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CAMBRIDGE Primary Mathematics

Teacher's Resource 4

Emma Low & Mary Wood

Second edition

Digital Access

Cambridge Assessment International Education

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Primary Mathematics

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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. https://nrich.maths.org.

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The following items are available on Cambridge GO. For more information on how to access and use your digital resource, please see inside front cover.

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Improving learning through questioning

Language awareness

Metacognition

Skills for Life

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Lesson plan template and examples of completed lesson plans

Curriculum framework correlation

Scheme of work

Diagnostic check and mark scheme

Mid-year test and mark scheme

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You can download the following resources for each unit:

Differentiated worksheets and answers

Language worksheets and answers

Resource sheets

End-of unit tests and answers

Introduction

Welcome to the new edition of our Cambridge Primary Mathematics series.

Since its launch, the series has been used by teachers and learners in over 100 countries for teaching the Cambridge Primary Mathematics curriculum framework.

This exciting new edition has been designed by talking to Primary Mathematics teachers all over the world. We have worked hard to understand your needs and challenges, and then carefully designed and tested the best ways of meeting them.

As a result of this research, we've made some important changes to the series. This Teacher's Resource has been carefully redesigned to make it easier for you to plan and teach the course.

The series still has extensive digital and online support, including Digital Classroom which lets you share books with your class and play videos and audio. This Teacher's Resource also offers additional materials available to download from Cambridge GO. (For more information on how to access and use your digital resource, please see inside front cover.) teaching pedagogies like active learning and metacognition and this Teacher's Resource gives you full guidance on how to integrate them into your classroom.

Formative assessment opportunities help you to get to know your learners better, with clear learning intentions and success criteria as well as an array of assessment techniques, including advice on self and peer assessment.

Clear, consistent differentiation ensures that all learners are able to progress in the course with tiered activities, differentiated worksheets and advice about supporting learners' different needs.

All our resources are written for teachers and learners who use English as a second or additional language. They help learners build core English skills with vocabulary and grammar support, as well as additional language worksheets.

We hope you enjoy using this course.

Eddie Rippeth

Head of Primary and Lower Secondary Publishing, Cambridge University Press

Acknowledgements

About the authors

Emma Low

Emma graduated from University of London with a BA(Ed) in Education with Mathematics and Computer Studies and holds a MEd in Mathematics Education from the University of Cambridge. Within her Masters degree she studied a variety of international education systems and strategies which she uses in her teaching and writing.

Emma was a primary school teacher and Mathematics and ICT Leader, then became a Mathematics Consultant for the Local Authority, supporting schools through professional development and authoring publications. Emma has also taught secondary mathematics at an Outstanding comprehensive school.

Since 2010 Emma has been a freelance consultant and writer. She provides engaging and inspiring professional development, and supports effective and creative planning, teaching and assessment. Emma has written professional development materials as an associate of the National Centre for Excellence in the Teaching of Mathematics (NCETM). She has authored many mathematics textbooks, teachers' guides, mathematical games and activity books.

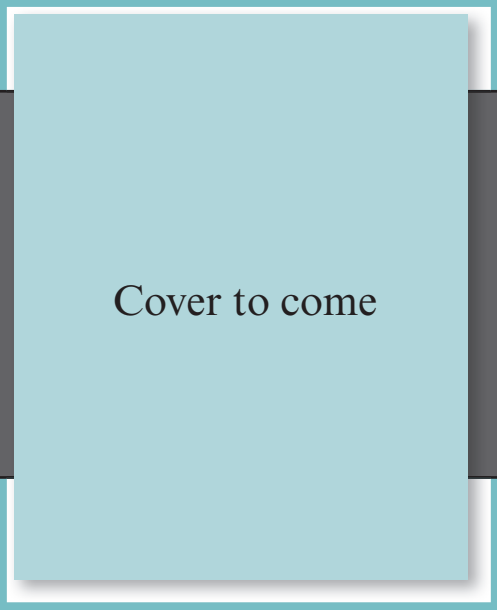
Mary Wood

Mary enjoys travelling and finding mathematics around her, including tile patterns on the roofs of churches and other buildings to the 'fat policeman' in Budapest, Hungary. His belt has the number 235 on it and 2, 3, 5 are the first three prime numbers.

Mary has a wealth of mathematical experience from an education career spanning over forty years. Following many years of classroom teaching, she has worked in educational consultancy and continuing professional development in the United Kingdom and overseas. Mary is an experienced examiner, which has allowed her to better understand the needs of teachers and students working in varied contexts. She enjoys writing and editing primary mathematics books.

How to use this series

All of the components in the series are designed to work together.



The Learner's Book is designed for learners to use in class with guidance from the teacher. It offers complete coverage of the curriculum framework. A variety of investigations, activities, questions and images motivate learners and help them to develop the necessary mathematical skills. Each unit contains opportunities for formative assessment, differentiation and reflection so you can support your learners' needs and help them progress.

The Teacher's Resource is the foundation of this series and you'll find everything you need to deliver the course in here, including suggestions for differentiation, formative assessment and language support, teaching ideas, answers, tests and extra worksheets. Each Teacher's Resource includes:

- a **print book** with detailed teaching notes for each topic
- **Digital Access** with all the material from the book in digital form plus editable planning documents, extra teaching guidance, downloadable worksheets and more.

Cover to come

The skills-focused write-in Workbook provides further practice of all the topics in the Learner's Book and is ideal for use in class or as homework. A three-tier, scaffolded approach to skills development promotes visible progress and enables independent learning, ensuring that every learner is supported. Teachers can assign learners questions from one or more tiers for each exercise, or learners can progress through each of the tiers in the exercise.

Digital Classroom includes digital versions of the Learner's Book and Workbook, complete with pop-up answers, designed for teachers to use at the front of the class. Easily share the books with the whole class on your whiteboard, zoom in, highlight and annotate text, and get your learners talking with videos, images and interactive activities.

Cover to come

Cover to come

The Games Book is a supplementary resource designed to encourage learners to apply their mathematical knowledge through games. It consolidates and reinforces learning appropriate to the stage.

screen grab

A letter to parents, explaining the course, is available to download from Cambridge GO (as part of this Teacher's Resource).

How to use this Teacher's Resource

This Teacher's Resource contains both general guidance and teaching notes that help you to deliver the content in our Cambridge Primary Mathematics resources. Some of the material is provided as downloadable files, available on **Cambridge GO**. (For more information about how to access and use your digital resource, please see inside front cover.) See the Contents page for details of all the material available to you, both in this book and through Cambridge GO.

Teaching notes

This book provides **teaching notes** for each unit of the Learner's Book and Workbook. Each set of teaching notes contains the following features to help you deliver the unit.

The **Unit plan** summarises the topics covered in the unit, including the number of learning hours recommended for the topic, an outline of the learning content and the Cambridge resources that can be used to deliver the topic.

Topic	Approximate number of learning hours	Outline of learning content	Resources
1.1 Counting and sequences	4	Count forwards and backwards including negative numbers. Recognise linear sequences. Describe term-to-term rules. Begin to explore non-linear sequences. Explore spatial patterns for square numbers.	Learner's Book Section 1.1 Workbook Section 1.1 Additional teaching ideas for Section 1.1 Resource sheet 1A Resource sheet 1B Resource sheet 1C Resource sheet 1G **Digital Classroom:** Stick patterns digital manipulative

The **Background knowledge** feature explains prior knowledge required to access the unit and gives suggestions for addressing any gaps in your learners' prior knowledge.

Learners' prior knowledge can be informally assessed through the **Getting started** feature in the Learner's Book. (See the Assessment for Learning downloadable file section for more information.)

BACKGROUND KNOWLEDGE

Before starting this unit, you may want to use the diagnostic check to check that learners are ready to begin Stage 4. The diagnostic check can help you to identify gaps in learners' knowledge or understanding, which you can help them address before beginning this unit.

The **Teaching skills focus** feature covers a teaching skill and suggests how to implement it in the unit.

TEACHING SKILLS FOCUS

Investigations

'Think like a mathematician' activities allow learners to explore mathematical topics. When learners say they are stuck, it is easy for teachers to give too much help. This section encourages you to stand back, watch and listen but not intervene unless absolutely necessary.

Reflecting the Learner's Book, each unit consists of multiple sections. A section covers a learning topic.

At the start of each section, the **Learning plan** table includes the learning objectives, learning intentions and success criteria that are covered in the section.

It is helpful to share learning intentions and success criteria with your learners at the start of a lesson so that they can begin to take responsibility for their own learning. This also helps develop metacognitive skills

LEARNING PLAN

Learning objectives	Learning intentions	Success criteria
4Nc.01	• Count on and back in steps of constant size.	• Learners can count on and back in steps of tens, hundreds and thousands.

The **Language support** feature contains suggestions for how to support learners with English as an additional language. The vocabulary terms and definitions from the Learner's Book are also collected here.

LANGUAGE SUPPORT

A negative number is written with a minus sign in front, for example −7. It is read as 'negative seven' not 'minus seven'. 'Minus 7' is an instruction to subtract 7. It might be helpful to display a definition and example for learners to refer to.

There are often common misconceptions associated with particular learning topics. These are listed, along with suggestions for identifying evidence of the misconceptions in your class and suggestions for how to overcome them.

Misconception	How to identify	How to overcome
Learners may use incorrect language; minus 1 instead of negative 1 when counting.	Listen to learners counting.	Always use correct language and correct any incorrect terminology.

For each topic, there is a selection of **starter ideas**, **main teaching ideas** and **plenary ideas**. You can pick out individual ideas and mix and match them depending on the needs of your class. The activities include suggestions for how they can be differentiated or used for assessment. **Homework ideas** are also provided.

Starter idea

Getting started (20 minutes)

Resources: Unit 1 Getting started exercise in the Learner's Book.

Description: Give learners 10 minutes to answer the Getting started questions in their exercise books. After 10 minutes, ask learners to swap their books with a partner and then check their partners' answers while you discuss the questions as a class. After the class have marked their work, walk round and check if there are any questions that learners struggled with. You may want to recap particular concepts as a class.

