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This Teacher’s Guide is designed to support the component parts of Nelson International Mathematics. The guide covers Student Book 5 and Workbook 5.

Support is presented under the following headings:

- **Concept and skill development** – an overview of the topic, which outlines the objectives covered and the skills students will develop in the section.
- **Vocabulary** – highlights the keywords that you should use in your teaching. Using the correct terminology yourself and encouraging students to use the same, plays an important part in the development of sound mathematical thinking.
- **Resources needed** – a list of the items that you and the students can use for suggested activities.
- **Mental warm-ups** – It is useful to spend about ten minutes each day doing an oral and mental activity so that students get a chance to use known facts, sharpen and improve their mental strategies and practise and consolidate previously learned mental calculation strategies (such as partitioning, compensating or bridging through multiples of ten). You cannot expect the students to recall mental facts quickly unless they have practised and repeated these regularly.

We have provided a bank of sample mental warm-ups on pages 24–39. In most cases, these activities can be done with the whole class. Students can show answers using place value cards or mini-whiteboards, or write answers in their books or on scrap paper. Alternatively, in some cases, it may be more useful to have different students come up and write answers on the board.

Some teachers may prefer to choose activities which are linked to the concepts that will be covered in lessons that follow. For example, before teaching the section on calculating a mean in data handling, you may do a mental activity adding sets of two-digit numbers mentally or revise division facts. However, the mental activities are designed to focus on mental calculation strategies, so they will not always link to new concepts being taught.

- **Teaching ideas** – these are listed under Practical activities (suggestions for activities that introduce the topics in a lively and engaging way before students tackle theoretical or written work) and Using the Student’s materials (notes to take you through the pages of the Student Book with suggestions for class and group work). Many sections also have Workbook activities, which are activities the students can complete in the write-in workbooks.

- **Informal assessment questions to ask** – a list of the types of question that might help you assess the topic, including questions that can stretch higher-attaining students or to give lower-attaining ones more practice.

- **Common errors and misconceptions** – tips and advice to draw your attention to areas that students frequently find difficult or confusing, so you can prepare additional material in advance.
Key to icons

In the Student Book, you will see icons identifying the main syllabus strand covered by a specific activity (or, in most cases, by a cluster of activities).

Number and calculation
Shape and space
Measures
Organising and using data

Note that some syllabuses identify ‘Problem-solving’ as a separate strand. However, because problem solving arises in each of the four other strands, we have simply identified problem solving as one of the different kinds of activity you will find in the Student Book.

This table gives you examples to show how and where the problem-solving objectives from the Cambridge Primary Mathematics Curriculum Framework are integrated and included in the Student Book and Workbook.

Problem solving

Problem solving is integrated throughout the materials. The following table lists the problem-solving objectives and gives one or two examples to show where this objective is specifically covered in the book. However, remember, the students will use problem-solving skills throughout this course and that there are many opportunities to meet each objective built into the materials.

<table>
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<tr>
<th>Objectives</th>
<th>References</th>
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<tr>
<td>5Pt1 Understand everyday systems of measurement in length, weight, capacity, temperature and time and use these to perform simple calculations</td>
<td>Chapters 3 and 5</td>
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<tr>
<td>5Pt2 Solve single and multi-step problems (all four operations); represent them, e.g. with diagrams or a number line</td>
<td>SB pp 25, 52</td>
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<td>5Pt3 Check with a different order when adding several numbers or by using the inverse when adding or subtracting a pair of numbers</td>
<td>SB pp 12 WB pp 11</td>
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<td>5Pt4 Use multiplication to check the results of a division, e.g. multiply 3.7 \times 8 to check 29.6 \div 8</td>
<td>SB pp 12 WB pp 8, 9</td>
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<td>5Pt5</td>
<td>Recognise the relationship between different 2D and 3D shapes, e.g. a face of a cube is a square</td>
</tr>
<tr>
<td>5Pt6</td>
<td>Estimate and approximate when calculating e.g. use rounding and check working</td>
</tr>
<tr>
<td>5Pt7</td>
<td>Consider whether an answer is reasonable in the context of a problem</td>
</tr>
<tr>
<td>5Ps1</td>
<td>Understand everyday systems of measurement in length, weight, capacity, temperature and time and use these to perform simple calculations</td>
</tr>
<tr>
<td>5Ps2</td>
<td>Choose an appropriate strategy for a calculation and explain how they worked out the answer</td>
</tr>
<tr>
<td>5Ps3</td>
<td>Explore and solve number problems and puzzles, e.g. logic problems</td>
</tr>
<tr>
<td>5Ps4</td>
<td>Deduce new information from existing information to solve problems</td>
</tr>
<tr>
<td>5Ps5</td>
<td>Use ordered lists and tables to solve problems systematically</td>
</tr>
<tr>
<td>5Ps6</td>
<td>Describe and continue number sequences, e.g. -30, -27, [], [], -18 ...; identify the relationship between numbers.</td>
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<tr>
<td>5Ps7</td>
<td>Identify simple relationships between shapes, e.g. these triangles are all isosceles because ...</td>
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<tr>
<td>5Ps8</td>
<td>Investigate a simple general statement by finding examples which do or do not satisfy it, e.g. the sum of three consecutive whole numbers is always a multiple of three</td>
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<tr>
<td>5Ps9</td>
<td>Explain methods and justify reasoning orally and in writing; make hypotheses and test them out.</td>
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<tr>
<td>5Ps10</td>
<td>Solve a larger problem by breaking it down into sub-problems or represent it using diagrams</td>
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In the Student Book, and in this Teacher’s Guide, you will see small icons next to some of the practical activities suggested for each topic. These icons indicate a specific type of activity.

This icon indicates a practical activity, which develops mathematical understanding through the use of manipulatives. Typical manipulatives used at this level include: blocks, dice, abaci, counters, measuring sticks, items used for non-standard measures, for example, paperclips or books for length; bottles or tins for capacity, and so
on. Sometimes practical activities do not involve manipulatives, for example, they might instead require students to explore their own movements or actions.

This icon indicates an activity involving construction, building or craft work. For example, students might cut out 2D shapes, build 3D shapes from modelling clay, cut out symmetrical shapes, and so on.

This icon indicates an activity involving discussion, debate or any other oral work. For example, students might talk about which method they found easiest or fastest for solving a specific problem. You may also see the same icon for singing, clapping or any other activities that develop listening and speaking skills.

This icon indicates an activity involving writing or drawing. For example, students might fill in answers to number sentences or questions.

This indicates a problem-solving activity.

**Fundamental principles**

This series makes the following assumptions about the teaching of mathematics:

- Students need concrete experiences in order to acquire sound mathematical understanding.
- Like adults, students learn best when they investigate and make discoveries for themselves.
- Students refine their understanding and develop conceptual structures by talking about their own thinking and what they have done.
- Individual students develop at different rates, some will find certain elements of mathematics difficult, others will understand them quickly.
- Students learn in a variety of different ways; mathematics teaching should provide a rich and wide variety of experiences.
- Students will become more mathematically able if allowed to develop reliable personal methods of working; the formal recording used by mathematicians is very difficult for most students to understand.
- The conventions of mathematics should be taught only once students are confident in their own knowledge, concepts and skills.
- Calculators and computers are tools with which students must become familiar in order to function effectively in the future.
- Students need plenty of opportunities to apply what they have learnt, and to relate their mathematics work to other areas of the curriculum and to their lives in general.
- Students learn mathematics most effectively when they enjoy and see relevance in what they are doing.
This course offers a wide range of mathematical experiences that reflect current thinking on the most effective ways of teaching and learning mathematics at the primary level. It recognises the professionalism of the teacher, and acknowledges that teachers are the best judges of experience appropriate for their own students. It does not impose an inflexible structure. Instead it provides a wide variety of practical activities, pencil and paper exercises and games linked to well-defined purposes or objectives. The teacher selects from this menu to meet the needs of classes, groups and individuals.

