CAMBRIDGE

Primary Mathematics

Learner's Book 4

Mary Wood & Emma Low

Introduction

Welcome to Stage 4 of Cambridge Primary Mathematics. We hope this book will show you how interesting Mathematics can be and make you want to explore and investigate mathematical ideas.

Mathematics is everywhere. Developing our skills in mathematics makes us better problem-solvers through understanding how to reason, analyse and reflect. We use mathematics to understand money and complete practical tasks like cooking and decorating. It helps us to make good decisions in everyday life.

In this book you will work like a mathematician to find the answers to questions like these:

- What are negative numbers and when are they used?
- How can you quickly find out if 1435 is in the 25 times table?
- Which is bigger: half a cake or 50 percent of a cake?
- What might you be doing at the time 23:30?
- What shape is a cone?
- What is a dot plot?
- What comes between the points north, east, south and west on a compass?

Talk about the mathematics as you explore and learn. This helps you to reflect on what you did and refine the mathematical ideas to develop a more effective approach or solution.

You will be able to practise new skills, check how you are doing and also challenge yourself to find out more. You will be able to make connections between what seem to be different areas of mathematics.

We hope you enjoy thinking and working like a mathematician.

Mary Wood and Emma Low

Contents

How to use this book

In this book you will find lots of different features to help your learning:

Questions to find out what you know already.

Getting started

1. Write the term-to-term rule for finding the next term in these sequences.
   a 185, 180, 175, . . .   b 235, 245, 255, . . .   c 901, 801, 701, . . .
2. Read these numbers to your partner, then write each number in words.
   a 601   b 299   c 111
3. Write the number you make when you put the place-value cards together.
   a

   3 0 0
   6 0
   4
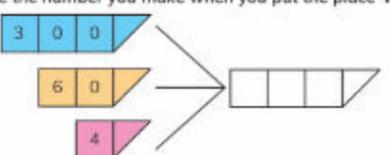
What you will learn in the unit.

We are going to . . .

- count on and back in steps of tens, hundreds and thousands starting from any number
- count back through zero to include negative numbers such as −2
- recognise linear sequences and non-linear sequences

Important words that you will use.

equivalent fraction
proper fraction

Step-by-step examples showing a way to solve a problem.

Worked example 2

Written method of addition

Calculate 235 + 174.

Estimate 200 + 200 = 400	Start with an estimate.
235 = 200 + 30 + 5	
174 = 100 + 70 + 4	Decompose the numbers.
235 + 174 = 300 + 100 + 9	Add the hundreds, tens and ones together.
= 409	Then compose the parts.

Answer: 409

There are often many different ways to solve a problem.

These questions will help you develop your skills of thinking and working mathematically.

2. Choose any two of these three sequences.
   How are they similar to each other and how are they different?
   2, 4, 6, 8 . . .   2, 5, 8, 11 . . .   3, 5, 7, 9 . . .

An investigation to carry out with a partner or in groups. Where this icon appears, the activity will help develop your skills of thinking and working mathematically.

Think like a mathematician

Use each of the numbers 3, 4, 5, 6 and 7 to complete the cross pattern. The total going across must be the same as the total going down.
You will show you are **specialising** when you find solutions to the problem.
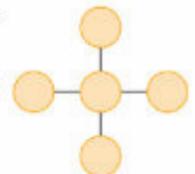
Questions to help you think about how you learn.

Number lines are useful for calculating and showing connections between values. Sometimes one is drawn for you, but sometimes you can draw your own to help.
Look at the questions in the exercise and write down how you have used number lines to help you.

This is what you have learned in the unit.

Look what I can do!

☐ I can find a missing number represented by a symbol.
☐ I can find a missing operation sign represented by a symbol.

Questions that cover what you have learned in the unit.

Check your progress

1. Write the missing number.
   100 − ☐ = 58
2. Write the missing number.
   2 + 20 + ☐ = 100
3. A total of 245 chairs are needed for a school performance.
   169 chairs are already in place.
   How many chairs need to be put in place?

At the end of several units, there is a project for you to carry out using what you have learned. You might make something or solve a problem.