The **Cross-curricular links** feature provides suggestions for linking to other areas of the Primary curriculum.

CROSS-CURRICULAR LINKS

When working with temperatures there are many opportunities to address issues related to climate and climate change.

There is also an opportunity for learners to explore the location of the cities around the world, looking at maximum and minimum temperatures. They can consider northern and southern hemispheres to explain why some cities are hottest in July and coldest in January while other cities are coldest in July and hottest in January.

Thinking and Working Mathematically skills are woven throughout the questions in the Learner's Book and Workbook. These questions, indicated by ✦, incorporate specific characteristics that encourage mathematical thinking.

✦ **4** Bruno says, 'The largest 5-digit number is 1 less than a hundred thousand.' is Bruno correct? Explain your answer.

The teaching notes for each unit identify all of these questions and their characteristics. The **Guidance on selected Thinking and Working Mathematically questions** section then looks at one of the questions in detail and provides more guidance about developing the skill that it supports.

Guidance on selected *Thinking and Working Mathematically* questions

Learner's Book Exercise 1.1, questions 2 and 3

Question 2 is a 'compare and contrast' activity; it addresses **generalising** (what is the same about two sequences) and **specialising** (testing the sequences to see if they fit the generalisation).

Additional teaching notes are provided for the six **NRICH projects** in the Learner's Book, to help you make the most of them.

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. **https://nrich.maths.org**.

PROJECT GUIDANCE: PROJECT 1 DEEP WATER

Why do this problem?

This task is designed to help learners gain familiarity with negative numbers on a number line. It gives them the opportunity to explore calculating with negative numbers in a context

Digital resources to download

This Teacher's Resource includes a range of digital materials that you can download from Cambridge GO.

Helpful documents for planning include:

- **Letter for parents – Using the Cambridge Primary resources:** a template letter for parents, introducing the Cambridge Primary Mathematics resources.
- **Lesson plan template:** a Word document that you can use for planning your lessons. Examples of completed lesson plans are also provided.
- **Curriculum framework correlation:** a table showing how the Cambridge Primary Mathematics resources map to the Primary Mathematics curriculum.
- **Scheme of work:** a suggested scheme of work that you can use to plan teaching throughout the year.

Each unit includes:

- **Differentiated worksheets:** these worksheets are provided in variations that cater for different abilities. Worksheets labelled 'A' are intended to support less confident learners, while worksheets labelled 'B' are designed to challenge more confident learners. Answer sheets are provided.
- **Language worksheets:** these worksheets provide language support and can be particularly helpful for learners with English as an additional language. Answers sheets are provided.
- **Resource sheets:** these include templates and any other materials that support additional activities given in the teaching notes.
- **End-of-unit tests:** these provide quick checks of the learner's understanding of the concepts covered in the unit. Answers are provided. Advice on using these tests formatively is given in the next section.

Additionally, the Teacher's Resource includes:

- **Diagnostic test and mark scheme:** a test to use at the beginning of the year to work out the level that learners are working at. The results of this test can inform your planning.
- **Mid-year test and mark scheme:** a test to use after learners have studied Units 1-9 in the Learner's Book. You can use this test to check whether there are areas that you need to go over again.
- **End-of-year test and mark scheme:** a test to use after learners have studied all units in the Learner's Book. You can use this test to check whether there are areas that you need to go over again, and to help inform your planning for the next year.
- **Answers to Learner's Book questions**
- **Answers to Workbook questions**
- **Glossary**

Using the assessment resources formatively

<This section is to come from the Commissioning editors. Title may change. Ideally one page>

About the curriculum framework

The information in this section is based on the Cambridge Primary Mathematics curriculum framework from 2020. You should always refer to the appropriate curriculum framework document for the year of your learners' examination to confirm the details and for more information.
Visit ***www.cambridgeinternational.org/primary*** *to find out more.*

The Cambridge Primary Mathematics curriculum framework from 2020 has been designed to encourage the development of mathematical fluency and ensure a deep understanding of key mathematical concepts. There is an emphasis on key skills and strategies for solving mathematical problems and encouraging the communication of mathematical knowledge in written form and through discussion.

At the Primary level, it is divided into three major strands:

- Number
- Geometry and Measure
- Statistics and Probability.

Algebra is introduced as a further strand in the Cambridge Lower Secondary Mathematics framework.

Underpinning all of these strands is a set of Thinking and Working Mathematically characteristics that will encourage learners to interact with concepts and questions. These characteristics are present in questions, activities and projects in this series. For more information, see the introduction to Thinking and Working Mathematically section in this resource, or find further information on the Cambridge Assessment International Education website.

A curriculum framework correlation document (mapping the Cambridge Primary Mathematics resources to the learning objectives) and scheme of work are available to download from Cambridge GO (as part of this Teacher's Resource).

About the assessment

Information concerning the assessment of the Cambridge Primary Mathematics curriculum framework is available on the Cambridge Assessment International Education website www.cambridgeassessment.org.uk

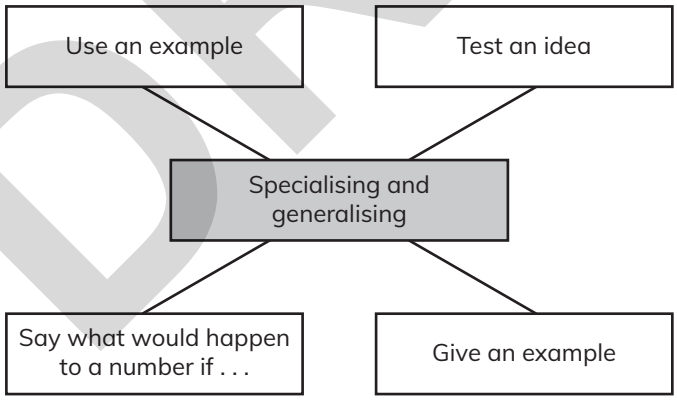
Introduction to Thinking and Working Mathematically

Thinking and working mathematically is an important part of the Cambridge Primary Mathematics course. The curriculum identifies four pairs of linked characteristics: specialising and generalising, conjecturing and convincing, characterising and classifying, and critiquing and improving.

There are many opportunities for learners to develop these skills throughout Stage 4. Throughout the exercises in the Learner's Book and the Workbook, we have added this icon alongside questions that can be used by you with your learners to develop the Thinking and Working Mathematically characteristics. There is a list of these questions and their intended characteristics in the teaching notes for each unit.

This section provides examples of questions that require learners to demonstrate the Thinking and Working Mathematically characteristics, along with sentence starters to help learners formulate their thoughts. Within the teaching notes for each unit, we have also selected one question from each exercise and provided further guidance on Thinking and Working Mathematically within the context of the question to help familiarise you with all of the characteristics.

Specialising and generalising



Specialising

Specialising involves choosing and testing an example to see if it satisfies or does not satisfy specific maths criteria. Learners look at specific examples and check to see if they do or do not satisfy specific criteria.

Example:

Find a fraction that could go in the box. $\frac{1}{3} < \square < \frac{2}{3}$

Learners show they are **specialising** when they choose examples of fractions and check to see whether the answer is correct, for example $\frac{1}{2} = \frac{3}{6}$ which lies between $\frac{2}{6}$ and $\frac{4}{6}$

SENTENCE STARTERS

- I could try …
- … is the only one that …
- … is the only one that does not …

Generalising

Generalising involves recognising a wider pattern by identifying many examples that satisfy the same maths criteria. Learners make connections between numbers, shapes and so on and use these to form rules or patterns.

Example:

Put this set of numbers in order starting with the smallest.

−6 6 12 −12 0 −18

Describe the number pattern.

The pattern continues in the same way.

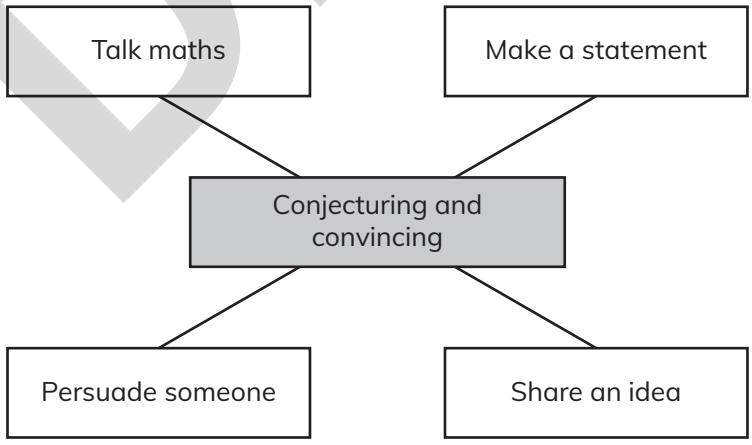
Will 121 be in the pattern? How do you know?

Learners will show they are **generalising** when they notice that all the numbers in the sequence divide exactly by 6 but 121 does not. Alternatively, they could notice that the numbers are all even, but 121 is odd.

SENTENCE STARTERS

- I found the pattern . . . so . . .

Conjecturing and convincing



Conjecturing

Conjecturing involves forming questions or ideas about mathematical patterns. Learners say what they notice or why something happens or what they think about something.

Example:

What is the highest possible remainder when you divide by 2?

What is the highest possible remainder when you divide by 5?

What is the highest possible remainder when you divide by 10?

Make a general rule comparing the divisor (the number you are dividing by) and the remainder.

Learners will show they are **conjecturing** when they offer answers leading to a generalised solution such as the highest possible remainder is always 1 less than the divisor.

SENTENCE STARTERS

- I think that . . .
- I wonder if . . .

Convincing

Convincing involves presenting evidence to justify or challenge mathematical ideas or solutions. Learners persuade people (a partner, group, class or an adult) that a conjecture is true.

Example:

The time is 9:25 am.

