

- There are 7 days in a full week.

  How many full weeks are there in 23 days?

  How many days are left over?

- Complete the table.

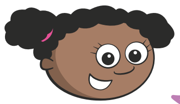
| Days | Weeks and days |
|---|---|
| 42 days | |
| | 5 weeks and 5 days |
| | 10 weeks and 5 days |
| 100 days | |

- Complete the conversions.
  - ▸ 1 year = ______ months
  - ▸ ______ years = 60 months
  - ▸ 3 years and 2 months = ______ months
  - ▸ ______ years and ______ months = 75 months
  - ▸ ______ years = 24 months
  - ▸ 2.5 years = ______ months

# Convert units of time

## Reasoning and problem solving

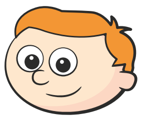
Whitney, Ron and Tiny are converting units of time.



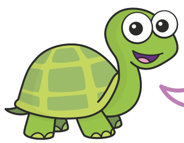
There are 60 seconds in a minute.

Whitney

There are 60 minutes in an hour.



Ron



That means that there are 120 seconds in an hour.

Tiny

Do you agree with Tiny?

Explain your answer.

No

Tiny has worked out 60 + 60 instead of 60 × 60

There are 3,600 seconds in an hour.

Tom is exactly 11 years old.

There have been two leap years in his life.

How many days has Tom been alive?

Convert your answer to hours.

Investigate for other ages.

4,017 days

96,408 hours

Three children are running a race.

- Dani finishes the race in 3 minutes and 5 seconds.
- Eva finishes the race in 192 seconds.
- Alex finishes the race in 2 minutes and 82 seconds.

Who wins the race?

Compare methods with a partner.

Dani

# Calculate with timetables

## Notes and guidance

Earlier in the year, in the statistics block, children read and interpreted timetables. In this small step, this learning is revisited and extended to include using timetables to solve problems that involve calculations with time.

Begin by recapping what timetables are, their purpose and how they are used. Show different timetables and explain how they show what is happening when. Model how to calculate using a timetable, for example lengths of time between events, how long a television programme is, times between stops on a train/bus journey. These can be challenging, especially when the times cross an hour; a number line can be used to support these calculations.

Children answer questions across a range of different timetables, then think of their own questions that could be answered with the information given in a timetable. Finally, children create their own accurate timetable with information provided.

## Things to look out for

- Children may confuse 12-hour and 24-hour clock times.
- Children may try to subtract times using the column method, misinterpreting times as decimals.

## Key questions

- What information can a timetable give you?
- Why are some parts of the timetable blank?
- How do you convert between times given using 12-hour and 24-hour clocks?
- How long does ______ take?
- How many minutes are there between ______ and ______?
- How can a number line help you to find the difference between two times?
- What questions could you ask about this timetable?

## Possible sentence stems

- The ______ train/bus from ______ takes ______ minutes to get to ______
- From ______ to the next hour is ______ minutes.
  From ______ to ______ is ______ minutes.
  The total time taken is ______ + ______ = ______ minutes.

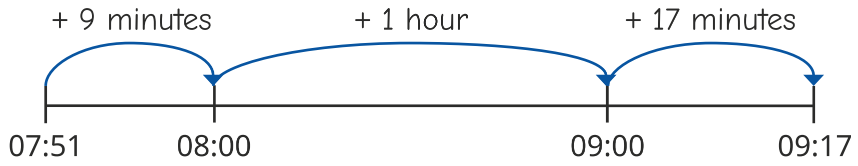
## National Curriculum links

- Solve problems involving converting between units of time

# Calculate with timetables

## Key learning

- Use Mo's number line to work out how long it is between 07:51 and 09:17




- Use the timetable to answer the questions.

| | | | | | |
|---|---|---|---|---|---|
| Bus Station | 06:05 | 06:35 | 07:10 | 07:43 | 08:15 |
| Shelf Roundabout | 06:15 | 06:45 | | 07:59 | 08:31 |
| Shelf Village Hall | 06:16 | 06:46 | 07:25 | 08:00 | 08:32 |
| Woodside | 06:21 | 06:50 | 07:28 | | |
| Odsal | 06:26 | 06:55 | 07:33 | 08:15 | 08:45 |
| Railway Station | 06:40 | 07:10 | 07:48 | 08:30 | 09:00 |

▶ Why are some of the times blank?