**Frameworks for teaching**

**Summary of the approach**

The learning framework of this course can be summarised as: do – talk – record.

**Doing**

Students develop their skills by manipulating apparatus, playing games, investigating patterns and rules, modelling problems and talking about their ideas with peers before they are expected to record their work.

**Talking**

Through discussion, students can make sense of what they have been doing. They can then begin to generalise from their experiences. The teacher’s central role is to create such situations and to judge when to intervene.

Most of the activities in this Teacher’s Guide will help you to facilitate discussion, and will encourage students to listen to each other and experiment with different ways of thinking about and solving problems.

**Recording**

At stage 5, students are likely to have refined their skills and knowledge and developed the use of strategies that they find easy and useful for solving problems. They may still need to use informal and very personal methods (jottings) of recording steps in a process, or keeping track of what they have done. Jottings are an important step in moving towards non-standard methods of calculation (such as diagrams and jumps on a number line) that give the students a foundation for more concise standard written methods of recording.

It is very important that you allow, and in fact encourage, students to make use of jottings as they work. Here are some possible ways of doing this in the classroom:

- Do jottings of your own as you work out solutions. For example, if you are demonstrating how to calculate $144 \times 5$ you might jot the following on the board to show how you are thinking:
  - 1440
  - 720
• Talk through the jottings as you make them. For example, 144 times 10 is 1440, half of that is 720. This modelling process helps students to see that jottings are important and useful.

• Make space for jottings in the students’ exercise books. You can reinforce the importance of jottings as a means of showing your working by encouraging the students to jot as they work. If you only allow jotting on scrap paper, students may think it is not as important or valuable as their ‘real’ work in their book.

• Limit the use of prepared sheets with boxes for answers and no space for jotting down steps.

• Do activities where jotting is the point of the activity, for example, ask students to represent \(\frac{3}{4}\) visually in as many ways as possible, or ask them to work out problems where they will need to jot down interim steps to keep track of the process: for example, how many ways can you find of making one dollar using any combination of 50 cent and 10 cent pieces.

• Ask students to share their jottings and compare them to show that there are different methods of working. This can help the students to see that some strategies are more efficient than others and, in turn, refine their own thinking. In the ‘make a dollar’ task above you may find that some children draw coin combinations, others list them and those who are more able and confident may make a table and work more systematically. All of these methods may provide the correct answers, but obviously some will take longer than others.

In the early stages of using apparatus in a new way, recording may take the form of drawings or words and drawings. Some students will gradually find this time-consuming and will simplify their recording independently. Others may need your suggestions and encouragement. As a teacher, you will need to work out carefully when a student is ready to use a standard mathematical symbol or format, so that recording is based on full comprehension.

Although at stage 6, you will teach students some standard written methods for operations on larger numbers, it remains crucial that you do not force children into formal and standard methods of recording calculations before they have fully grasped the process and are confident in the methods.

**Individual differences**

Everyone learns at their own pace, and in different ways, although experiences may be common. Adults in the real world bring a wide variety of approaches to their work, often ones they have devised for themselves despite many years in school learning standard methods. This course recognises individual differences and aims to give students the chance to explore the world of mathematics and solve problems in their own way. The course is also designed to provide equal opportunities to all students who may use it, regardless of their gender or ethnic, cultural or linguistic background.
Developing mental strategies

Adults perform many mathematical tasks mentally either because the tasks are simple, or because it is quicker to work things out in the head than use pencil and paper or a calculator. Too much work with paper and pencil can inhibit students from developing the flexibility and range of strategies necessary for efficient mental work.

A central aim in this course is to develop in students the ability to add or subtract numbers mentally, and to use quick recall of multiplication facts. Many of the activities encourage students to move directly from their own strategies with apparatus to working things out in their heads.

Students should be made aware of the role of mental methods as a first resort when a calculation is necessary, and not be led to believe that there is a particular method for a particular type of work, such as vertical presentation for ‘best work’, ‘answers only’ for mental arithmetic, or ‘working out’ only in rough books or on scraps of paper.

This Teacher’s Guide presents many ideas for oral work and suggests alternatives to the standard methods to help promote the development of effective mental methods. All arithmetical problems in this course are presented horizontally to encourage students to choose and use their preferred method.

One of the most significant changes to the Cambridge Primary Mathematics Curriculum Framework for 2012 onwards is the inclusion of a specific set of objectives under the category of Mental Strategies. These objectives aim to ensure that students are encouraged to use number facts and a range of mental strategies to add, subtract, multiply and divide. The idea is that these mental strategies are developed and used across all stages, and that students will continue to use them alongside more formal written methods as appropriate.

Mental calculation is important for both school-level mathematics and daily life, not least because it is often the most effective and simplest way to get an answer. At stage 6 in the primary school, it is usually the most effective method for solving most of the problems that students are faced with. Teaching, and encouraging the use of, mental strategies helps students to realise that numbers are quantities (rather than just seeing them as separate digits). This in turn allows them to take advantage of the particular properties of the actual numbers involved in a problem and to decide which strategy lends itself best to solving it. Mental strategies also allow students to develop a good sense of equivalence in mathematics. At a basic level, this could be simply saying $5 + 6 = 5 + 5 + 1 = 11$, but it forms the basis of algebraic manipulation and the more abstract functions that students will have to deal with at higher levels.

Here are some of the reasons that researchers around the world give to support the idea that mental computation should be included at all stages in school curricula:

- Mental calculations account for more than 80% of the calculations that adults do in daily life
Mental calculation is essential for estimation. This is an important skill because many of the calculations we do in daily life do not require an exact answer. For example, these pies cost $1.90 each, can I buy three with $5? (2 × 3 = 6, so no.) These pies are $1.90 each, I’m buying six and the seller is asking for $15, that can’t be right!

You often need to do some mental calculation before you can use a calculator, and you need to have some idea of how big or small the answer will be to check that you have used a calculator correctly.

When students have a range of mental strategies, they are able to find the easiest way of doing calculations.

Mental strategies rely on basic number relationships and they build on counting work from earlier grades, so they provide an excellent way for students to develop good number sense.

Many of the patterns and relationships that make up the study of mathematics are numerical, but they are too vast and numerous to learn by heart, so it makes sense to develop a concept of how these work, so that you can transfer the skills to solve previously unseen problems in creative ways. To make sense of this, you just have to think about place value and counting. Once students learn the rules for making numbers, they can read and write any number. We would not, for example, teach every single number from 10 000 to 100 000 in a rote way. Instead, we expect the students to apply their knowledge to make, read and write numbers in this range.

In the sections that follow, we will explore what it means to develop mental strategies both in theory and in the classroom. Then we will present a general approach to teaching mental calculation strategies, with some examples to show how this might work. The actual strategies themselves are dealt with in more detail in the Student’s materials and teaching guidance by topic in this Teacher’s Guide.

What are mental strategies?

Essentially mental strategies are the individual methods we use to solve problems ‘in our heads’.

As an example, try to answer this question without doing any pen and paper calculation: how many 45c tickets can you buy with $10?

Once you have an answer, think about what you did to find the answer. Did you think in any of these ways?