Haibo says, 'The time is closer to 09:00 than to 10:00.

Explain why Haibo is correct.

Learners will show they are **convincing** when they do calculations to show that 9:25 is closer to 9:00 than to 10:00.

The time interval between 9:00 and 9:25 is 25 minutes.

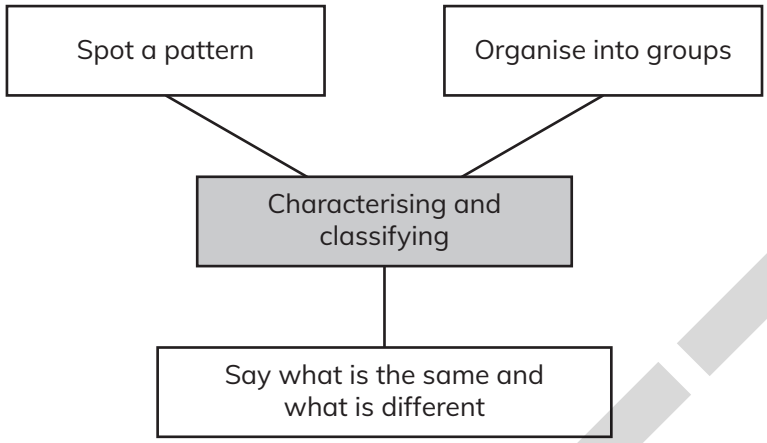
The time interval between 9:25 and 10:00 is 35 minutes.

The time interval between 9:25 and 10:00 is longer than between 9:00 and 9:25.

SENTENCE STARTERS

- This is because . . .
- You can see that . . .
- I agree with . . . because . . .
- I disagree with . . . because . . .

Characterising and classifying

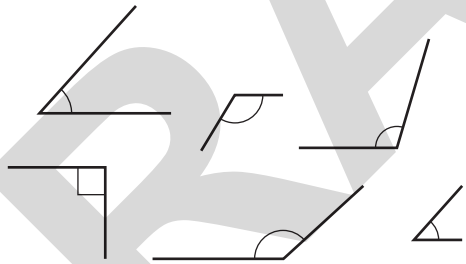


Characterising

Characterising involves identifying and describing the properties of mathematical objects. Learners identify and describe the mathematical properties of a number or object.

Example:

Sort the angles into different categories. Explain how you sorted them.



Learners will show they are **characterising** when they identify a property of the angles which can be used to sort them, for example, acute, obtuse and right.

SENTENCE STARTERS

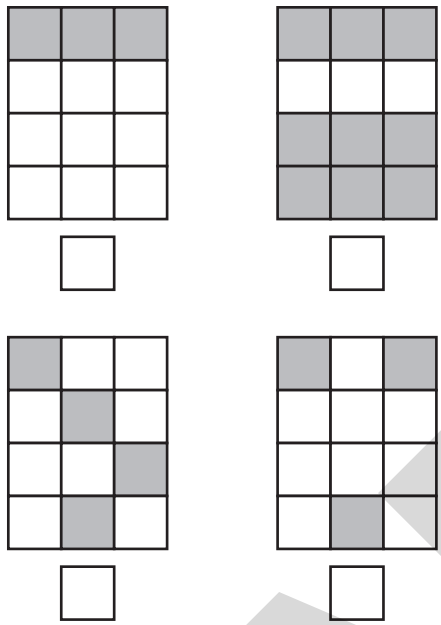
- This is similar to . . . so . . .
- The properties of . . . include . . .

Classifying

Classifying involves organising mathematical objects into groups according to their properties. Learners organise objects or numbers into groups according their mathematical properties. They use Venn and Carroll diagrams.

Example:

Tick (✓) each shape that has exactly $\frac{1}{4}$ shaded.

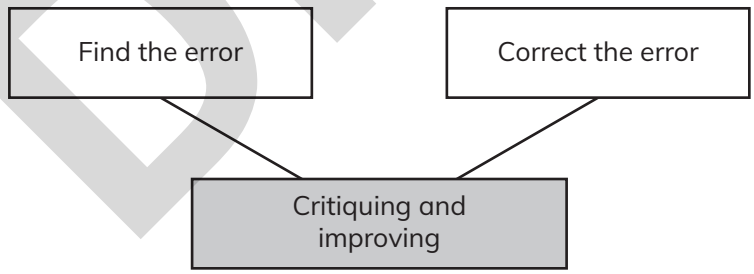


Learners will show they are **classifying** when they sort the diagrams into those that show $\frac{1}{4}$ shaded and those that do not show $\frac{1}{4}$ shaded.

SENTENCE STARTERS

- . . . go together because . . .
- I can organise the . . . into groups according to . . .

Critiquing and improving



Critiquing

Critiquing involves comparing and evaluating mathematical ideas for solutions to identify advantages and disadvantages. Learners compare methods and ideas by identifying their advantages and disadvantages.

Example:

Parveen tried to write these temperatures in order starting with the coldest.

0 °C –2 °C 3 °C –9 °C

What mistake has Parveen made?

How can you help her correct this mistake?

This question provides an opportunity for learners to practise **critiquing** when they are asked to identify the error. Parveen knows that 3 is greater than 2 so 3 °C will be warmer than 2 °C. She has not taken any notice of the negative signs. She should place her numbers on a number line to help her correct the mistake.

SENTENCE STARTERS

- the advantages of . . . are and the disadvantages are . . .

Improving

Improving involves refining mathematical ideas to develop a more effective approach or solution. Learners find a better solution.

Example:

Find the mistake in this calculation.

Explain what is wrong.

Correct the calculation.

		4	7
	×		6
2	4	4	2

		4	7
	×		6
	2	8	2
		4	

Answer

The 4 tens should be carried.

Learners are **improving** when they correct the calculation.

SENTENCE STARTERS

- . . . go together because . . .
- I can organise the . . . into groups according to . . .

Approaches to teaching and learning

The following are the key pedagogies underpinning our course content and how we understand and define them.

Active learning

Active learning is a teaching approach that places student learning at its centre. It focuses on how students learn, not just on what they learn. We, as teachers, need to encourage learners to 'think hard', rather than passively receive information. Active learning encourages learners to take responsibility for their learning and supports them in becoming independent and confident learners in school and beyond.

Assessment for Learning

Assessment for Learning (AfL) is a teaching approach that generates feedback which can be used to improve learners' performance. Learners become more involved in the learning process and, from this, gain confidence in what they are expected to learn and to what standard. We, as teachers, gain insights into a learner's level of understanding of a particular concept or topic, which helps to inform how we support their progression.

Differentiation

Differentiation is usually presented as a teaching approach where teachers think of learners as individuals and learning as a personalised process. Whilst precise definitions can vary, typically, the core aim of differentiation is viewed as ensuring that all learners, no matter what their ability, interest or context, make progress towards their learning intentions. Teachers therefore need to be responsive, and willing and able to adapt their teaching to meet the needs of their learners.

Language awareness

For many learners, English is an additional language. It might be their second or perhaps their third language. Depending on the school context, learners might be learning all or just some of their subjects through English.

For all learners, regardless of whether they are learning through their first language or an additional language, language is a vehicle for learning. It is through language that students access the learning intentions of the lesson and communicate their ideas. It is our responsibility, as teachers, to ensure that language doesn't present a barrier to learning.

Metacognition

Metacognition describes the processes involved when learners plan, monitor, evaluate and make changes to their own learning behaviours. These processes help learners to think about their own learning more explicitly and ensure that they are able to meet a learning goal that they have identified themselves or that we, as teachers, have set.

Skills for Life

How do we prepare learners to succeed in a fast-changing world? To collaborate with people from around the globe? To create innovation as technology increasingly takes over routine work? To use advanced thinking skills in the face of more complex challenges? To show resilience in the face of constant change? At Cambridge, we are responding to educators who have asked for a way to understand how all these different approaches to life skills and competencies relate to their teaching. We have grouped these skills into six main Areas of Competency that can be incorporated into teaching, and have examined the different stages of the learning journey and how these competencies vary across each stage.

These six key areas are:

- Creativity – finding new ways of doing things, and solutions to problems
- Collaboration – the ability to work well with others
- Communication – speaking and presenting confidently and participating effectively in meetings
- Critical thinking – evaluating what is heard or read, and linking ideas constructively
- Learning to learn – developing the skills to learn more effectively
- Social responsibilities – contributing to social groups, and being able to talk to and work with people from other cultures.

Cambridge learner and teacher attributes

This course helps develop the following Cambridge learner and teacher attributes.

Cambridge learners	Cambridge teachers
Confident in working with information and ideas – their own and those of others.	**Confident** in teaching their subject and engaging each student in learning.
Responsible for themselves, responsive to and respectful of others.	**Responsible** for themselves, responsive to and respectful of others.
Reflective as learners, developing their ability to learn.	**Reflective** as learners themselves, developing their practice.
Innovative and equipped for new and future challenges.	**Innovative** and equipped for new and future challenges.
Engaged intellectually and socially, ready to make a difference.	**Engaged** intellectually, professionally and socially, ready to make a difference.

Reproduced from Developing the Cambridge learner attributes *with permission from Cambridge Assessment International Education.*

More information about these approaches to teaching and learning is available to download from Cambridge GO (as part of this Teacher's Resource).

Setting up for success

Our aim is to support better learning in the classroom with resources that allow for increased learner autonomy while supporting teachers to facilitate student learning.

Through an active learning approach of enquiry-led tasks, open-ended questions and opportunities to externalise thinking in a variety of ways, learners will develop analysis, evaluation and problem-solving skills.

Some ideas to consider to encourage an active learning environment are as follows:

- Set up seating to make group work easy.
- Create classroom routines to help learners to transition between different types of activity efficiently, e.g. move from pair work to listening to the teacher to independent work.
- Source mini-whiteboards, which allow you to get feedback from all learners rapidly.
- Start a portfolio for each learner, keeping key pieces of work to show progress at parent–teacher days.
- Have a display area with learner work and vocab flashcards.