▶ How long does it take the 06:35 bus to travel from the bus station to Odsal?

▶ How long does it take the 08:32 bus to get from Shelf Village Hall to the railway station?

- Use the timetable to answer the questions.

| | | | | |
|---|---|---|---|---|
| Ilkley | 14:01 | 14:31 | 15:01 | 15:31 |
| Ben Rydding | | 14:39 | 15:09 | 15:39 |
| Burley in Wharfedale | 14:12 | 14:44 | | 15:44 |
| Menston | 14:17 | 14:49 | 15:15 | 15:49 |
| Guiseley | 14:20 | | 15:18 | 15:52 |
| Leeds | 14:31 | 14:59 | 15:29 | 16:33 |

▶ How long does the 14:01 train from Ilkley take to get to Menston?

▶ How often do trains leave Ilkley for Leeds?

▶ How much longer does it take the 15:39 train from Ben Rydding to get to Guiseley than the 15:09 train from Ben Rydding to Guiseley?

▶ Teddy arrives in Burley in Wharfedale at 2:50 pm.

He wants to get to Leeds.

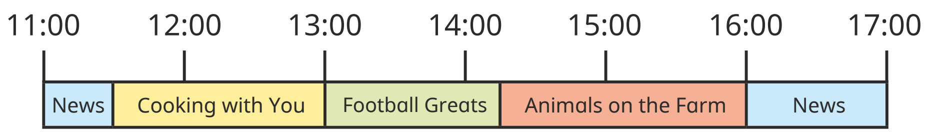
When is the earliest he will arrive in Leeds?

Ask a partner more questions that can be answered using the timetable.

# Calculate with timetables

## Reasoning and problem solving

Here is an extract from a TV guide.




Rosie turns on the TV at 12 noon.

What will be on?

Estimate how long *Animals on the Farm* lasts.

Between 11 am and 5 pm, how many minutes is the news on for altogether?

Ask a partner more questions that can be answered using the guide.

*Cooking with You* | 1 hour and 45 minutes | 90 minutes

Here is part of a bus timetable.

| | | | | | |
|---|---|---|---|---|---|
| Trinity Street | 05:40 | 06:00 | 06:20 | 06:35 | 06:50 |
| Marford Hill | 05:51 | 06:13 | 06:33 | 06:48 | 07:05 |
| Chister Business Park | 06:07 | 06:25 | 06:48 | 07:03 | 07:20 |
| Railway Station | 06:18 | 06:38 | 07:00 | 07:15 | 07:35 |

Mr Khan is getting the train from the railway station at 07:05

- He lives a 9-minute walk from Marford Hill bus stop.
- The train platform is an 8-minute walk from the railway station bus stop.
- The train journey is 1 hour and 18 minutes.

What time does Mr Khan need to leave his house?

How long will it be from Mr Khan leaving his house to getting off the train?

6:04 | 2 hours 19 minutes

Summer Block 6

# Volume

# Small steps

| | |
|---|---|
| Step 1 | Cubic centimetres |
| Step 2 | Compare volume |
| Step 3 | Estimate volume |
| Step 4 | Estimate capacity |

# Cubic centimetres

## Notes and guidance

In Year 3, children compared volumes of liquids using words such as “empty”, “full”, “more” and “less”. In this small step, they learn that volume refers to the amount of three-dimensional space an object takes up, and they measure volume using cubes.

Children make simple shapes with interlocking cubes and describe the volume of each shape in terms of the number of cubes. They then look at pictorial representations and work out how many cubes there are in each shape, including counting the cubes that cannot be seen in the picture. They then find the volume of a variety of shapes, using both concrete and pictorial representations, using the fact that each cube has a volume of one cubic centimetre (written 1 $cm^3$).