- You can buy two 45c tickets with 1 dollar, so you can buy about 20 with $10.
- Ten 45s are 450. 450 and 450 is 900, that’s 20 tickets. You have one dollar left, so you can get two more, 22.
- 45 is almost 50, two 50s are $1, so I can buy about 20.

Very few adults will solve this problem by doing formal long division (1000 divided by 45) in their heads. This illustrates an important point about mental strategies – they do not involve simply visualising formal algorithms.
in your head and solving them without writing them down. Rather, mental strategies are the ways in which we use number facts that we have learnt by heart together with the relationships that exist between numbers and operations in order to solve problems. When you are teaching mental strategies for calculation, it is therefore crucial to focus on the mental processes that students use to get to the correct answer.

Recall of number facts is an important element of mental mathematics because other strategies use and depend on these. At Stage 6, students should know addition and subtraction facts to 20 by heart. They should also know multiplication facts to 100 (2 to 10 times tables). The daily mental mathematics time can be used to consolidate these facts. In general, if a student can give the answer to a known facts such as $9 \times 7$ within 2–3 seconds then you can tell that he or she has memorised and internalised it.

**Implications for classroom practice**

The Nelson International Mathematics series has the key mental strategies for each stage built into the student’s materials. There is additional support included in the Teacher’s Guide in terms of the teaching activities section for each topic as well as the sample daily mental maths activities to allow students to practise and refine their skills. In addition, we offer a series of parent cards that explain the approach and suggest how parents can support it in the home. The provision of these materials makes it easy for teachers to meet the objectives of the revised framework. However, the materials do not stand alone – your classroom methodology and the ways in which you teach, support and encourage students to use mental strategies are of utmost importance in implementing these objectives.

In a classroom where mental strategies are given their due importance, the teacher’s role would include:

- being flexible in recognising and accepting whichever strategies the students use (including allowing them to choose their own strategies as well as to work in different ways).
- using different mental strategies yourself and modelling them for the class so that they can compare them with the ones they are using.
- helping students to think about their own strategies so that they can refine them and work towards more efficient strategies.

These examples demonstrate how the teacher’s behaviour and actions can support or hinder this approach.

A class is given the following subtraction: $73 - 27$.

Note that the problem is given horizontally. This is the first element of a flexible approach because it does not force the students into thinking that they have to do vertical subtraction in columns with carrying.
Here are four students’ workings.

**A**

\[
\begin{align*}
73 - 27 & \quad +3 & \quad +3 \\
76 - 30 & = 46
\end{align*}
\]

**B**

\[
\begin{align*}
73 - 27 & \quad 77 - 27 - 4 \\
50 - 4 & \quad 46
\end{align*}
\]

**C**

\[
\begin{align*}
73 - 27 = 46 & \quad 70 + 3 \\
27 & \quad 43 + 3
\end{align*}
\]

**D**

\[
\begin{align*}
-4 & \quad -3 & \quad -20 \\
46 & \quad 50 & \quad 53 & \quad 73
\end{align*}
\]

All the students have the correct answer but they have found it using different strategies:

- Student A has used a strategy that involved adding the same amount to each number to get numbers that are easy to subtract.
- Student B has added four to the first number to get a number that is easy to subtract from and then subtracted the four again at the end using knowledge of bonds to ten.
- Student C has decomposed the larger number into 70 + 3 and then subtracted the 27 before adding the 3 back.
- Student D has used an empty number line and done the subtraction in parts, subtracting 20 first, then subtracting 3 to bridge to 50 before subtracting the last 4.

The teacher in this classroom has several options, for example:

- He or she can ask the class to put their hands up to give the answer. This focuses on the answer and ignores the processes by which the students worked the answer out. It also makes it difficult for those students who are still trying to work things out, because the quicker students put up their hands and try to get the teacher’s attention, distracting them and making it difficult to think.
- Similarly, the teacher can ignore how these students have worked and do a column subtraction to show the class how to get to the answer.

Both of the above choices are counter-productive as they do not help the students develop confidence and in fact, moving straight to the ‘old fashioned’ algorithms has been shown to undo students’ understandings of place value.

When you value mathematical thinking and reasoning, you must make time to discuss how students got to their answers. This may involve modelling their solutions on the board and having the students verbalise and explain what they did. The students will learn from these explanations and showing them different options allows them to compare their own methods and strategies with those of others and to decide whether to move to a strategy they find more efficient. Modelling solutions and explaining thinking also makes the mathematics visible to students who may not have grasped it.
When you just give students an answer, the mathematical strategies are invisible to them – they cannot see how you worked it out.

Here is the working of a fifth student.

\[73 - 27\]

\[27\]

\[-4\]

\[50\]

\[46\]

This student has subtracted 7 from 3 and automatically used negative numbers (even though this has not been taught to the class at this stage). She then subtracted 50 from 70 before treating the negative number like a subtraction.

The last example is a good one to emphasise the teacher’s role. In many primary classrooms (and in fact in some primary maths textbooks) students are taught ‘you cannot take a larger number away from a smaller number’ because the teacher wants them to borrow from the next place value before subtracting. However, this is an incorrect and very misleading statement (particularly as students will have to deal with integer subtraction at higher stages). The student in the last example is totally comfortable with negative numbers and she does in fact use them correctly. A flexible teacher will share this method with the class and allow them to discuss it without insisting that they use it. If some children say ‘you cannot take 7 from 3’ a flexible teacher will ask them why not, and perhaps use examples such as ‘borrowing’ money or the integer number lines that students have used for temperature to show that in some cases you can. Of course, using a calculator to find 3 – 7 will also show that you can get a negative answer.

**Teaching mental calculation strategies**

The general approach to teaching strategies for mental calculation can be seen as three steps:

1. **Introduce the strategy**
   - Start by writing the multiplication 35 × 40 on the board.
   - Ask the students how they could find the answer.

2. **Reinforce the strategy**
   - Multiply by multiples of ten by rewriting the multiple as 10 × \(n\).
   - **Start by writing the multiplication 35 \times 40 on the board.**
   - **Ask the students how they could find the answer.**

3. **Assess students’ mastery of the strategy**
• If one of the students suggests viewing it as $35 \times 10 \times 4$ ask them to explain the strategy to the class with your help.

• If no one suggests this, model the strategy yourself. Your modelling could include concrete materials (such as place value charts or a diagram showing that $40 = 10 \times 4$). At the demonstration phase, your modelling should include jottings to show the steps in the process.

• Discuss the thinking behind the strategy as you model it. For example, it is quite hard to multiply by 40, but it is easy to multiply by 10 and by 4, so I am going to write 40 as $10 \times 4$. I am going to multiply 35 by 10 first. Do you remember what happens to the digits when we do that? (Prompt class to say that the digits move left and we use 0 as placeholder for units.) Now I have $350 \times 4$. I’m going to work this out by doubling. Double 35 is 70, so double 350 is 700 and double 700 is 1400.

• Next, do some more examples using appropriate numbers to demonstrate the logic of the strategy and discuss when it would be useful (i.e. what numbers would it work with?). If you like, you can show the students examples of when this would not be the most useful strategy. (For example, if the calculation is $\times 50$ it may be faster to multiply by 100 and halve the answer, or if the calculation is $49 \times 40$, it may be better to use compensation strategies and work out $50 \times 40 = 2000$ and then $–49$). Remind the students that the choice of strategy depends on which methods they prefer and which numbers they find easiest to work with.

**Reinforcing the strategy**

The key components for reinforcement are:

• Providing lots of similar examples to practise the strategy in isolation and develop competence in using it. You will find that the Student Book and Workbook provide pages of examples for specific strategies as they are developed.