Planning for active learning

1 **Planning learning intentions and success criteria:** these are the most important feature of the lesson. Teachers and learners need to know where they are going in order to plan a route to get there.

2 **Introducing the lesson:** include a 'hook' or starter to engage learners using imaginative strategies. This should be an activity where all learners are active from the start of the lesson.

3 **Managing activities:** during the lesson, try to: give clear instructions, with modelling and written support; coordinate logical and orderly transitions between activities; make sure that learning is active and all learners are engaged; create opportunities for discussion around key concepts.

4 **Assessment for Learning and differentiation:** use a wide range of Assessment for Learning techniques and adapt activities to a wide range of abilities. Address misconceptions at appropriate points and give meaningful oral and written feedback which learners can act on.

5 **Plenary and reflection:** at the end of each activity and at the end of each lesson, try to: ask learners to reflect on what they have learnt compared to the beginning of the lesson; build on and extend this learning.

To help planning using this approach, a blank Lesson plan template is available to download from Cambridge GO (as part of this Teacher's Resource). There are also examples of completed lesson plans.

We offer a range of Professional Development support to help you teach Cambridge Primary Mathematics with confidence and skill. For details, visit **cambridge.org/education**

Developing mental strategies

Learners begin to use mental methods in the early stages of learning mathematics, usually starting with counting objects and progressing to using number lines or squares to help them work out answers. Later, they are taught to remember and recall number facts and develop the language necessary to talk about mathematics. As they progress, they learn more sophisticated mental methods. They may develop some methods intuitively, but some you will need to teach. It is important that you provide regular opportunities for learners to explain and discuss their methods so they share ideas with one another and acquire a range of mental strategies.

At some stage, it can become hard for learners to hold intermediate steps of a calculation in their heads. At this point, encourage them to make notes or jottings. Not all learners will do a mental calculation in the same way, but some methods are more efficient and reliable than others. If you allow time for learners to discuss, explain and compare different methods you can guide them towards choosing and using efficient methods. Learners will see the need for methods that can be applied generally and this eventually leads towards using standard written methods.

You should start all mathematics lessons with a counting activity, tables or other mental activity. The session can be used to:

- practise and consolidate the rapid and accurate recall of number facts
- revise mental strategies for tackling number problems
- explain and demonstrate new mental strategies
- discuss different ways of solving problems
- reinforce the correct use of mathematical vocabulary.

This section provides details of starter ideas, main teaching ideas and plenary ideas that you could use within lessons to develop strategies for mental calculations involving addition, subtraction, multiplication and division.

LANGUAGE SUPPORT

There is a lot of vocabulary associated with the four basic mathematical operations. You may want to display these words in the classroom to help learners become familiar with them. You should ensure learners are using the correct vocabulary in discussions and encourage them to use a variety of terms, perhaps by asking questions such as, 'How else could you say that?'

Addition		Subtraction	
add	total	subtract	difference
more	altogether	take away	count back
plus	count on	minus	decrease
sum	increase	leave	
Multiplication		**Division**	
lots of	multiply	share	halve
groups of	product	group	
times	double	divide	

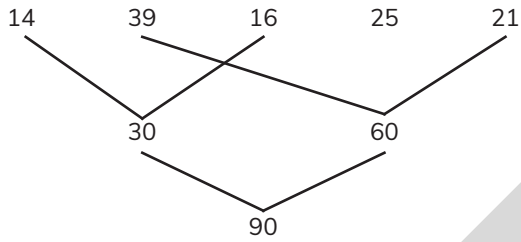
Starter ideas

1 Reordering numbers (5–10 minutes)

Resources: None.

Description: This activity is good for reminding learners about the commutative and associative laws for addition.

Ask learners to find the total of 14, 39, 16, 25 and 21 and then discuss the methods used.
If necessary, remind them that they can re-order the calculation to make it easier, for example:



90 + 25 = 115

Provide other examples using different vocabulary, for example:

Find the sum of 19, 33, 26, 47 and 21

Answer: 146

Add together 7, 42, 24, 38 and 16

Answer: 127

2 Using doubles (10 minutes)

Resources: Calculators.

Description: Ask learners, 'What is double 24? Can you explain your method?' Accept any answer offered but encourage partitioning (decomposing):

double 20 = 40

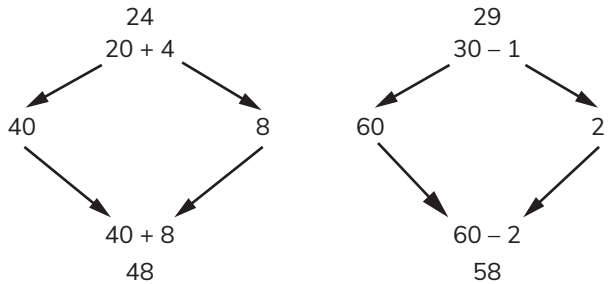
double 4 = 8

so double 24 = 48

Repeat with other examples allowing learners to explain their strategies. These may depend on the number, for example:

double 29 is equivalent to double 30 − double 1

Encourage learners to use jottings to support mental calculation.



Explain the activity called Double my number, and allow time for learners to play the game as follows.

One student writes down a 2-digit number in secret, they use a calculator to double it then show a second student the calculator display. The second student has to say what number was doubled.

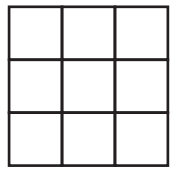
Calculators can be used as a teaching aid to promote mental calculation and explore mathematical patterns. With guidance from you, learners will start to understand when it is appropriate to use a calculator.

3 Table practice – a game for 2 players (5–10 minutes)

Resources: A dice or spinner.

Description: These instructions are given for the three times table; you can adapt them for other tables.

Each player draws a 3 by 3 grid.



Player 1 rolls the dice, multiplies the score by 3 and records the answer in their grid. Player 2 then does the same thing. Continue until both players' grids are full.

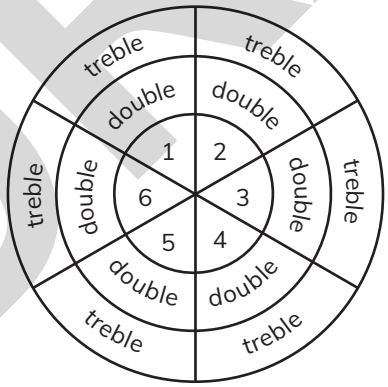
Players take turns to roll the dice again. Multiply the dice score by 3. If the answer is on either player's grid then they cross out that number. If the number appears more than once, only cross out one number.

The winner is the first player to have all of their numbers crossed out.

4 Darts (10 minutes)

Resources: None.

Description: Draw a dartboard like this:



Ask learners to double and treble the numbers on the grid.

Ask learners to imagine throwing three darts and set them challenges to solve in pairs. Allow thinking time, then take feedback.

- Where would the darts need to land to make the highest score? What is the highest score? How did you decide?

Answer: treble 6 three times = 54

- Where would the darts need to land to make the lowest score? What is the lowest score?

Answer: 1 three times = 3

- How could you score 30? Find different ways.

Answer: double 5 + double 5 + double 5 or double 6 + double 6 + 6 and so on

- How could you score 45?

Answer: treble 5 three times or treble 6 + treble 6 + treble 3 and so on

Main teaching ideas

1 Using addition and subtraction facts (20 minutes)

Learning intention: Recall addition facts to 10 and 100 and use them to develop strategies for addition and subtraction.

Resources: Resource sheet A Addition and subtraction strategies.

Description: Ask learners to answer the following two questions mentally.

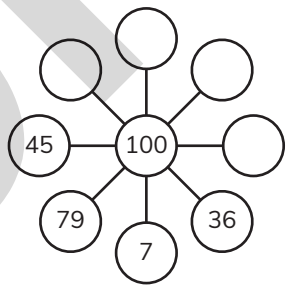
- Find the missing number: 57 + ☐ = 100
- Write the same digit in both boxes to make this sum correct.

☐ 4 + 3 ☐ = 100

Ask learners to share their methods. Establish that when adding two 2-digit numbers to give 100 the ones digits must add to 10 and the tens digits must add up to 90. This fact can help solve similar problems quickly.

Practise using the following question.

- Complete the spider diagram so that opposite numbers total 100.

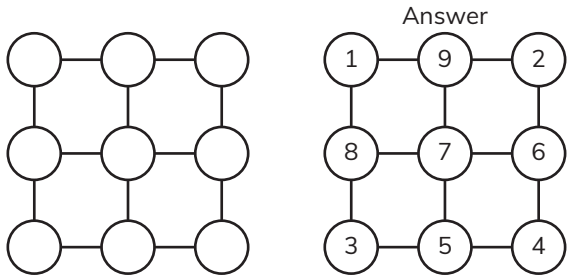


Choose one, or both, of the activities on Resource sheet A Addition and subtraction strategies to give learners an opportunity to work mentally.

› **Differentiation ideas:** To support learners, provide additional practice working with complements to 100, then extend to complements to 90, 80 and so on.

Confident learners can use number facts to solve puzzles of the following type.

Arrange the numbers 1, 2, 3, 4 . . . 9 in the circles so that each side of the square adds up to 12.



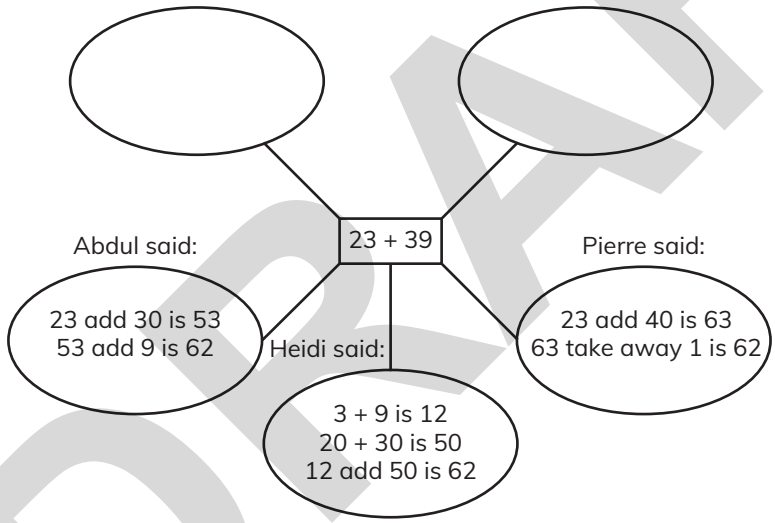
2 Mental methods for addition and subtraction (20 minutes)

Learning intention: Use a mental method to add or subtract whole numbers.