Finally, they make and measure the volumes of cuboids. Children recognise that some of the cubes in a pictorial representation cannot be seen, but that the total volume can be found by counting the number of cubes in each layer. This leads to the formula to work out the volume of a cuboid, which is covered in Year 6

## Things to look out for

- Children may only count the visible cubes when working out the volume of a 3-D shape.
- Children may omit units from their answer.

## Key questions

- What is volume?
- What unit can you use to measure volume?
- What is the difference between one square centimetre and one cubic centimetre?
- How many cubes is the shape made up of?
- What is the volume of the shape/cuboid?
- How can you make a cuboid that has 16 cubes?

  Is there more than one way?

## Possible sentence stems

- The number of cubes needed to make the shape is ______
- The volume of the shape is ______ cubic centimetres.
- There are ______ cubes in each layer and there are ______ layers.

  There are ______ cubes altogether.

## National Curriculum links

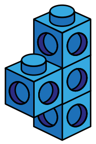
- Estimate volume [for example, using 1 $cm^3$ blocks to build cuboids (including cubes)] and capacity

# Cubic centimetres

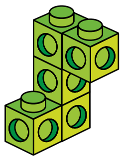
## Key learning

- Jack and Kim are using cubes to make shapes.

**Jack**



**Kim**

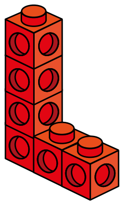


How many cubes have they each used?

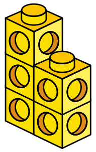
- Dora and Max have each made a shape using cubes.

The volume of each cube is 1 $cm^3$

**Dora**



**Max**

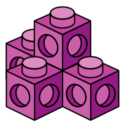


What is the volume of each of their shapes?

- Tommy uses cubes to make this 3-D shape.

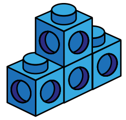
Each cube has a volume of 1 $cm^3$

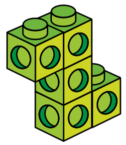
What is the volume of Tommy's shape?

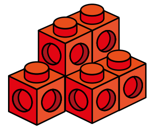


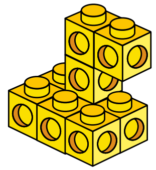
- What is the volume of each 3-D shape?

Each cube has a volume of 1 $cm^3$



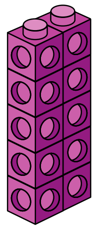


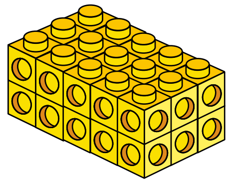


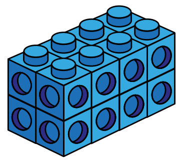


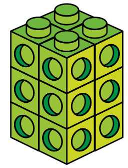
- Rosie makes some cuboids using cubes.

Each cube has a volume of 1 $cm^3$





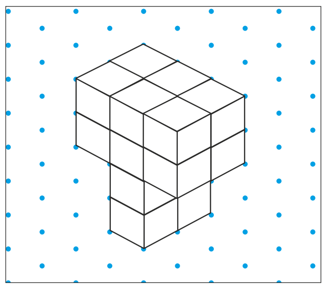




What is the volume of each cuboid? How did you work it out?

- Scott draws a "T" shape on isometric paper.

How many cubes does he need to make his 3-D shape?

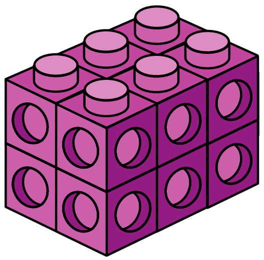


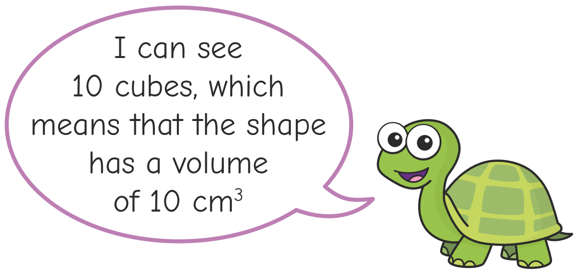
# Cubic centimetres

## Reasoning and problem solving

Dani makes this cuboid.