• Getting students to talk about and explain their thinking and methods as they use them. As they become more confident in using a strategy, they may find shorter and more efficient methods.

• Allow (and in fact encourage) jottings and pen and paper workings as you develop mental methods.

The activities you use to reinforce a strategy should be varied in type and presentation, so that students do not treat it as a rote activity, and structured in ways that encourage maximum participation. You will find suggestions to help you do this in the teaching guidelines section for each topic.

When you introduce a strategy you will need to allow sufficient time for the students to explore it and become comfortable with how it works. As they become more competent in using it, you can reduce the time spent on different activities.

Once most of the class are using the strategy confidently, your role is to help them integrate the strategy with others that they use. One method of doing this is to provide activities that include a mix of calculations, some of which are not suited to the particular strategy. It is often useful to present
a mixed exercise, ask the class to look at the problems and then spend some
time discussing which strategies students think will work best for different
problems. Encourage them to identify the properties of the numbers that
suggested each strategy to them.

Assessing whether students can use the strategy
Assessing mental strategies should take a variety of forms. However, the
main aim of you classroom assessment is to see whether the students can
work efficiently and accurately by choosing an appropriate strategy rather
than to test the use of a particular strategy. So, for example, you may use
‘timed’ tests in which the students compete against themselves to recall
facts and do mental calculations over a set period (such as a test a day for
five days) in order to improve their own time and/or accuracy. You will find
examples of timed tests in the Student’s Workbook.

You can also play games to assess mental computation skills. Games such as
‘beat the calculator’ that the students play in pairs offer an opportunity for
you to observe the students as they work and to record any observations that
you make.

One method of assessing whether the students can recall facts and use
mental strategies is to gauge the time it takes them to respond to a question.
As mentioned earlier, response time for known facts should be 3 seconds or
less. With the other mental strategies, a good response time is 5–10 seconds
(depending on how difficult the problem is). Bear in mind though, that is
a goal to work towards rather than a strict guideline. When students are
beginning to use a strategy, you would allow them as much time as they need
to apply it and answer the problem.

Talking to students in small groups or one-to-one is also important for
assessing their competence, particularly if what they jot down is unclear or
incomplete. Asking questions about how they were thinking will allow you to
see whether they understand the strategy and whether or not they can use it.

Calculators
It is essential that students learn to use a calculator confidently, understand
what the display means and check that the answer is correct. It is likely
that the students in your class are already familiar with mobile phones,
computers and other gadgets. Many of them will already know how to use
numbers in electronic equipment properly. However, you cannot assume that
they have this knowledge; make sure that they develop it through regular
use of calculators in the classroom. We assume that students have easy
access to at least simple calculators.

Activities involving the calculator are integrated into work on numbers,
measures and data. In addition there are many activities in which calculator
use – even if not specifically mentioned – may be appropriate. The calculator
fits into mathematics learning in a number of overlapping ways:

Mental calculations
In many activities, we use the calculator keys after a mental arithmetical
operation in order to arrive at the desired result – for example the display
shows 17.5 and students need to make it 29.8. They will have to work out
that +12.3 is appropriate before entering it on the calculator.
This type of activity encourages estimation and the reversing of operations. Most calculator games in the course are of this type.

**Formation of concepts**
Calculator activities encourage generalisations or abstractions about numbers. For example, you will find that students quickly extend their number range far beyond that prescribed in the syllabus if they use a calculator regularly. Evidence has shown that students understand very large, very small, and negative numbers more thoroughly at a younger age through the availability of calculators.

**Translation**
Translating between concrete experiences and their symbolic representation proves extremely difficult for many students. The calculator provides one way of becoming more fluent in this translation, as students can replicate concrete operations through the symbols on the keyboard and display, and check that the answer matches.

**Checking**
The calculator can be used to check the results of computation attempted mentally or on paper. This should encourage mental estimation. It may be worth considering that the calculator could be used in the first instance, and mental and/or written methods used to check.

**Arithmetical or algebraic logic**
School calculators commonly use ‘arithmetical logic’. This means that they perform number operations in the sequence in which they are entered, without regard to the conventions of algebraic logic, where multiplication and division take precedence over addition and subtraction.

A student entering:

\[ 3 + 4 \times 5 - 2 \]

into an arithmetical calculator will arrive at the answer 33, whereas an algebraic calculator would calculate the multiplication first. For example:

\[ 3 + (4 \times 5) - 2 \]
\[ = 3 + 20 - 2 \]
\[ = 21 \]

The algebraic calculator accepts all the entries but does not organise and process the information until the \[ \text{[=]} \] is pressed. The arithmetical calculator, on the other hand, gives a subtotal each time an operation sign is pressed. This difference is significant, especially when dealing with functions and number chains. If students are using arithmetical calculators and the hierarchy of the operations is important, they will need to use brackets and understand the precedence of the multiplication and division signs over addition and subtraction signs.

**Computers**
The use of a computer can support students’ learning of mathematics in a variety of ways. Obviously, your use of computers will depend on the resources available at your school. However, it is useful to know about the
range of technologies available, as it is likely that your school will become increasingly well resourced as time goes on.

- **CD-Roms** are disks that contain electronic files with plenty of reference information. They may include an array of printable materials such as worksheets and practice sheets, tests, resources such as graph paper, maps, and so on.

- **Games** enable students to apply their mathematical skills through fun, interactive activities. Many educational games are designed to develop specific skills. If you have these available at your school, try to build in the use of games regularly each week. Find games that reinforce the specific areas of mathematics in which your students need regular practice. If there are specific games your class is particularly keen to spend a lot of time playing, you may want to use game time as a reward for completing classwork or homework.

- **The Internet** is a rich resource for teaching suggestions as well as a source of much reference material. Keep a list of maths teaching websites that you use regularly. If you find articles of particular interest, download and print them, and add them to your resource files.

The BEAM mathematics project website. (www.beam.co.uk) offers a full list of all their teaching support resources as well as a range of free resources (click on the ‘free resources’ tag). The free resources include downloadable worksheets for classroom or extension use and discussion papers and articles related to developments in primary mathematics to support professional development of maths teachers.

You can also find a wide variety of materials to support your planning, teaching and assessment of Cambridge Primary Mathematics on www.cie.org.uk.

There are interesting articles, research and activities on the Plus Magazine website of the University of Cambridge. (http://plus.maths.org).

**Exploring and investigating**

Primary mathematics has traditionally tended almost exclusively towards short, directed tasks which result in ‘right’ or ‘wrong’ answers. The activities in this course provide a balance between short, fairly self-contained activities and open-ended investigations that can be returned to and developed over a long period of time.

Most of the activities are designed to develop students’ awareness of the range of mathematical possibilities open to them when tackling a mathematical task. As much as possible, allow students to take control, make decisions and explore the many avenues that can arise from a simple starting point.

Even ‘dead ends’ and ‘mistakes’ provide valuable experiences, stimulating further questioning and exploration. A student freely investigating with a calculator, pressing a few ‘wrong’ keys, for example, is likely to have a better ‘feel’ for, and interest in, our number system than the student who is only allowed to use the calculator for checking the answers to ‘sums’.
Students should always be encouraged to ask ‘What if?’ and ‘Why?’ when investigating. These questions may lead to uncharted territory, new challenges, fresh understanding and the development of new skills.