Resources: Resource sheet B Compensation methods.

Description: Display the following diagram and say: 'There are many ways of adding 23 and 39 mentally. Here are three of them. Does anyone have a different method?'

Discuss alternative methods, then ask learners which method they prefer and why. Learners will be **critiquing** (TWM.07) when they compare the methods to identify advantages and disadvantages of each one.



Repeat with subtraction.

Keeping a constant difference

As learners understand subtraction as the difference between two numbers, they can investigate what occurs if both numbers are changed by the same amount. Manipulating numbers in this way allows learners to create a friendlier problem, for example:

81 − 39 = 82 − 40 (adding 1 to both numbers) = 42

Provide learners with a selection of problems they can solve efficiently using this strategy and ask them to share their approach.

61 − 29 164 – 119 114 – 89 51 – 26 39 – 17 391 – 146 86 − 47

Answers: 32, 45, 25, 25, 22, 245, 39

Compensation methods

This method is useful for adding and subtracting numbers that are close to a multiple of 10, such as those that end in 1 or 2, or in 8 or 9. The number to be added or subtracted is rounded to a multiple of 10 plus or minus a small number, for example:

23 + 39	63− 39
= 23 + 40 − 1	= 63 − 40 + 1
= 63 − 1	= 23 + 1
= 62	= 24

Ask learners to calculate the following using this strategy:

161 – 79 164 + 78 114 – 89 51 + 29 327 – 29 391 + 149 856 − 69

Answers: 82, 242, 25, 80, 298, 540, 787

› **Differentiation ideas:** To support learners with the compensation method, provide them with Resource sheet B Compensation methods.

To challenge confident learners, ask them to work in pairs to create a set of problems, with answers, to exchange with their partner.

3 Using mental methods to solve problems (20 minutes)

Learning intention: Use any suitable method to add or subtract whole numbers.

Resources: Resource sheet C Solving number problems

Description: Introduce the problems. Learners work in pairs. They choose which problem to work on and discuss a suitable method to solve it. They each solve the problem and check their answers with each other.

While they are working, choose learners to share their methods and solutions with the whole class during a plenary.

› **Differentiation ideas:** To support learners, allow them time to discuss with their partner and, if necessary, help them with questions and hints to get them started.

- Question 1: You may find it helpful to use cards that can be moved easily.
- Question 2: Make sure you use a pencil so the line can be erased if you make an error.
- Question 3: Find Alyssa's number first, then Kim's number.
- Question 4: It will help you to find all of the answers if you are systematic.

Confident learners will be able to tackle more than one problem in the time allowed.

Answers:

1 1, 4, 7, 8 2, 3, 7, 8 3, 4, 5, 8
1, 5, 6, 8 2, 4, 6, 8 3, 4, 6, 7 2, 5, 6, 7
2 Route that totals 200 goes through 10, 12, 37, 69, 45 and 27.
3 Bella 65, Alyssa 27, Tanya 38, Sara 29, Kim 48
4 1, 3, 21 1, 5, 19 1, 7, 17 1, 9, 15 1, 11, 13
3, 5, 17 3, 7, 15 3, 9, 13 5, 7, 13 5, 9, 11

4 Doubling and halving (20 minutes)

Learning intention: Understand and use doubling (multiplying by 2) and halving (dividing by 2).

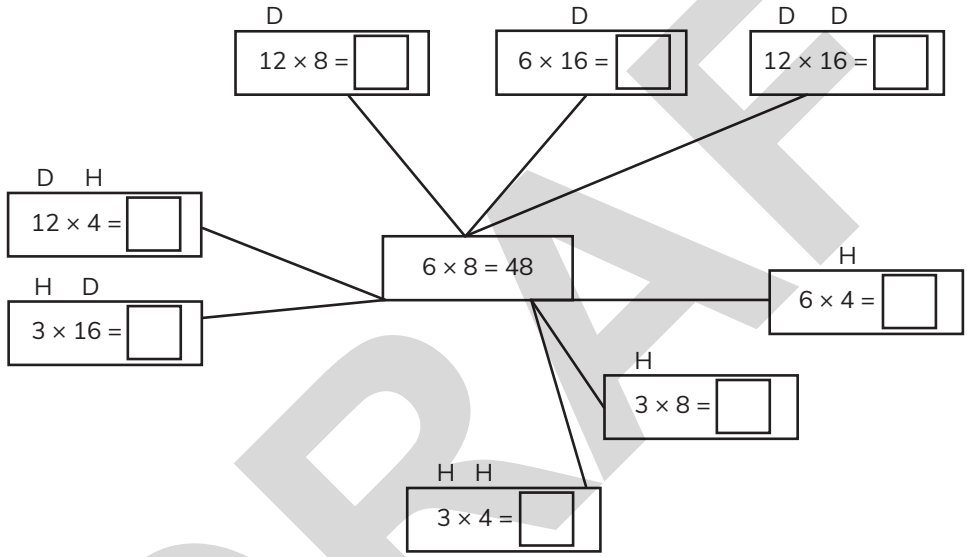
Resources: None.

Description: Remind learners that doubling and halving are inverse operations by using 'Think of a number' activities. For example:

- I'm thinking of a number. When I double it my answer is 38. What is my number?
- I'm thinking of a number. When I halve it my answer is 4. What number am I thinking of?

Start with a known fact, for example 6 × 8 = 48, and ask learners to use this fact to work out the other facts on the diagram. (On the diagrams, D represents double and H halve. You may wish to add these later as you take feedback.)

Allow a few minutes for learners to find solutions then take feedback.



Summarise the feedback by listing the strategies.

Using doubling and halving

- Doubling one number and halving the other in a known fact leaves the answer unchanged, for example:
  - 6 × 8 = 3 × 16 = 48
  - 6 × 8 = 12 × 4 = 48
- Use halving starting from a known fact, for example if you know that 6 × 8 = 48 then halving one of the numbers gives:
  - 6 × 4 = 24
  - 3 × 8 = 24
- Use doubling starting from a known fact, for example if you know that 6 × 8 = 48 then doubling one of the numbers gives:
  - 6 × 16 = 96
  - 12 × 8 = 96

› **Differentiation ideas:** To support less confident learners, you could place them together in a group so that you are able to give additional support.

To challenge confident learners, encourage them to be adventurous once they have completed the basic diagram, for example, double, then double again or halve, then halve again.

5 Using factors to help you multiply and divide mentally (20 minutes)

Learning intention: Choose an appropriate mental calculation to multiply and divide whole numbers.

Resources: Resource sheet D Multiplication table in code.

Description: Introduce the activity by explaining to learners that you have a multiplication table that is written in code and you would like them to help you crack the code.

Ask them to work in pairs for five minutes.

You may need to support some pairs by giving hints and asking questions (only one bullet point at a time).

- The table is in order so it starts 1 times something.
- What do you notice about Δ? How will that help you?

Answer: It gives you the table, 5 and $5 \times 5 = 25$

- Fill in the digits you know. What do you notice about the units digit of the answer in each line?

Answer: It alternates 5 and 0, enabling learners to complete the first 6 lines of the table and hence continue with the next line.

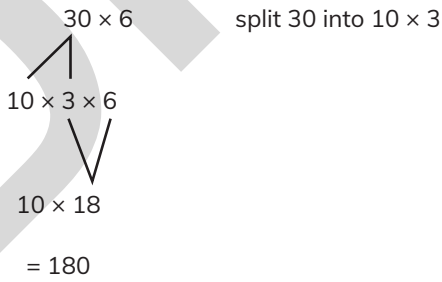
Make sure that learners complete the next line of the table as $7 \times 5 = 35$ and understand that 7 and 5 are factors of 35.

Ask learners to jot down the answers to these calculations:

$3 \times 6 =$ ☐ $30 \times 6 =$ ☐ $300 \times 6 =$ ☐ $3 \times 60 =$ ☐ $3 \times 600 =$ ☐

Ask, 'How did you work out your answers?

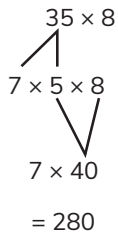
Say that 3 and 10 are factors of 30, so we have used factors to help us multiply.



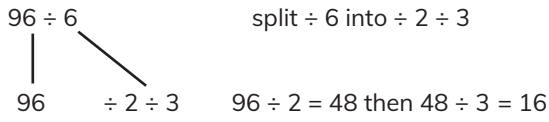
Ask learners to use factors to help them multiply 35×8 and divide 96 by 6. Take feedback and summarise strategies as follows.

Using factors

- Split one number into a factor pair to make multiplication easier, for example:



- Split one number into a factor pair to make division easier, for example:



› **Differentiation ideas:** Use the suggested questions to support less confident learners.

Provide confident learners with other, more challenging, codes to solve.

6 Using decomposition to help you multiply and divide mentally (20–30 minutes)

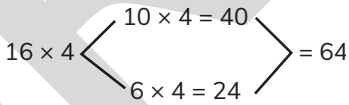
Learning intention: Choose an appropriate mental calculation to multiply and divide whole numbers.

Resources: None.