Each cube has a volume of 1 $cm^3$






Do you agree with Tiny?

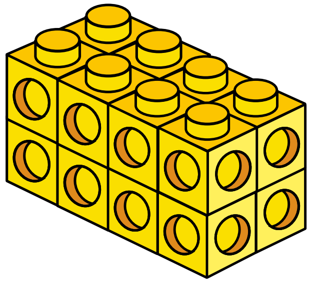
Explain your answer.

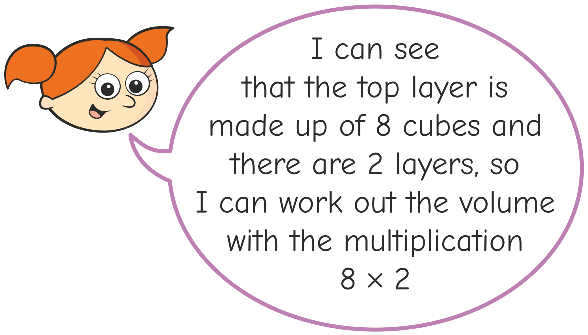
No

There are two cubes that cannot be seen.

volume = 12 $cm^3$

Alex is working out the volume of this cuboid.






Is Alex correct?

Explain your answer.

Yes

# Compare volume

## Notes and guidance

This small step builds on the previous step by comparing the volumes of different shapes. In Year 3, children compared the volume of liquid in different containers using simple vocabulary. In this small step, they find the volume of different shapes by counting cubes, then decide which shape has the greater volume.

Begin by looking at 3-D shapes made from interlocking cubes, asking children to say which contains more cubes and so has the greater volume. Children can then move on to pictorial representations, working out the number of cubes needed to make each shape before deciding which has the greater volume.

Finally, children compare cuboids. They may find it easier to make the cuboids themselves in order to work out the volume, or they may count the number of cubes in each layer, then multiply this by the height of the shape.

## Things to look out for

- Children may assume that a taller shape always has a greater volume.
- Children may say that a shape with more cubes in it has a greater volume than one with fewer cubes, without considering the sizes of the cubes.

## Key questions

- What is volume?
- What is a cubic centimetre?
- How can you find the total volume of the shape?
- What is the volume of shape A?
- How can you tell which shape has the greater volume?
- Which has the greater volume, shape A or shape B?
- Are the cubes the same size? Why does this matter?

## Possible sentence stems

- The volume of shape A is ______ and the volume of shape B is ______

  Shape ______ has the greater volume.
- To work out the volume of the shape I can…

## National Curriculum links

- Estimate volume [for example, using 1 $cm^3$ blocks to build cuboids (including cubes)] and capacity

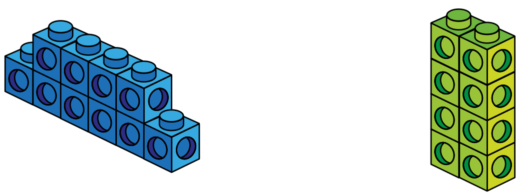
# Compare volume

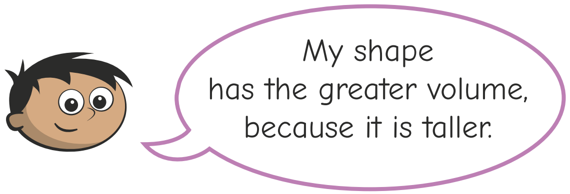
## Key learning

- Dora and Amir each make a shape using cubes.

  Each cube has a volume of 1 cm³

  **Dora** **Amir**





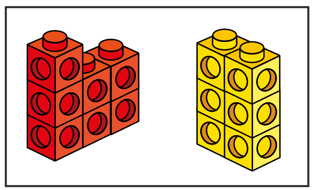

  Do you agree with Amir?