Many investigations have no final solution or easily accessible generalisation for the students. Some have a simple pattern or rule which may be discovered and explained. However, many students will want to know why certain patterns repeat, and offer explanations about the rules which govern them. This is the first step towards generalisation, and teachers can encourage this by asking questions such as: ‘Why is the same number added each time?’ or ‘Can you guess what will happen next?’

The value in investigations lies in students pursuing them to the limits of their ability, and in the new skills that are acquired on the way. For some students, the early, often concrete, experimentation is enough to give them confidence, and increase their enjoyment of using already acquired skills.

There are many different ways of recording investigative work. Students should initially be allowed to explore and note their discoveries freely. Teachers may wish to intervene periodically to help them organise the results so that emerging patterns are identified and interpreted.

Sources of investigation

Many everyday objects can provide rich sources of investigative work. The hundred square, addition square and multiplication square all contain many fascinating patterns. Students can also explore patterns in solid and flat shapes, such as the relationships between faces, edges and vertices of 3D shapes, and the relationships between sides, corners and angles of 2D shapes.

Use investigations to enrich the introduction of new concepts. For example, you can introduce number patterns through developing number chains and introduce geometric patterns through explorations of colour arrangements on geo-boards. Students can explore the relationship between area and perimeter, and between volume and the dimensions of cuboids.

As they develop an investigative approach, help students to become systematic in the way they work. This will help them to understand the structure and formal approaches of mathematical theory.

Mathematics in real life

Some students may struggle to understand the relevance of mathematics in their everyday lives. This course places great emphasis on making students aware of the relevance of mathematics to their own real lives.

In this Teacher’s Guide, you will find ideas for using the student’s own environment as a stimulus for mathematical activities. The Student Book and Workbook frequently require students to look at the mathematics in the classroom, the playground and their own homes. Each set of activities and problems requires new skills and fresh understanding. Many questions are open-ended or have no exact solution, and students are asked to make predictions, generalisations and estimates, and to evaluate their own answers. Encourage this skill in all areas of the curriculum.
Students use their understanding of mathematics at home and at school, in situations such as sorting toys or books, working out the times of television programmes, making patterns, helping to prepare food and playing board or card games.

**In school**

In school, there are many opportunities for you to teach mathematics through familiar situations, so that the students experience its usefulness and appreciate the order and sense that mathematics gives to life. For example, students can identify the date each day, as well as the time at various points throughout the lesson. Registration, dinner money, timetables, sorting and putting away equipment will provide a range of relevant experience in data work, measures and shape and space as well as number.

**Play**

Students of all ages should have opportunities to play both in and out of school. This offers them the freedom to explore new situations, to make discoveries for themselves and to be creative. Unfamiliar mathematics equipment should be introduced through play, with the students exploring the functions and possibilities inherent in the materials. A good example of this is to experiment with pairs of compasses by drawing patterns and pictures before using them as mathematical instruments.

Construction kits offer students the opportunity to explore shapes and inverse operations, through building and dismantling.

**At home**

Part of the teacher’s role is to involve parents and guardians in the students’ learning. Parents need not be limited to supervising their children’s homework. There are many activities that can involve the parent actively in the child’s learning, and that can provoke mathematical discussion and language at home.

Parents can be encouraged to extend their children’s mathematical understanding through playing board and card games and by encouraging them to help with normal home activities such as cooking, gardening, cleaning and organising the home, drawing up plans and measuring when redecorating, and estimating how many or how much when shopping.

The Nelson International Mathematics scheme offers a set of parent cards that explain the approach taken in the series and suggest how parents can support it in the home. You can guide parents to these online resources, or you may like to print these out and send them home with the students.

Many of the students will also voluntarily help and encourage younger brothers and sisters in games and getting organised.

Family visits and holidays give students the opportunity to see environments different from their own, and to experience time and distance.
They are also likely to be budgeting pocket money, saving for special things and predicting how long it will take them to afford treats.

Students may have computer games that require them to use a variety of mathematical skills. They are likely to see and use a wide range of electronic equipment at home, which demands mathematical skills to be used properly.

Many students will also be responsible for their own timekeeping and have a degree of responsibility for others.

Some homes will not actively encourage girls to use construction kits, computers or calculators, and some parents will not be confident of their own mathematical skills or understanding. As a teacher, you can help a great deal by making explicit the mathematical content of everyday experiences and activities.

This book contains many suggestions for investigations, problems and research that students and parents can work on at home. Games made from suggestions in the scheme could become the core of a ‘lending library’ of games for students to take home for a period of time, to play with parents, or brothers and sisters. This would not only link home and school but also give parents and teachers a basis for discussion.

**Organisation**

**The classroom**

Each teacher will have preferences about how best to organise the available space. However, here are some useful guidelines for any classroom, irrespective of how it is arranged.

**Storage**

Always store equipment in such a way that students have easy access to it and can check it periodically. Clearly label all items and encourage students to make their own decisions about what they need.

**A mathematics centre**

This may or may not be where the equipment is stored, but it will be a part of the classroom that is bright and attractive with displays of students’ work and other mathematical stimuli. The centre is a place for students to go at odd moments in the day, to be challenged with mathematics-related questions and activities.

Questions and activities should be provided by both teachers and students for interactive problem solving, for example: ‘The answer is 15.2. What was the question?’, inviting students to write out their suggestions. A number pattern or sequence, on a series of cards organised by the students, may be ‘secretly’ altered by the teacher, and the students have to discover what has changed, and put it right.

The BEAM organisation offers a wide range of primary mathematics resources including manipulatives (place value cards, large dice, dominoes, fraction grids and spinners), games and online resources that are a useful and enriching addition to any classroom mathematics centre. You can see the full range of BEAM products on their website www.beam.co.uk or you can request a catalogue from your local Nelson Thornes representative.
The students

Class teaching
At times it is efficient to work with the class as a whole, perhaps when introducing a new topic. The course offers plenty of ideas for this kind of approach. The planned work needs to be suitable for all students, with individual needs and ability taken into account in subsequent group or individual follow-up activities.

Group work
You can group students in similar or mixed-ability groups, to suit the purpose of the work. This offers students the opportunity to collaborate, to discuss their work with each other and the teacher, for peer teaching to take place and for the work to be matched to their needs. It enables the teacher to work simultaneously with a number of students and this minimises the need for repeated explanations to individuals. Group teaching is an effective form of classroom organisation for both teacher and students.

Working individually or in pairs
At times it may be appropriate for students to work as individuals or in pairs, to provide extra help to students who need it, or to stimulate and challenge the higher-attaining students. Working individually gives students the opportunity to concentrate on their own thinking, to develop this through investigations and problem solving, to work quietly and in private, and to experiment with materials. Students working in pairs have the opportunity to develop collaborative skills, to play games together and to share ideas in an investigation.

Assessment and record keeping
A significant part of a primary school teacher’s day is spent on the informal evaluation of a student’s or group’s learning, and in deciding what the next learning experiences should be.

Assessment can be both formal and informal, and can serve a number of functions. Ongoing observations and discussions with students can give teachers valuable diagnostic and formative information on which to base their teaching. Students’ written and practical work can yield valuable insight into the current stage of their conceptual development and the extent to which they are developing effective skills.

Ideally, assessment should take place throughout the year and its goal should be to support students as they learn and develop their mathematical skills. For this to happen, students need to be actively involved in both their own learning and their assessment. This means that they should understand how they are going to be assessed and how their success will be measured; they need to begin to evaluate themselves, to set targets for themselves and to reflect on their own learning, so that they become more and more self-confident in mathematics.