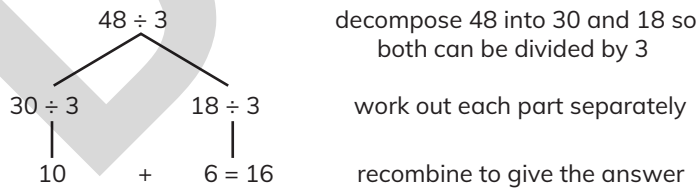
Description: Ask learners to work in pairs to find different ways of calculating 16 × 4 and 48 ÷ 3. Allow time, then ask learners to demonstrate their methods. Discuss with learners the advantages and disadvantages of each method. Learners will show they are **critiquing** (TWM.07) when they do this.

Ensure that learners are familiar with the method of decomposing one number to multiply and divide using jottings.

- Decompose a number to make a simpler multiplication, for example:



- Decompose a number to make a simpler division, for example:



Ask learners to make a poster showing different methods, including those from the other activities, for doing these calculations. In each case they must show which method they prefer and say why.

25 × 9 42 ÷ 3 45 × 6 72 ÷ 6

› **Differentiation ideas:** You may need to offer additional support to groups of less confident learners while the rest of the class get started on the activity.

Challenge confident learners to work in pairs to set questions for their partner to calculate. They should then discuss whether they would use the same method.

Plenary ideas

1 The answer is . . . What is the question? (5–10 minutes)

Resources: None.

Description: Write a number on the board, for example 98, and ask learners to write down three questions that would give an answer of 98. Collect ideas and discuss the methods used to give the answer.

› **Assessment ideas:** Listening to learners' responses will give you information about how well learners chose an appropriate strategy.

2 True or false? (10 minutes)

Resources: None.

Description: As learners are working on mental calculation activities, look out for errors that they make. Use these as a basis for writing number sentences on the board and also include some statements that are correct. Learners must decide whether each statement is true or false and explain their decision.

Example: 17 + 15 = 41 is false because:

- 7 + 5 = 12 so the number must end in 2.
- Two odd numbers added together make an even number, and 41 is not even.
- The answer must be less than 40 because 20 + 20 = 40 and 15 and 17 are both less than 20.

› **Assessment ideas:** Listening to learners' responses will give you information about how well they are making connections, for example' to work on odd and even numbers and estimation.

3 What else do you know? (10–15 minutes)

Resources: None.

Description: Write a multiplication fact such as 12 × 5 = 60 on the board. Ask learners to construct a diagram to show other facts that can be found. Start them off by giving a set of related facts for example:

Explain that they can continue this 'branch' or start a new 'branch'.

Allow five minutes for learners to work on their diagrams, then work as a class to build a diagram using as many different mental methods as possible.

› **Assessment ideas:** Watching learners as they work and listening to their suggestions will give you information about their progress.

4 Using known facts to find new facts (10–15 minutes)

Resources: None.

Description: Write this question on the board:

Here are some number facts.

1 × 17 = 17

2 × 17 = 34

4 × 17 = 68

8 × 17 = 136

Use these facts to work out 13 × 17.
Show your method.

Answer: Show how to add the products for 1 × 17, 4 × 17 and 8 × 17.
1 × 17 = 17
4 × 17 = 68
8 × 17 = 136

13 × 17 = 221

Give similar examples for learners to work on. For example:

1 Here are some number facts.
1 × 29 = 29
2 × 29 = 58
4 × 29 = 116
8 × 29 = 232
Show how you can use these facts to calculate 17 × 29.

Answer: (8 × 29) + (8 × 29) + (1 × 29) = 232 + 232 + 29 = 493

2 Here is a number fact: 19 × 5 × 8 = 760
Show how to use this fact to work out 19 × 5 × 16.

Answer: 760 × 2 = 1520

› **Assessment ideas:** Watching learners as they work and listening to their suggestions will give you information about their progress.

Downloadable resources

Resource sheets:

A Addition and subtraction strategies
B Compensation methods
C Solving number problems
D Multiplication table in code

1 Numbers and the number system

Unit plan

Topic	Approximate number of learning hours	Outline of learning content	Resources
1.1 Counting and sequences	4	Count forwards and backwards including negative numbers. Recognise linear sequences. Describe term-to-term rules. Begin to explore non-linear sequences. Explore spatial patterns for square numbers.	Learner's Book Section 1.1 Workbook Section 1.1 Additional teaching ideas for Section 1.1 **Digital Classroom:** Stick patterns digital manipulative
1.2 More on negative numbers	2	Read and write positive and negative numbers. Understand negative numbers in context.	Learner's Book Section 1.2 Workbook Section 1.2 Additional teaching ideas for Section 1.2
1.3 Understanding place value	3	Read and write whole numbers up to a million. Understand place value. Multiply and divide a whole number by 10 and 100.	Learner's Book Section 1.3 Workbook Section 1.3 Additional teaching ideas for Section 1.3

CONTINUED			
Topic	Approximate number of learning hours	Outline of learning content	Resources
			1A Stick patterns 1B Sequence cards 1C Dotty patterns 1D December temperature game 1E Temperature cards (−10 °C to +10 °C) 1F Multiplication and division loops 1G Thermometers 1H Place value chart
Cross-unit resources			
Diagnostic check and mark scheme Learner's Book Check your progress **Digital Classroom:** Unit 1 slideshow **Digital Classroom:** Unit 1 activity Worksheet 1A Worksheet 1B Language worksheet 1A Language worksheet 1B Unit 1 test and answers			

Thinking and Working Mathematically questions in Unit 1

Questions	TWM characteristics covered
Learner's Book	
Exercise 1.1 question 2	Specialising, Generalising
Exercise 1.1 question 3	Specialising, Generalising
Exercise 1.1 question 5	Convincing
Exercise 1.1 question 6	Convincing
Exercise 1.1 Think like a mathematician	[TO ADD]
Exercise 1.2 question 7	Critiquing
Exercise 1.3 question 4	Convincing
Exercise 1.3 question 7	Characterising
Exercise 1.3 Think like a mathematician	[TO ADD]
Check your progress question 3	Specialising, Generalising
Check your progress question 7	Specialising
Check your progress question 8	Specialising

CONTINUED	
Workbook	
Exercise 1.1 question 7	Convincing
Exercise 1.1 question 11	Generalising, Convincing
Exercise 1.1 question 14	Generalising
Exercise 1.2 question 13	Convincing
Exercise 1.3 question 13	Specialising

BACKGROUND KNOWLEDGE

Before starting this unit, you may want to use the diagnostic check to check that learners are ready to begin Stage 4. The diagnostic check can help you to identify gaps in learners' knowledge or understanding, which you can help them address before beginning this unit.

We are surrounded by numbers in our everyday life, for example, on road signs, scores in cricket or times in athletics. Having a display of pictures in the classroom can help learners to see how numbers affect their lives.

In earlier stages, learners practised counting on and back in steps of single-digit numbers, tens and hundreds. They recognised, described and extended linear sequences, and in Stage 3 they described the term-to-term rule for linear sequences. They became fluent reading, writing and comparing numbers to at least 1000.

Learners used base 10 materials and place value charts to help them understand place value. They know how the value of each digit is determined by its position in a number. Learners have learned how to decompose and regroup numbers as a basis for adding and subtracting numbers in columns. They used their knowledge of place value to multiply whole numbers by 10.

In this unit, we will build on these experiences as we increase the range of numbers to include thousands, ten thousands and hundred thousands. We will count back through zero to include negative numbers and explore how these numbers are used in the real world.

Digital Classroom: Use the Unit 1 slideshow to lead a class discussion on our number system. The i button will explain how to use the slideshow.

Supporting learners with the Getting started exercise

To support learners with work on sequences, provide regular counting activities during lesson starters. Represent the resulting sequences as jumps along a number line so learners can see, for example, that counting on in tens is the same as a sequence with a term-to-term rule of 'add 10'.

Check prior learning by reviewing learners' work using the Getting started exercise in the Learner's Book.

A good understanding of place value underpins all calculation work. Encourage learners to use place value cards as a practical way of composing (300 + 60 + 4 = 364) and decomposing (364 = 300 + 60 + 4) and also to use place value charts to show the value of individual digits. Ensure that you emphasise the use of zero as a place holder. As an extension of the work on place value, demonstrate on a place value chart how the movement of any digit one place to the left represents multiplication by 10.

TEACHING SKILLS FOCUS

Investigations

'Think like a mathematician' activities allow learners to explore mathematical topics. When learners say they are stuck, it is easy for teachers to give too much help. This section encourages you to stand back, watch and listen but not intervene unless absolutely necessary.

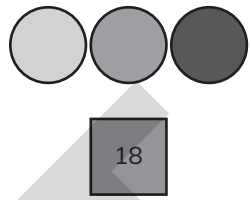
The following guide is based on the consecutive numbers investigation in Section 1.1, but the ideas can easily be adapted to other investigations.

Check that learners understand the term 'consecutive'. If you think they may need support getting started, use the following activity, discuss what it means for numbers to be consecutive, and ask learners to choose two consecutive numbers and add them together. Ask the following questions:

- How did you add the numbers together (for example, mental methods including double plus 1)?
- Is there a different way to do it?
- What to you notice about your answer?
- If the total is 21, what are the two consecutive numbers?
- How did you work it out?
- What are the first two consecutive numbers that total more than 100? More than 1000?

If learners appear to be stuck with the investigation in the Learner's Book, prompt with questions like these to guide them to the discovery that the number in the square is three times the middle number.

- Give me any three consecutive numbers.
- Write down three consecutive numbers that have a total of about 27.
  How did you choose your numbers?
- Draw a ring around the middle numbers in the two completed sets of beads.
  Look at the number of circles and the circled number. What do you notice?
- Can you use these ideas to help you complete this set of beads?



Ask learners who complete the investigation early to make some sets of beads for their partner to try. An interesting extension for the more confident could be to investigate what happens if there is an even number of circles.

Reflection

When learners have completed the investigation reflect on your experience.

- What went well and what did not go as planned?
- How hard was it to prompt rather than give guidance or answers?
- Did you try suggesting that learners worked in pairs? Did you summarise learners' findings during a plenary? If not, try these strategies next time.