Projects and their accompanying teacher guidance have been written by the NRICH Team. NRICH is an innovative collaboration between the Faculties of Mathematics and Education at the University of Cambridge, which focuses on problem solving and on creating opportunities for students to learn mathematics through exploration and discussion: nrich.maths.org.

Project 1

Deep water

Here is a picture of a bridge spanning part of the sea at an estuary. The scale marked on one of the bridge supports shows the level of the water. The zero on the scale is at the base of the bridge. At the moment the water is 2 metres below the base of the bridge, shown by the −2 on the scale.

If the water level rose and reached the base of the bridge, how much would it have risen by?
If the water level then rose again and reached the number 2 on the scale, how much more would it have risen? How much would it have gone up by in total?

Thinking and Working Mathematically

There are some important skills that you will develop as you learn mathematics.

Specialising
is when I choose an example and check to see if it satisfies or does not satisfy specific mathematical criteria.

Characterising
is when I identify and describe the mathematical properties of an object.

Generalising
is when I recognise an underlying pattern by identifying many examples that satisfy the same mathematical criteria.

Classifying
is when I organise objects into groups according to their mathematical properties.

Critiquing
is when I compare and evaluate mathematical ideas, representations or solutions to identify advantages and disadvantages.

Improving
is when I refine mathematical ideas or representations to develop a more effective approach or solution.

**Conjecturing**
is when I form mathematical questions or ideas.

Convincing
is when I present evidence to justify or challenge a mathematical idea or solution.

1 Numbers and the number system

This unit is all about our number system. You will look at linear sequences and non-linear sequences, negative numbers, multiplying and dividing by 10 and 100, and place value.

Imagine you save $2 each week.

Can you write a number sequence for how much you have at the end of each week?

You add the same amount each time, so this is a linear sequence.

The term-to-term rule is 'add 2'.

If you save a different amount each time, the sequence will be non-linear.

One of the main ideas in place value is that the value of a digit depends on its position in the number.

Think about what the digit 7 is worth in $7 and $70.

Do you have enough money to buy the bike?

There are $7 in the bag   The bike costs $70

Think about the numbers 126 and 162.

What is the value of the digit 2 in each number?

Getting started

1   Write the term-to-term rule for finding the next term in these sequences.

   a   185, 180, 175, . . .   b   235, 245, 255, . . .   c   901, 801, 701, . . .

2   Read these numbers to your partner, then write each number in words.

   a   601   b   299   c   111

3   Write the number you make when you put the place-value cards together.

   a   3 0 0
       6 0
       4

   b   9 0 0
       9
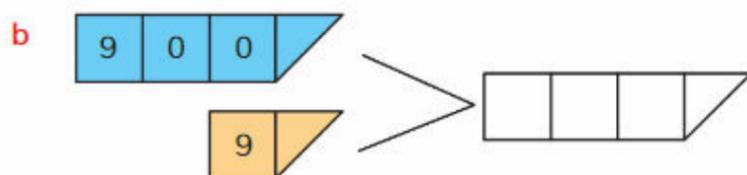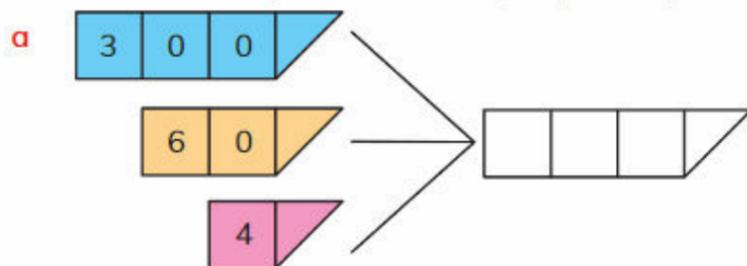
4   Copy and complete these number sentences.

   a   562 = ☐ + 60 + ☐

   b   305 = 300 + ☐

5   Write the missing numbers.

   a   16 × 10 = ☐

   b   56 × ☐ = 560

› 1.1 Counting and sequences

We are going to . . .

- count on and back in steps of tens, hundreds and thousands starting from any number
- count back through zero to include negative numbers such as −2
- recognise linear sequences and **non-linear sequences**
- extend sequences and describe the term-to-term rule
- recognise and extend patterns that represent square numbers.