For assessment to support the development of learning, assessment styles must be varied and relevant to the students. The programme of assessment should present opportunities for students to talk about and demonstrate what they have learned (through oral work, worksheets, exercises, tasks, projects, tests and other activities).
**Facilitating assessment**

- Give students a variety of tasks that require them to apply different skills – for example, writing tasks, using concrete apparatus or working with money. In this way students are able to show what they know in different and exciting ways.
- Think about the most appropriate way to assess a task or activity and identify the skill that you need to assess. This will help you to decide what assessment technique is most suitable at any time.
- Develop your own observation sheets to use as students work through the activities in a topic and use this to observe and assess skills and learning.
- Watch, observe and ask students questions as they work through topics, rather than only assessing the final product. This will allow you to see where they have difficulty and to address problems that may impact on understanding.
- Use a range of different contexts for assessment (individual, peer, group, oral, written) and keep clear and well-organised records of your observations and any marks you allocate. This is not only useful for your own purposes, but is also equips you to report back to parents about their child’s progress.

**Formal testing**

From Level 3 onwards, you may want to include testing as part of the learning process. Some schools will opt for outside tests from different curriculum providers, but it is useful to introduce the idea of mental and written testing as these will be used as the students progress through school.

In this course, we provide assessment suggestions for different activities and topics in the Teacher’s Guide. Cambridge Primary provides end of stage tests, called Progression Tests, for Stages 3–6. The tests are designed to allow measurement of students’ progress and identification of their strengths and weaknesses.

To help teachers prepare students for the Cambridge Progression Tests, we have provided a set of tests in the same style and format as questions in the Progression Tests.

Seven tests are provided for this stage. Tests 1–6 are intended to consolidate work as students progress through the stage. The relationship between these tests and the chapters is as follows:

- Test 1: Chapters 1–4
- Test 2: Chapters 5–8
- Test 3: Chapters 9–12
- Test 4: Chapters 13–16
- Test 5: Chapters 17–20
- Test 6: Chapters 21–24

The final test, ‘Stage 5 Practice Test’, covers the entire Stage 5 curriculum and is intended for use as a practice for the Cambridge Progression Test.
Mental maths activities bank

You should aim to do a mental maths activity that takes about ten minutes each day.

This section contains some examples that you can use as is, or adapt to suit your own classroom. We have tried to provide a range of different types of activities (factual recall, games, grids, tables, problem solving and puzzles) to show some of the ways in which you can approach the mental maths part of the lesson. However, this is not a definitive list and some activities will appeal more to some classes and teachers than others. If you need additional ideas and suggestions, there are several useful websites for teachers which give ideas and resources. Type ‘mental maths warm-ups’ into your search engine and you will be directed to a range of sites covering this topic. One very useful site is www.transum.org which offers a range of maths activities including a ‘starter of the day’ many of which can be used with electronic whiteboards or screen projectors attached to the computer.

As you read through the activities remember:

- Most of these activities can be repeated by simply using different values. Many of them can also be adapted to make them simpler or more difficult.
- Many of these activities can be done with no resources. However, some require you to prepare grids and/or game boards or to supply students with apparatus such as dice or cards. We suggest that you keep the materials you develop and use them to build up a mental maths resource bank of your own. For example, when you prepare grids or tables with missing values, or magic squares with a wrong number, do this on card and if possible, laminate the card so that it can be re-used. Lamination also means that students can use dry-wipe markers on the cards and these can be cleaned easily. Another option is to prepare apparatus on computer and to print these out onto overhead transparency sheets. These can be stuck onto white card to make a re-usable resource that can be wiped clean.

To make it easier for you to select activities to match what you are doing and that meet your students’ needs at different times, we have organised them into six sections:
1. Place value and number sense
2. Rounding and estimating
3. Mental problem solving
4. Calculation skills
5. Calendars and time
6. Shape, space and measures
1. **Place value and number sense**

Do lots of activities in which the students have to count in given steps. Vary these according to what you are doing in class and the number range that the students are working in. For example:

- Count from 9999 to 10 020
- Count aback from 25 000 to 44 980
- Count in tens from 1150 to 1300
- Count back in tens from 15 000 to 14 500

Ask questions based on counting back and forwards using a number line marked from 0 to 10 000 in intervals of 500 (0, 500, 1000, 1500, etc). Some possible questions are:

- What is 100 more than 6000?
- What is 100 less than 1500?
- What is 100 less than 10 000?
- What is 100 more than 3500?
- What is 100 more than 4900?

Tell the students to listen carefully as you say some numbers and then write them down. For example, you may read out a set of numbers such as:

- twenty two thousand, four hundred and thirty-five
- forty one thousand, nine hundred and three
- ten thousand and ninety-nine
- sixty three thousand and seven
- five thousand, seven hundred

Read out some numbers and ask the students to jot down the value of one particular digit. For example, what is the value of 3 in each of these numbers.

- 43 516
- 1366
- 1493
- 23 678
- 44 213
- 32 908

(When you do this kind of activity, make a list of numbers in advance to make sure the numbers you use only have one digit with the value you are looking for!)

Let the students work in pairs to play the ‘10 questions’ game. Ask the students to each write down a number without showing their partner (you can select the range for example, any number less than 5000). The students then try to guess what number their partner has written down by asking questions that can only be answered by yes or no. For example, Is it odd? Does it have three digits? Are there more units than tens? And so on. Once the students have asked 10 questions they should try to guess the number.
If they can’t, their partner can give them a clue and allow them to ask two more questions before guessing again. For example, My number is between 300 and 350. It has no tens.

Write any five- or six-digit number on the board. For example: 302 645

- Ask students to say the number aloud
- Ask different students to say how many hundred thousands, ten thousands, tens, units etc there are
- Point to a digit and ask students to say its value
- Ask students to reverse the digits and say the number
- Let students make five different numbers using digits from the given number in any order
- Let them exchange these and say each other’s numbers aloud
- Repeat the place value questions using numbers the students have made

Write a selection of five- and/or six digit numbers on cards. If you make numbers with similar digits, it makes the activity a little more demanding. Display the number cards randomly on the board. For example:

- Say numbers aloud in words and ask students to come and identify the number you said. For example thirty two thousand four hundred and fifty-six.
- Let the students reverse the digits and say the numbers aloud. (If you are going to do this, be clear about what they should do with a 0 in the units place or do not use any numbers with 0 in the units place.)

Place the students in groups of two. Give them instructions such as:

- count forwards in thousands from 40 000 to 50 000
- count forwards in tens from 15 890 to 16 020
- count backwards in hundreds from 6300 to 5200

Give groups of students a set of up to six mixed digits (on cards). Instruct the groups to make:

- the smallest possible number
- the largest possible number
- the smallest possible odd/even number
- the largest possible odd/even number
Ask the students to write down any 3-digit number. Write a random set of three digit numbers on the board.

- Let the students make number sentences using your numbers and the number they have written down using the <, > or = signs.
- Let the students use mental strategies and jottings to find the difference between the numbers in their number sentences. Spend some time talking about the strategies they suggest.

Ask the students to write a five- or six-digit number on paper. Choose one student to come to the front of the class and display their number. Ask, whose numbers are greater than this? Let the students display their numbers. Repeat for smaller than. Choose one student at random. Let her or him come up and stand to the left or right of the other one (depending on whether their number is smaller or greater) displaying their number. Choose other students who should come up and position themselves appropriately between the numbers already on display.