Guidance on mental mathematics

Being able to count involves much more than an ability to rote count. Learners need to be able to count forwards and backwards in steps of different size and relate this to counting in multiples, for example, 5, 10, 15, 20, . . .

Some learners may find number lines helpful, particularly when bridging through hundreds (99, 100, 101 or 499, 500, 501 or counting back 101, 100, 99) or thousands (999, 1000, 1001 and counting back) or including positive and negative numbers (3, 2, 1, 0, −1, −2, −3).

CONTINUED

When learners are multiplying and dividing by 10 and 100, you can practise using 'people maths'. Learners hold a digit card and sit on chairs labelled with Th, H, T, O, etc. They then move one or two places to the left or right to show multiplication or division by 10 or 100.

Th	H	T	O	
			7	7 x 10 = 70
		7	0	70 x 10 = 700
	7	0	0	7 x 100 = 700

1.1 Counting and sequences

LEARNING PLAN

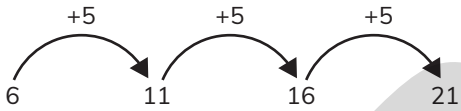
Learning objectives	Learning intentions	Success criteria
4Nc.01	• Count on and back in steps of constant size.	• Learners can count on and back in steps of tens, hundreds and thousands.
		• Learners can count back through zero to negative numbers.
4Nc.04	• Recognise and extend linear sequences.	• Learners can recognise and continue sequences that have steps of constant size.
	• Describe term-to-term rule for a sequence.	• Learners can describe sequences.
	• Recognise and extend non-linear sequences.	• Learners recognise sequences that do not have a constant difference.
4Nc.05	• Recognise square number patterns.	• Learners can draw patterns that represent square numbers: 1, 4, 9, . . .
4Ni.01	• Read and write numbers greater than 1000.	• Learners can read and write numbers greater than 1000.

LANGUAGE SUPPORT

A negative number is written with a minus sign in front, for example −7. It is read as 'negative seven' not 'minus seven'. 'Minus 7' is an instruction to subtract 7. It might be helpful to display a definition and example for learners to refer to.

Word	Definition	Word used in a sentence
negative	Less than zero.	**Negative** three degrees centigrade is three degrees below zero.
minus	A mathematical operation or procedure to work out subtraction.	Eight **minus** six is two (8 − 6 = 2).

Difference: the 'jump size' between terms. For example, the difference between the terms in this sequence is +5



Linear sequence: a number pattern which increases (or decreases) by the same amount each time. For example, the pattern 2, 6, 10, 14, . . . follows the rule 'add 4'

Negative number: a number less than zero. You use a minus (−) sign to show a negative number

Non-linear sequence: a pattern where the numbers do not increase or decrease by the same amount each time. For example, in this sequence the numbers double each time: 2, 4, 8, 16, . . .

Rule: a rule tells you how things or numbers are connected. For example, the terms 1, 2, 4, 7, 11, . . . are connected by the rule 'add 1 more than you added last time'

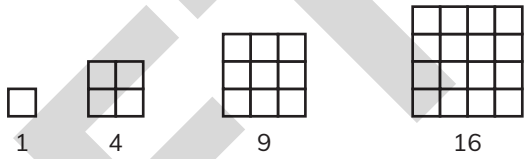
Sequence: an ordered set of numbers, shapes or other mathematical objects arranged according to a rule. For example:

3, 6, 9, 12, 15, . . .

1, 4, 9, 16, 25, . . .

□, ○, Δ, □, ○, Δ, □, . . .

Spatial pattern: a pattern that includes drawings. For example, these patterns show square numbers



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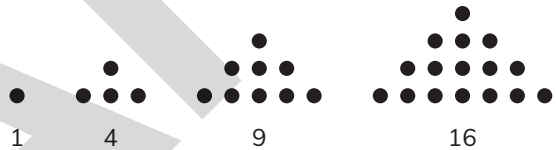


Square number: the number you get when you multiply a whole number by itself. For example, 4 × 4 = 16

16 is a square number.

The square numbers appear along the diagonal on a multiplication square.

Term: part of a sequence separated by commas. For example, in the sequence 1, 2, 3, 4, . . . the first term is 1 and the third term is 3

Term-to-term rule: a rule you can use to find the next number in the sequence. For example, in the sequence 7, 10, 13, . . . the term-to-term rule is 'add 3'

Common misconceptions

Misconception	How to identify	How to overcome
Learners may use incorrect language; minus 1 instead of negative 1 when counting.	Listen to learners counting.	Always use correct language and correct any incorrect terminology.
Learners may believe that −5 is more than −2 because 5 is more than 2.	Listen to learners counting.	Show the numbers on a number line.

Starter idea

Getting started (20 minutes)

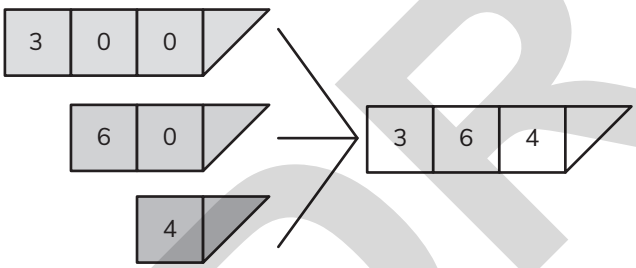
Resources: Unit 1 Getting started exercise in the Learner's Book.

Description: Give learners 10 minutes to answer the Getting started questions in their exercise books. After 10 minutes, ask learners to swap their books with a partner and then check their partners' answers while you discuss the questions as a class. After the class have marked their work, walk round and check if there are any questions that learners struggled with. You may want to recap particular concepts as a class.

Refer to the Background knowledge section at the start of this unit for suggestions about how to address gaps in learners' prior knowledge.

Make sure you give learners practice in saying numbers correctly, for example 601 is 'six hundred and one' not 'six oh one'. Use place value charts and arrow cards to support learners' understanding of place value.

1000	2000	3000	4000	5000	6000	7000	8000	9000
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



Main teaching idea

Exploring stick patterns (20–30 minutes)

Learning intention: Recognise and extend sequences; describe term-to-term rule for a sequence.

Resources: sticks, Resource sheet 1A Stick patterns, (optional) Stick patterns digital manipulative in Digital Classroom C.

Description: Invite learners to explore the stick patterns on Resource sheet 1A then bring the class together to discuss findings.

In **Digital Classroom**, you can use the Stick patterns digital manipulative with your class to build stick patterns to investigate linear sequences. You can use this manipulative with the resource sheet.

Answers:

a Sequence: 4, 7, 10, 13, . . . Term to term rule: 'add 3'
b Sequence: 4, 8, 12, 16, . . . Term to term rule: 'add 4'
c Sequence: 3, 5, 7, 9, . . . Term-to-term rule: 'add 2'
d Sequence: 6, 11, 16, 21. Term-to-term rule: 'add 5'
e Sequence: 5, 9, 13, 17. Term-to-term rule: 'add 4'
f Sequence: 5, 9, 13, 17. Term-to-term rule: 'add 4

Ask learners to reflect on the activity.

- What do you notice about patterns (b), (e) and (f)?

Answer: They have the same **term-to-term rule** 'add 4'.

- What do you notice about the difference between successive **terms** in each sequence?

Answer: The difference is **constant** so the sequence is **linear**. There is no need to draw more diagrams as the **next term** can be found by adding the difference between the terms.

- How could you find the 10th term in the sequence?

Answer: Use sticks or draw more patterns or continue the sequence 4, 7, 10 . . .

This activity helps learners to think about patterns in a visual way before they consider the more abstract number patterns in Exercise 1.1.

› **Differentiation ideas:** Encourage less confident learners to make the patterns using sticks before they progress to drawings. Working in pairs may help them. More confident learners will quickly see that there is no need to make the patterns with sticks or to draw the pattern. Once they know the rule (how many sticks are added each time) they can continue the pattern.

You could ask confident learners to explore each sequence further:

- Can you work out how many sticks would be in the 10th pattern without making or drawing the diagrams?
- Can you work out how many sticks would be in the 100th pattern?

Plenary idea

What is my sequence? (10 minutes)

Resources: None.

Description: Select a sequence, for example multiples of 5, but do not share this with the class. Ask learners to suggest numbers which you write in a box only if they are in the sequence. You may give a range of numbers for them to choose from; in this case whole numbers up to 100 would be suitable.

In my sequence	
30 15	16

Learners should aim to identify the sequence as soon as possible.

This activity can be carried out as a whole class or in small groups.

› **Assessment ideas:** You can learn a lot about learners' understanding by the time it takes to find the sequence and the numbers they choose. If the number indicates they may know the sequence, ask why they chose it. You could ask learners how they decided which number to choose. Did they choose a favourite number or were they testing a particular hypothesis?

Guidance on selected *Thinking and Working Mathematically* questions

Learner's Book Exercise 1.1, questions 2 and 3

Question 2 is a 'compare and contrast' activity; it addresses **generalising** (what is the same about two sequences) and **specialising** (testing the sequences to see if they fit the generalisation).

Question 3 is an 'odd one out' activity. All the sequences are linear with a rule 'add 3'. This question addresses **generalising** (all sequences have same term-to-term rule) and **specialising** (choosing and testing an example to see if it satisfies or does not satisfy specific maths criteria, for example, it includes a negative number).

Homework ideas

1 Use the 'Count me in' activity on the NRICH website.

Learners are presented with a set of numbers and the challenge 'How do you know whether you will reach these numbers when you count in steps in sixes from zero?'

2 Use Resource sheet 1C Dotty patterns.

Answers:

a 4, 8, 12

b 1, 5, 13

c Next two patterns drawn.

d Dots on perimeter: 4, 8, 12, 16, 20, . . .
Start at 4 and add 4 each time.
Dots inside square: 1, 5, 13, 25, 41, . . .
Start at 1 and add 4, then 8, then 12, then 16, . . .