You will continue counting forwards and backwards in steps of constant size and you will start to use negative numbers.

Around the coasts of Antarctica temperatures are between −10 °C and −30 °C.

Try counting back in tens starting at 30 and ending with −30.

difference
linear sequence
negative number
non-linear sequence
rule
sequence
spatial pattern
square number
term
term-to-term rule

Worked example 1

Carlos writes a number sequence.

The first term in his sequence is 8.

He uses the rule 'subtract 2' to work out the next term.

What is the fifth term in his sequence?

$$8 \xrightarrow{-2} 6 \xrightarrow{-2} 4 \xrightarrow{-2} 2 \xrightarrow{-2} 0$$

Start with 8 and subtract 2 each time until you have five terms.

Answer: The fifth term is 0.

Worked example 2

The numbers in this sequence increase by 50 each time.

$$60 \xrightarrow{+50} 110 \xrightarrow{+50} 160 \xrightarrow{+50} \ldots$$

What is the first number greater than 1000 that is in the sequence?

Explain how you know.

60, 110, 160, 210, 260, . . .

Write down the first few terms.

(You could write down all the terms in the sequence, but it would take a long time.)

Answer: The terms all end in 10 or 60 so the first number greater than 1000 is 1010.

Exercise 1.1

1 a Mia counts on in steps of 100.

She starts at 946.

Write the next number she says.

b Kofi counts back in steps of 100.

He starts at 1048.

Write the next number he says.

c Bibi counts on in steps of 1000.

She starts at 1989.

Write the next number she says.

d Pierre counts back in steps of 1000.

He starts at 9999.

Write the next number he says.

e Tara counts back in ones.

She counts 3, 2, 1, 0.

Write the next number she says.

2   Copy and complete this square using the rule 'add 2 across and add 2 down'.

What do you notice about the numbers on the diagonal?
Discuss with your partner.

+2

+2 | 1 | | | | |
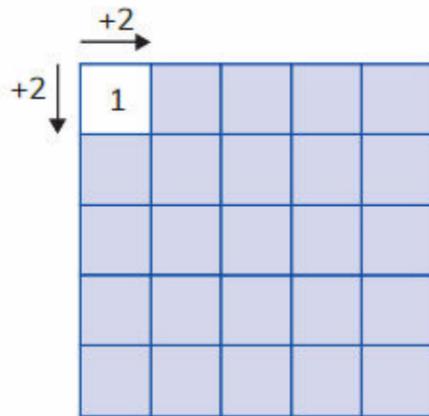
Draw two more 5 by 5 squares and choose a rule using addition.
Predict what the numbers on the diagonal will be before you
complete the squares.

3   Choose any two of these three sequences.

How are they similar to each other and how are they different?

| 2, 4, 6, 8, . . . | | 2, 5, 8, 11, . . . | | 3, 5, 7, 9, . . . |

4   Look at these sequences.

Which could be the odd one out? Explain your answer.

| 13, 16, 19, 22, . . . | | 8, 11, 14, 17, . . . | | −5, −2, 1, 4, . . . |

| 9, 12, 15, 18, . . . | | 16, 19, 22, 25, . . . |
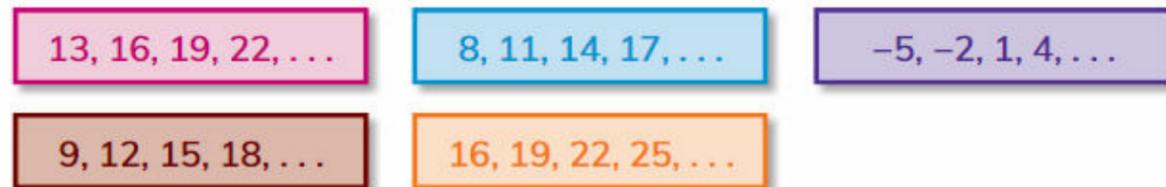
Think about your answers to questions 3 and 4.
Are there other possible answers?

5   Use different first terms to make sequences that all have the term-to-term rule 'add 3'.
Can you find a sequence for each of the following?

a   Where the terms are all multiples of 3.

b   Where the terms are not whole numbers.

c   Where the terms are all odd.

d   Where the terms include both 100 and 127.