Write a list of positive and negative temperatures on the board. For example:

12  -3  0  -5  -4  9  5  -7  -1  1  -9

- Draw a blank number line on the board to represent a thermometer with the start and finish marked only.
- Ask the students to find the lowest temperature. Write this on the left-hand side of the scale. Repeat for the highest temperature, writing it on the right-hand side of the scale.
- Ask students to volunteer to come up to the board. Let them choose one of the temperatures and have them position it on the scale as accurately as they can. Once all the numbers have been placed, discuss whether there are any inaccurate placements. Let the students decide and suggest how to move the numbers if necessary. This activity can be adapted to work with decimals, fractions, mixed numbers and whole numbers.

Give the students some possible digits for each place value and ask them to work out how many numbers are possible with a given number of digits. For example:

- The hundreds place can have: 2, 3, 4 or 5
- The tens place can have: 1, 2, 3, 4, 5 or 6
- The units place can have: 0, 1, 2, 3
- How many three-digit number can you make?

Prepare a set of 40 cards with the digits 0 – 9 repeated four times. (If your classes are larger than 36, you will need more cards.) Shuffle these and deal 6 cards at random to small groups of students. Give the students a task to make (using all the cards):

- the biggest possible number
- the smallest possible number
- the number as close as possible to 999 999
- a number less than 500 000
You can vary the task by changing the instructions and changing the number of digits. (For example, make the largest possible three-digit number.)

Write several four-digit numbers on the board. Round each to the nearest 10, 100 or 1000 (choose one place value to round to per activity). Make sure some of the rounded values are incorrect. For example:

(rounding to the nearest 100)
2345 → 2300
2662 → 2660
4129 → 4200
3888 → 4000
3999 → 4000

Ask the students to find the incorrectly rounded numbers and to correct them. Repeat this using different numbers and rounding to different places.

Give the students a set of number cards with the digits from 0 – 9. They should draw two at random and write them as a fraction with a denominator of 100. Repeat this five or six times. They then complete a table like this one for each fraction they made.

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Decimal</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. 60/100</td>
<td>0.6</td>
<td>60%</td>
</tr>
</tbody>
</table>

2. **Rounding and estimating**

To practise and reinforce rounding off mentally, draw a grid like this one on the board. If you are going to reinforce rounding to the nearest ten, make sure the numbers all have a value other than 0 in the units place.

| 456 | 1275 | 499 | 109 |
| 3245 | 6501 | 1295 | 1082 |
| 3509 | 8024 | 8019 | 876 |
| 103 | 562 | 901 | 1052 |

You can ask students to copy the grid, and have them rewrite the numbers, rounding them to a given place value as they go (for example, the nearest 10, the nearest 100). Alternatively, you can tell the class that you are going to round these numbers to the nearest ten. Then work through the grid, pointing at the numbers and asking different student to give the rounded number. Repeat this for different place values.

If you have some way of displaying a large picture in the classroom, it is useful to show a photograph of a number of items (for example a tray of beans, stitches in a knitted jersey or bees on a hive) and ask the students to estimate how many there are. Let them explain how they got to their answer.
Write a set of six numbers on the board. For example, a set of three- and four-digit numbers like these:

593  3199  5804  7083  908  427

Let the class estimate to find which two numbers should be added to get the total closest to a given number. For example, which two should we add to get the total closest to 10 000?

You can easily adapt this activity to deal with subtraction.

Let the students work in pairs. Ask them to choose any five digits and write them down. (You can vary this by stipulating digits can or cannot be repeated). Tell students to check that their partner has written down five digits before you give the target number to prevent them cheating. Write a target five-digit number on the board. For example 40 000. Let the students arrange the digits they have chosen to make the number closest in value to 40 000. Let them compare numbers and decide whose is closest. Play a few times using different target numbers.

Play a calculator game in which the students work in pairs. One student should enter a 4, 5, or 6 digit number. The other should try to wipe-out the digit in a given place value without changing any other digits. You instruct them, for example, to wipe out the hundred. If the number is 345 234, the student needs to know to subtract 200 to do this. Repeat, with the other student choosing the number.

Use number lines and/or measuring tapes/scales to practise rounding decimals and measurements to the nearest whole number. Display the number line so that it is visible to all the students. For example:

Then ask questions such as:

• is 23.6 closer to 23 or 24?
• is 33.5 closer to 33 or 34?
• Which whole number is closer to 29.25 – 29 or 30?
• Pete’s little brother weighs 22 kilograms to the nearest kilogram. Is it possible for his brother’s actual mass to be: 22.3 kg? 22.19 kg? 22.9 kg, 22.54 kg, 23.01 kg?

All questions can be adapted to different values and different measurements.

Ask two students to each pick a digit-card (1 – 9). Let them combine these to make two decimal fractions. For example, they pick 2 and 7 and make 2.7 and 7.2. Let the class round each decimal fraction to the nearest whole number.

### 3. Mental problem solving

Write the number sequence 3, 6, 12 … on the board. Ask the students to silently decide what the next two numbers in the sequence should be.

Write 3, 6, 12, 24, 48 and 3, 6, 12, 21, 33 on the board.

Ask the students to say which solution they think is correct and why.

If they don’t say that both are possible, then tell them that they are and ask them to work out how the students got their answers (doubling for sequence 1 and adding consecutive multiples of 3 for the second one). Give the students a few more similar examples to complete. Ask them to find two ways to complete each one.

For example: 30, 60, 120 …

4, 8, 16 …

5, 10, 20 …

Play a game with periods of time. Write a time period on the board. For example, 16 days. Then ask the students to estimate and write down how many weeks this is. Repeat this for different units. For example 4 weeks – how many days, 8 months, approximately how many weeks?

Draw a series of grids like this one on the board to reinforce and practise addition and subtraction.

<table>
<thead>
<tr>
<th>47</th>
<th>19</th>
<th>23</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>15</td>
<td>44</td>
</tr>
<tr>
<td>50</td>
<td>27</td>
<td>31</td>
</tr>
</tbody>
</table>

Move a pointer across the grid and ask the students to work out what operation was required to get from the starting value to the end value. You can jump vertically, horizontally or diagonally and move one or two places. For example:

From 47 one down to 10: answer minus 37

From 47 across diagonally to 31: answer minus 16
You can use this as a game in which the students work in pairs to move on a
grid and answer each other. They can use a calculator to check the answers.
You can make this activity more difficult by increasing the size of the grid
and extending the number range.

Display the traditional rhyme ‘As I was going to St Ives’

_As I was going to St Ives_
_I met a man with seven wives_
_Every wife had seven sacks_
_Every sack had seven cats_
_Every cat had seven kittens_
_Kittens, cats, sacks, wives_

_How many were going to St Ives?_

Let the students work out the total number of kittens, sacks, cats and
wives. Ask them to explain how they worked it out. Change the activity by
changing the numbers. For example, I met a man with twenty wives ...

Play number combination games involving more than one operation.
For example:
- Use each digit 1, 3, 4, 6 and 9 once only to make a calculation that gives
  3280.

To find digits that work, do a calculation yourself. \(91 \times 36 + 4 = 3280\). Then
write them in size order for the students.

Make a letter-number code in which you give the letters of the alphabet a
numerical value. This can be simple, such as \(A = 1\), \(B = 2\), \(C = 3\) and so
on till \(Z = 26\). Ask students questions such as:
- What is the value of your first name in this code?
- What is the value of your family name?
- Can you find a word that is worth \(50\)?
- Can you find a word that is worth more than \(75\)?
- Can you make a word worth at least \(200\)?