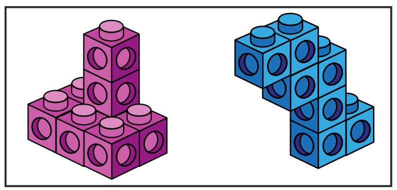
  Explain your answer.

- Each cube has a volume of 1 cm³

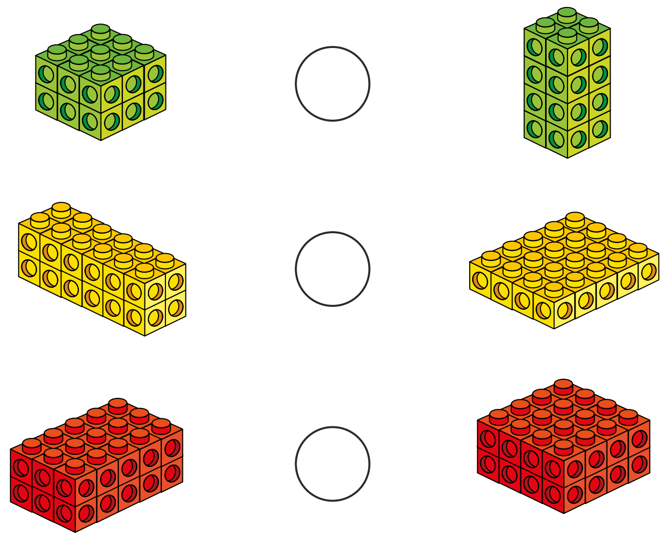
  What are the volumes of the shapes?

  In each pair, which shape has the greater volume?





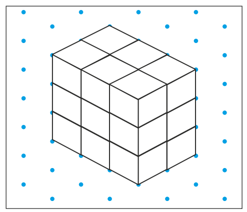
- Write <, > or = to compare the volumes of the cuboids.

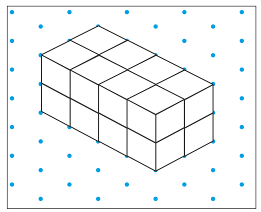


- Dexter and Annie each draw a cuboid on isometric paper.

  Whose cuboid has the greater volume?

  **Dexter** **Annie**



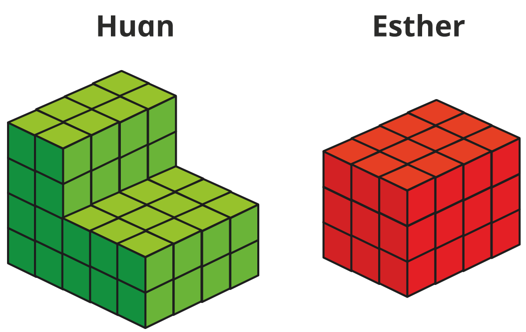


# Compare volume

## Reasoning and problem solving

Huan, Esther and Tom each build a shape using cubes.

Each cube has a volume of 1 $cm^3$

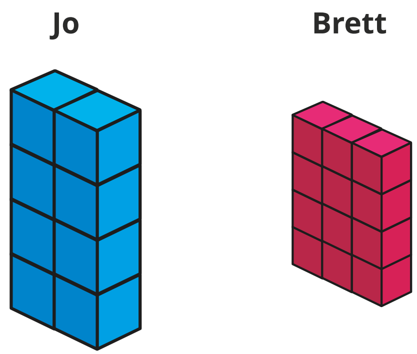


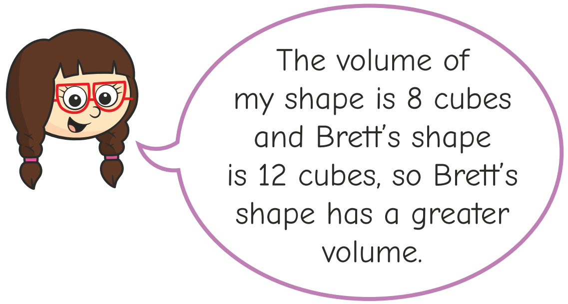

Tom's shape has a volume that is greater than Esther's but smaller than Huan's.