6   Abdul makes a number sequence.

The first term of his sequence is 397.

His term-to-term rule is 'subtract 3'.

Abdul says, 'If I keep subtracting 3 from 397 I will eventually reach 0.'

Is he correct?

Explain your answer.

7   Which sequences are linear and which are not?

Write the next term for each sequence. Explain your answers to your partner.

a   Add five: 4, 9, 14, . . .

b   Subtract four: 20, 16, 12, . . .

c   Add one more each time: 2, 3, 5, . . .

d   Multiply by three: 2, 6, 18, . . .

e   Subtract one less each time: 50, 41, 33, . . .

f   Divide by two: 32, 16, 8, . . .

8   Here is a spatial pattern.
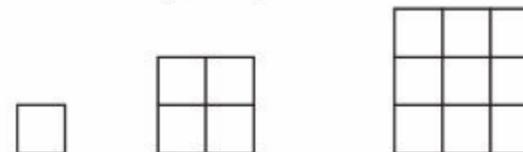
Draw the next term in the pattern.

What number does it represent?

Think like a mathematician

These sets of beads have **consecutive** numbers in the circles.

The numbers add up to the number in the square.

Example:
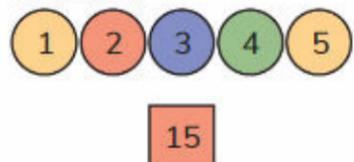
(1)(2)(3)(4)(5)

[15]

- You will show you are **specialising** when you identify examples that fit the criteria 'The numbers add up to the numbers in the square'.
- You will show you are **generalising** when you notice a way of finding the middle number.

Complete these sets of beads.

a ○ ○ ○

[27]

b ○ ○ ○ ○ ○

[25]
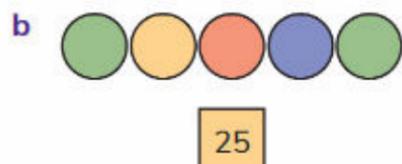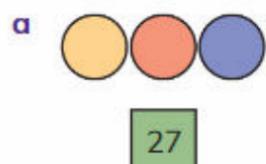
Tip

Consecutive numbers are next to each other.

For example, 3, 4, 5 and 6.

Describe to a partner how to find the middle number of each set of beads.

- You will show you are **specialising** when you identify examples that fit the criteria 'The numbers add up to the numbers in the square.'
- You will show you are **generalising** when you notice a way of finding the middle number.

Look what I can do!

☐ I can count on and back in steps of different sizes.

☐ I can extend linear sequences and describe the term-to-term rule.

☐ I can recognise non-linear sequences.

☐ I can extend patterns that represent square numbers.

> 1.2 More on negative numbers

We are going to . . .

- read and write numbers less than zero, for example –6 is negative six
- understand how negative numbers are used in the real world, for example to describe a very cold temperature or a position below sea level.

In this section, you will use negative numbers in contexts such as temperature or being above or below sea level.

An iceberg is ice that has broken off a glacier and is now floating. There is much more ice below sea level than there is above sea level.

temperature
zero

metres
10
0
sea level
–10
–20
–30
–40
–50
–60
–70
–80
–90
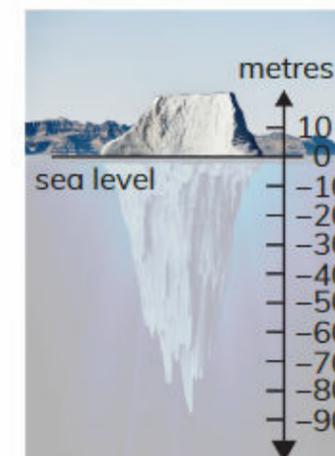
Worked example 3

The temperature in England is 11 °C.

The temperature in Iceland is 15 ° colder.

What is the temperature in Iceland?

–15

–10   –4   0   10 11
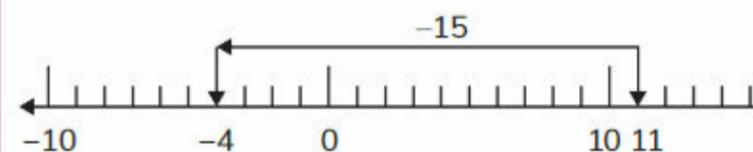
Draw a number line to help.