1.2 More on negative numbers

LEARNING PLAN

Learning objectives	Learning intentions	Success criteria
4Ni.01	• Read and write numbers less than zero, for example, −6 is negative six.	• Learners can read and write numbers less than zero, for example, −6 is negative six.
4Np.04	• Understand numbers less than zero, for example, to describe a very cold temperature or a position below sea level.	• Learners can use negative numbers in context, for example, very cold temperatures or depths below sea level.

LANGUAGE SUPPORT

We use a **thermometer** to measure **temperature**. If a reading lies between two markers on the **scale**, we can only estimate the temperature.

You may need to explain or clarify the mathematical meaning of the word 'scale' as it has many different meanings in everyday language:

- A **scale** is a set of numbers or levels used to measure or compare things.
- The **scale** of a map, plan or model is the relationship between the size of something in the map, plan or model and the real thing.
- In music, a **scale** is a fixed sequence of notes.
- The **scales** of a fish or reptile are small, flat pieces of hard skin.
- You can use bathroom **scales** to find out how heavy you are.

Learners may also need support when deciding when to use, for example, 'colder' rather than 'coldest'.

	Use when comparing two temperatures	Use when comparing three or more temperatures
cold	colder	coldest
warm	warmer	warmest
hot	hotter	hottest

Temperature: how hot or cold something is. You can use a thermometer to measure temperature in degrees Celsius

Zero: another name for nothing or nought. On a number line it is the point where numbers change from positive to negative

Common misconceptions

Misconception	How to identify	How to overcome
Learners may use incorrect language; minus 1 instead of negative 1 when counting.	Listen to learners counting.	Always use correct language, and correct any incorrect terminology.
Learners may believe that −5 is more than −2 because 5 is more than 2.	Listen to learners counting.	Show the numbers on a number line.

Starter idea

Count forwards and backwards (10–15 minutes)

Resources: Number line (optional).

Description: Include counting on and back in different steps as part of a repertoire of mental warm-up activities to use at the beginning of each lesson.

Start at 10 and count back in ones writing the numbers on the line as they are said. Listen out for learners who say, for example, 'minus 1' instead of 'negative 1' when counting.

Repeat for other sequences.

Main teaching idea

Exploring negative numbers (20 minutes)

Learning intention: Understand numbers less than zero, for example, to describe a very cold temperature or a position below sea level.

Resources: Display thermometer, Resource sheet 1G Thermometers for learners.

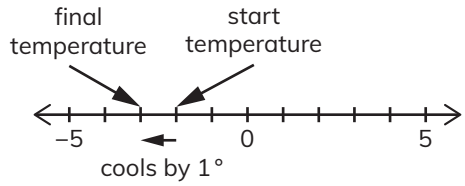
Description: Ask learners where they have seen or heard negative numbers used. For example, in weather forecasts, on a thermometer or in a lift.

Display a thermometer (learners may need to have a copy in front of them) and ask questions such as:

- Which temperature is lower −5 °C or −2 °C?
- Put these temperatures in order, starting with the coldest: 0 °C, −3 °C, 3 °C

- If the temperature was −2 °C and it cools by 1°, what is the new temperature?

  Model the answer on a number line.



- Give me two temperatures between 0 °C and −10 °C. Which one is colder? How do you know?

Learners could now complete Exercise 1.2 questions 1, 2 and 3 in the Learner's Book.

› **Differentiation ideas:** Support learners by providing them with a number line or copy of a thermometer so they can count along the scale. You may need to support them with the language cold → colder → coldest (see the Language support box). To challenge more confident learners ask them to write questions to swap with a partner.

Plenary idea

Make a line (an activity for pairs) (10 minutes)

Resources: A set of number cards (−10 to 10)

Description:

- Place 0 in the centre of the table face up.
- Shuffle the remaining cards, placing them face down with ten cards either side of zero.

- Player 1 turns over a card and decides where it should go in the line. They replace the card in that position with their card and give the discarded card to player 2.
- Player 2 uses this card and decides where it should go in the line.
- Repeat, in turns, until the number line is complete.

› **Assessment ideas:** Observe learners as they play the game and ask questions such as 'What number goes next to −4?'

Guidance on selected *Thinking and Working Mathematically* questions

Learner's Book Exercise 1.2, question 7

This question provides an opportunity for learners to practise **critiquing** (TWM.07). They need to answer the question for themselves in order to find the error. They could place the numbers on a number line to show the order starting from the smallest number: −9 °C, −2 °C, 0 °C, 3 °C.

Parveen knows that 5 is greater than 4, so 5 °C will be warmer than 4 °C. She has not taken any notice of the negative signs. She should place her numbers on a number line to help her correct the mistake.

CROSS-CURRICULAR LINKS

When working with temperatures there are many opportunities to address issues related to climate and climate change.

There is also an opportunity for learners to explore the location of the cities around the world, looking at maximum and minimum temperatures. They can consider northern and southern hemispheres to explain why some cities are hottest in July and coldest in January while other cities are coldest in July and hottest in January.

Homework ideas

1 Make a poster. Learners could find examples of negative numbers in everyday life, or investigate climate statistics and how people adapt to living in extreme temperatures.

2 Introduce the table showing the average temperatures in some cities in January.

City	Temperature (°C)
Bejing, China	−3
Budapest, Hungary	1
Delhi, India	14
Istanbul, Turkey	5
Karachi, Pakistan	18
Moscow, Russia	−8
Ulanbator, Mongolia	−20

Ask learners to find the city in the table that is the coldest. Investigate other cities that are very cold in January or in July.

1.3 Understanding place value

LEARNING PLAN

Learning objectives	Learning intentions	Success criteria
4Ni.01	• Read and write number names and numbers greater than 1000.	• Learners read and write whole numbers to a million.
4Np.01	• Understand and explain that the value of each digit in a number is determined by its position in that number.	• Learners can say the value of each digit in any whole number.
4Np.02	• Use knowledge of place value to multiply and divide numbers by 10 and 100.	• Learners can multiply and divide whole numbers by 10 and 100.
4Np.03	• Compose, decompose and regroup whole numbers.	• Learners can compose (put together), decompose (split) and regroup whole numbers.

LANGUAGE SUPPORT

Sometimes there are differences in the vocabulary used internationally. Some key words have alternative versions.

Used in this book	Alternative
ones	units
decompose	partition or write in expanded form
regroup	recombine

Compose: put together. For example, 600 + 30 + 2 is 632

Decompose: break down a number into parts. For example 456 is 400 + 50 + 6

Regroup: change the way a number is written. For example, 456 = 400 + 50 + 6, but you can change this to 400 + 40 + 10 + 6

Equivalent: having the same value

Thousand: a 4-digit number that is 10 times larger than a hundred

Ten thousand: a 5-digit number that is 10 times larger than a thousand

Hundred thousand: a 6-digit number that is 10 times larger than ten thousand

Million: equal to one thousand thousands and written as 1 000 000. 1 million = 10 × 10 × 10 × 10 × 10 × 10

Place holder: use of zero to hold other digits in the correct position. For example, in the number 804 the '0' acts as a place holder for the tens

Place value: the value of a digit determined by its position

Common misconceptions

Misconception	How to identify	How to overcome
Referring to 'add a nought' when multiplying by 10.	Encourage learners to explain methods.	Demonstrate how digits move relative to the decimal point. (Never accept 'rules' that do not generalise, for example, 0.5 × 10 ≠ 0.50).
Write and/or say large numbers incorrectly, for example, saying the number as a list of digits like a telephone number or failing to deal with zero as a place holder.	During oral work.	Identify the value of each digit and say the number in expanded form, for example 405 321 = 400 000 + 5000 + 300 + 20 + 1 said as 'four hundred and five thousand, three hundred and twenty-one'.

Starter idea

Multiplication loop (10 minutes)

Resources: Multiplication by 10 loop cards cut out from Resource sheet 1F Multiplication and division loops.

NOTE: The multiplication and division by 10 and 100 cards can be used as a plenary.

Description: Hand out the multiplication by 10 loop cards. It does not matter who begins. The first learner says: 'I have . . . Who has . . .?' The learner with the answer to the question takes up the chant. Play ends when all the cards have been used.

Play the game each day for a week, aiming to complete it in less time each day.

This activity is concerned with developing quick recall. Mistakes may indicate that learners do not fully understand the concepts. Do not stop the flow of the activity, but make a note to speak with the learner(s) later in the lesson.

Main teaching idea

Introduction to place value (10 minutes)

Learning intention: Read and write number names and numbers greater than 1000; decompose whole numbers.

Resources: None.

Description: Write the number 343 on the board and explain that it is an example of a palindromic number. A palindromic number reads the same when written forwards or backwards. Ask learners to give other examples of palindromic numbers.

Take examples, such as 9779. Write the number on the board. Say the number: nine thousand, seven hundred and seventy-nine. Decompose the number into thousands, hundreds, tens and ones: 9000 + 700 + 70 + 9.

Challenge learners to write down all of the 4-digit palindromic numbers where the sum of the digits is 10. Learners can work in pairs to find the numbers. Collect responses, ensuring that the numbers are written, said and decomposed (as above). Encourage learners to work systematically.

Answer: 1441, 2332, 3223, 4114, 5005

› **Differentiation ideas:** Differentiate between less and more confident learners by asking different questions, so that the numbers used are appropriate to learners. For example:

- Find a 3-digit palindromic number where the sum of the digits is 5. Is there more than one answer?

Answer: 131 and 212

- Find a 3-digit palindromic number where the sum of the digits is 12. Is there more than one answer?

Answer: 282, 363, 444, 525

This activity leads nicely into Learner's Book, Exercise 1.3, question 3.

Plenary idea

Who am I? (A game for groups) (10 minutes)

Resources: None.

Description: One learner chooses a 5- or 6-digit number and makes up some sentences to define the number.

For example, if they chose 86 471 they could say:

- My number has 5 digits.
- The ones digit is 1.