What could the volume of Tom's shape be?

any volume between 36 $cm^3$ and 56 $cm^3$

Jo and Brett each make a shape using cubes.




Do you agree with Jo?

Explain your answer.

No

# Estimate volume

## Notes and guidance

In this small step, children estimate the volumes of different objects, by using cubes with a volume of 1 $cm^3$ and building a shape similar to the 3-D object.

Give children cubes and ask them to estimate the volumes of objects found in the classroom. For example, they could estimate the volume of a small book by making a similar-sized cuboid with interlocking cubes. For each object, discuss whether the actual volume is greater or less than the estimate. For example, an apple may have a smaller volume than that of a similar-sized cuboid.

Children then consider the volumes of much larger objects such as rooms. They discuss why cubic centimetres would be inappropriate for larger volumes and think about the need for different units such as cubic metres.

## Things to look out for

- Some objects will be harder to recreate using interlocking cubes than others.
- Children may need support to decide if the estimated volume is greater or less than the actual volume.

## Key questions

- What is volume?
- How could you estimate the volume of the shape?
- Which of these two objects has the greater volume?
- How can you use cubes to estimate the volume of an object?
- If object A has a volume of ______, what do you estimate the volume of object B will be?
- Is the actual volume greater or less than the estimated volume?

## Possible sentence stems

- I estimate that the volume of ______ is ______ $cm^3$
- The actual volume of ______ is greater/less than the estimate.

## National Curriculum links

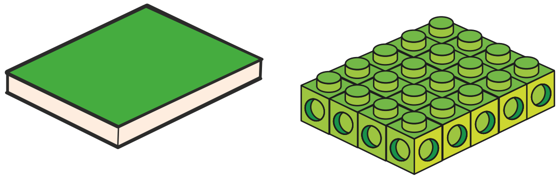
- Estimate volume [for example, using 1 $cm^3$ blocks to build cuboids (including cubes)] and capacity

# Estimate volume

## Key learning

- Mo wants to estimate the volume of the book using cubes.

  He makes a cuboid.

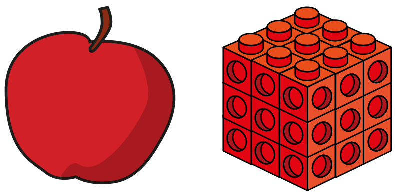


  Work out an estimate for the volume of the book.

  Is the actual volume of the book exactly the same as the estimate?

- Aisha is using cubes to estimate the volume of the apple.

  Each cube has a volume of 1 $cm^3$

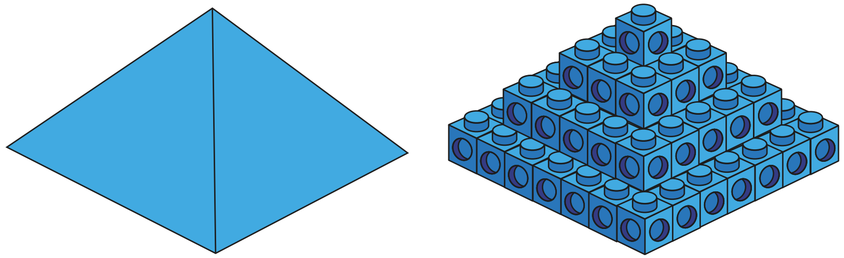


  Work out an estimate for the volume of the apple.

  Is the actual volume of the apple greater or smaller than the estimate?

- Filip is using cubes to estimate the volume of the pyramid.

  Each cube has a volume of 1 $cm^3$



  Work out an estimate for the volume of the pyramid.

  Is the volume of the pyramid greater or smaller than the estimate?

- Why would you not use cubic centimetres to measure the volume of a room?

  What different cubic unit could you use instead?