Start at 11.

The temperature is colder, so you jump back 15 places.

Answer: The temperature in Iceland is –4 °C.

Exercise 1.2

1 Look at the number line.

$$-10\ -9\ -8\ -7\ -6\ -5\ -4\ -3\ -2\ -1\ \ 0\ \ 1\ \ 2\ \ 3\ \ 4\ \ 5\ \ 6\ \ 7\ \ 8\ \ 9\ \ 10$$
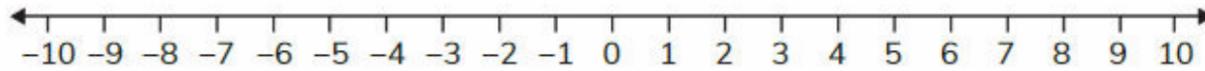
Write where you would land on the number line after these moves.

a   start   count on
    −5   1

b   start   count back
    −2   4

c   start   count on
    −3   3

d   start   count back
    6   9

2 Here is a number line.

A   B   C   D
$$-6 \qquad\qquad 0 \qquad\qquad 6$$
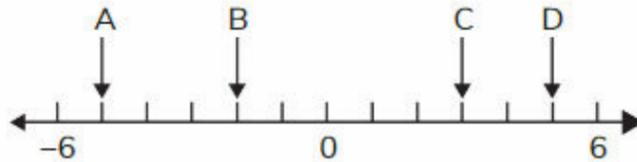
a   Which numbers do the arrows A, B, C and D point to?

b   Which letter shows the position of a number greater than −4 and less than 0?

3 Look at this thermometer.

What numbers are the arrows pointing to at a, b and c?

$$-10 \quad 0 \quad 10 \quad 20 \quad 30 \quad 40\,°C$$

a   b   c
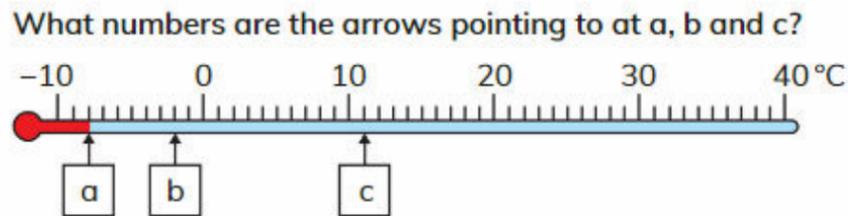
4 Which temperature is the coldest?

−6 °C   0 °C   1 °C   −2 °C

Tip

Use the thermometer in question 3 to help you.

5 The temperature in a town one day was 5 °C.
   The temperature dropped by 9 °C overnight.
   What was the lowest night-time temperature?

6 The letters on the number line are in the place of numbers.

$$-10 \qquad\qquad\qquad 0 \qquad\qquad\qquad 10$$
A B C D E F G H I J K L M N O P Q R S T U
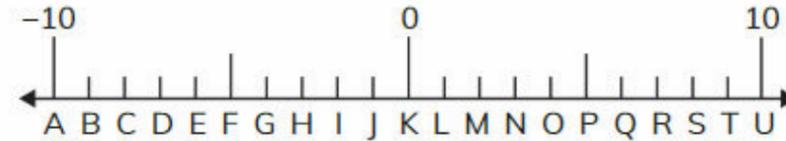
Copy and complete the table to solve the puzzle and find out where emperor penguins live.

−10	3	9	−10	7	−8	9	−2	−8	−10

7 What mistake has Marcus made?
   How can you help him correct this mistake?

   Negative 5 °C is warmer than negative 4 °C because 5 is bigger than 4.

8 a   What temperature is 6 degrees warmer than −4 °C?

   b   What temperature is 5 degrees less than 1 °C?

   c   What temperature is 3 degrees warmer than −2 °C?

   d   What temperature is 3 degrees cooler than 0 °C?

   e   What temperature is 5 degrees higher than −1 °C?

Number lines are useful for calculating and showing connections between values. Sometimes one is drawn for you, but sometimes you can draw your own to help.

Look at the questions in the exercise and write down how you have used number lines to help you.