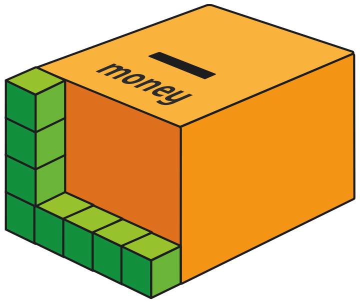
- Estimate the volume of:
  - your classroom
  - the school hall
  - your bedroom

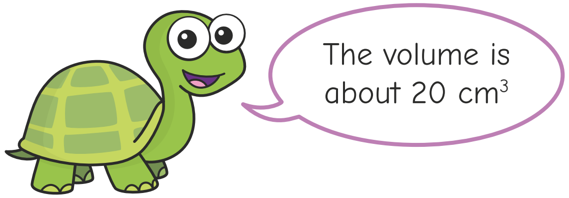
# Estimate volume

## Reasoning and problem solving

Tiny is using cubes to estimate the volume of a money box.

Each cube has a volume of 1 $cm^3$



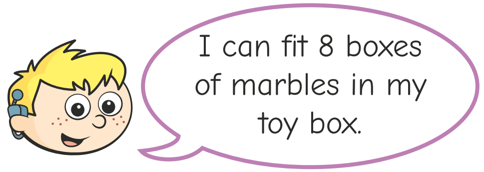

What mistake has Tiny made?

What is the approximate volume of the money box?

Tiny has not taken into account the depth of the money box.

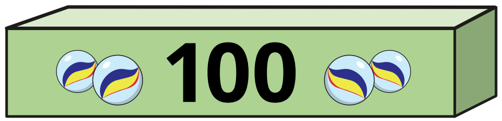
approximately 100 $cm^3$

Max has a toy box.




Each box of marbles can hold 100 marbles.

Each marble has a volume of 0.8 $cm^3$




Estimate the volume of Max's **toy box**.

Is the actual volume of Max's toy box greater or smaller than your estimate?

640 $cm^3$

# Estimate capacity

## Notes and guidance

In the final small step of this block, children move on to looking at the capacity of different objects.

Children should be aware of the difference between capacity and volume from earlier learning, knowing that the capacity of, for example, a jug is how much liquid the jug can hold and that volume refers to how much liquid is actually in the jug. They should also know that the term "capacity" is most commonly used when looking at amounts of liquid, and they will have met the measures litres and millilitres as far back as Year 2. They may need reminding that 1 litre is equal to 1,000 millilitres.

Spend some time showing children containers of different sizes, discussing the capacity of each, then matching capacities to containers. Looking at containers that children may be more familiar with, such as a 330 millilitre can and a 2 litre bottle, will help them with estimating the capacity of unknown containers. They can then estimate the capacity of a container where a known amount of something is already inside it.

## Things to look out for

- Children may confuse volume and capacity.
- Children may need support to identify which units to use.

## Key questions

- What is capacity?
- What is the difference between capacity and volume?
- Which of these containers has the greater capacity? How do you know?
- If there is ______ ml in the jug now, approximately how much will it hold when full?
- What units of measure are used for the capacity of bottles?
- How many millilitres are there in a litre?
- About how many times bigger is the ______ than the ______?

## Possible sentence stems

- The capacity of the container is ______ millilitres/litres.

  The volume of water in the container is about ______ millilitres/litres.
- Container A is about ______ times the size of container B.

## National Curriculum links

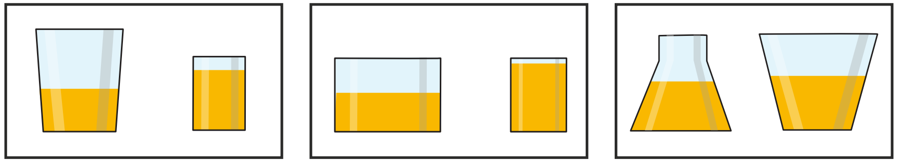
- Estimate volume and capacity [for example, using water]

# Estimate capacity

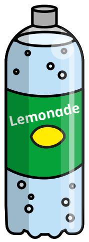
## Key learning

- Each pair of containers has the same amount of juice in it.

  Which container has the greater capacity in each pair?



- What is the most appropriate capacity of a large bottle of fizzy drink?

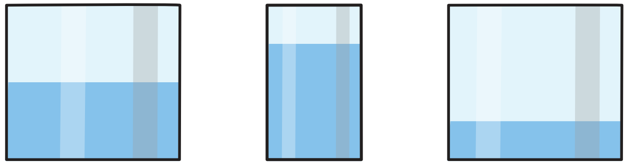



| | |
|---|---|
| 20 ml | 200 ml |
| 2 litres | 20 litres |

What is the approximate capacity of a teacup?

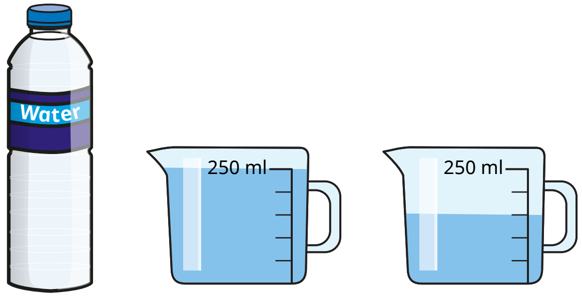
| | |
|---|---|
| 25 ml | 150 ml |
| 1.5 litres | 15 litres |

- There is 1 litre of water in each container.



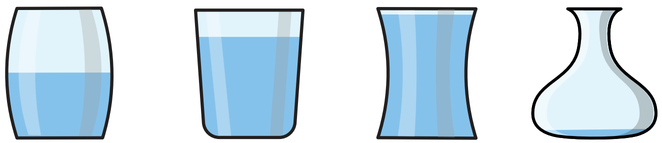
Estimate the capacity of each container.

- Sam pours all the water from the bottle into the two containers.




Estimate the capacity of the bottle.

- Each container has a capacity of 1 litre.

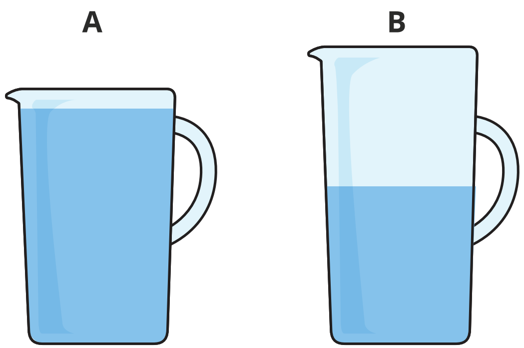


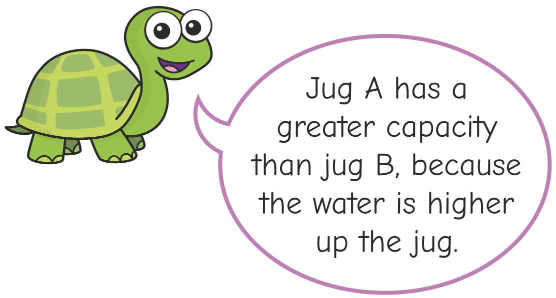
Estimate the volume of water in each container.

# Estimate capacity

## Reasoning and problem solving

There is 500 ml of water in each jug.




Do you agree with Tiny?

Explain your answer.

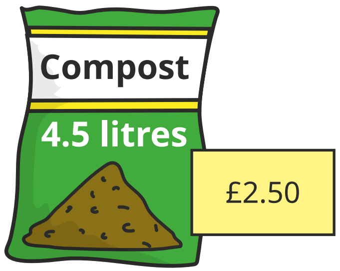
No

1 cubic centimetre of water is the same as 1 millilitre of water and has a mass of 1 gram.

What is the mass of 1 litre of water?

1,000 g or 1 kg

Ron buys compost to fill his flower bed.




He spends £17.50 on compost.

Estimate the capacity of Ron's flower bed.

31.5 litres