Logic puzzles such as the following are fun for students and involve a fair
amount of mental calculation to solve.
- I have a 7 L and a 5 L container. How can I use these to accurately
  measure 2 L of water? (Answer Fill the 7, pour it into the 5 leaving 2.
  Empty out the 5. Pour the two from the 7 into the 5. Fill the 7. Pour from
  the 7 to fill the 5. This will use 3 L and leave 4 L in the 7 L container.)
- How can you measure 1 litre with a 3 L and a 5 L container?
Ask the students to work out how many ways there are to make a dollar using any combination of 1c, 2c, 5c, 10c, 25c and 50c coins? This activity encourages students to work systematically and to use jottings to keep track of their thinking. The most successful students will start either with the largest coins or the smallest like this:

50 + 50
50 + 25 + 25
50 + 25 + 10 + 10 + 5
50 + 25 + 10 + 5 + 5 + 5

You can make this problem easier by limiting the coin combinations.

Test understanding of mathematical terms and vocabulary by posing worded problems to be solved mentally. For example:

- Find the number that can be increased by 3 to make 21
- What is the product of 4 and a number 5 greater than 4?
- What is the square of the difference between 16 and 7?
- What number do you get if halve the product of 9.8 and 100?
- What is the sum of 345 and double 90?

4. Calculation skills

Draw an empty 2 × 6 grid on the board. Get the students to copy it into their books.

Fill in the number from 1 – 12 on the grid in random order. For example:

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1</td>
<td>10</td>
<td>11</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>9</td>
<td>7</td>
<td>3</td>
<td>12</td>
</tr>
</tbody>
</table>

Give the students a multiplier (for example × 7 which suits work on converting weeks to days). They then fill in the product of multiplying each number on your grid by 7.

Use number grids like these to practise mental addition and subtraction. The operations are given across and down. Students can work in any order to fill in the missing values.
For subtraction, make sure you start with a large enough value to avoid negative numbers at too early a stage.

You may like to make a variety of these grids on laminated cards (one per side) and hand these out to students in random order for mental practise. Remember you can adapt them to work with decimal values as well.

Give one student a number, for example 7 and ask him or her to double it. Point to students at random and see how far you can get with doubling the number. To change it, add or subtract a value to get a different value. For example, once the students get to 448, say something like: next student, subtract 8. Now halve the values. Remember, halving is more difficult as the students will get to fractional values as soon as they have to halve an odd number. When this happens you can change the pattern by getting them to add a value such as 9½.

Play target number games. Give the class a number. This is the target number. Either let different students suggest different ways of getting to this number using whichever operations they like, or ask everyone to find ten different ways of getting to the number. For example, the target number is 86. Students could make the target by 80 + 6, 90 – 4, 8.6 × 10, 860/10 and so on. To make the game more challenging you can give instructions for operations. For example, make the target by adding three numbers. Make the target by doubling a number and then subtracting and so on.

Play a timed time-table game using whole numbers or decimals. Give the students the first five multiplications to establish the pattern. For example:

1 × 2.5
2 × 2.5
3 × 2.5
4 × 2.5

Ask them to write the answers and to continue with the table to see how far they can get in a given time.

Ask the students to find the sum of all the numbers from 1 to 10, 25, 50 and so on. This will encourage them to add quickly, but also to jot down reminder totals as they go.

Provide incomplete multiplication tables such as these and ask the students to find the missing values. This requires them to think strategically and to use inverse operations to find the missing values.
You can generate many of these tables yourself, but remember you need at least one horizontal and vertical multiplier and at least four values for the students to find the missing values. You can extend these to a higher number range as the students become more competent at multiplication.

Provide a sheet of operations that form equivalent pairs with one odd one out. These could be equivalent fractions, decimal fractions paired with mixed numbers or percentages of amounts. Ask the students to find the odd one out and to explain how they decided this was the odd one out. Here is a short example using fractions of amounts:

<table>
<thead>
<tr>
<th>(\frac{3}{10}) of 100</th>
<th>(\frac{9}{10}) of 20</th>
<th>10% of 90</th>
</tr>
</thead>
<tbody>
<tr>
<td>80% of 80</td>
<td>50% of 27</td>
<td>25% of 256</td>
</tr>
<tr>
<td>(\frac{25}{100}) of 72</td>
<td>(\frac{1}{2}) of 150</td>
<td>(\frac{1}{2}) of 60</td>
</tr>
</tbody>
</table>

Make a set of cards with the digits 1 to 7 written on them. Display these on the board. Draw a grid like this one on the board.

Ask the students to find ways of organising the digits so that the totals along any line (horizontal, vertical and diagonal) are the same. Encourage them to explain how they thought this out.
Make a set of cards with the digits 1 to 6 written on them. Draw a grid like this on the board.

```
  |   |   |
---|---|---|
  |   |   |
```

Ask the students to find ways of organising the digits so the sum of the vertical digits (the column) is equal to the sum of the horizontal ones (the row).

You can make this more difficult by changing the instructions. For example:

- Arrange the digits so the sum of the horizontal row is 2 greater than the sum of the vertical column
- Arrange the digits so the sum of the column is double the sum of the row

Give each pair of students a dice or a spinner with single digit numbers on it. Let them take turns to roll the dice and multiply the value they roll by 19, 21 or 25. They should take turns to roll 5 numbers and record their answers. Let them add up the products for the 5 calculations at the end to see who got the highest score. Work out the difference between the scores mentally too.

Play ‘minus the money’ in pairs. Each student starts with an amount of $10. They take turns to roll a dice and multiply the result by 10 (or any number you choose to reinforce). They must subtract that many cents from their total. They continue to play till one player has no money left.

Prepare a series of magic squares with one incorrect value. Ask the students to find the incorrect number and explain how they decided it was incorrect. They should also suggest what the correct value is.

<table>
<thead>
<tr>
<th>28</th>
<th>35</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>31</td>
<td>29</td>
</tr>
<tr>
<td>32</td>
<td>26</td>
<td>34</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>71</th>
<th>73</th>
<th>69</th>
</tr>
</thead>
<tbody>
<tr>
<td>66</td>
<td>68</td>
<td>70</td>
</tr>
<tr>
<td>67</td>
<td>72</td>
<td>65</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>93</th>
<th>92</th>
<th>97</th>
</tr>
</thead>
<tbody>
<tr>
<td>98</td>
<td>94</td>
<td>89</td>
</tr>
<tr>
<td>91</td>
<td>96</td>
<td>95</td>
</tr>
</tbody>
</table>

The highlighted number is the incorrect one, this is for your information only.

Number puzzles such as the examples here are massively useful for mental calculation.

Arrange the digits from 1 to 6 so that the sum on each line is equal.
Arrange the digits 1 to 9 so that the sum of each line is equal.

Arrange the digits 1 to 7 so that the sum on each line is equal.

Use all the digits from 1 to 7 once each only to make a sum that adds up to 100.

Check that students can apply knowledge of multiples, factors and divisibility rules using a simple activity like this one. Write a starting number on the board. For example, 64. Ask the students to jot down as many multiplications as possible to make this number. Repeat for other starting numbers including some prime numbers. You can also use decimal values once the students have had some practice in working with them.

Prepare a multiplication square. Point to an empty square and have different students give the product. For example:
Repeat this several times over a period of time, changing the values to reinforce multiplication facts and their translation to decimal values. Repeat for division as well.

Play games where students have to get three or four in a row (a variety of noughts and crosses) using the ideas of equivalence between fractions, decimals and percentages. Let the students play in pairs. Give each pair a prepared grid with suitable families of fractions on it. For example:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Repeat this several times over a period of time, changing the values to reinforce multiplication facts and their translation to decimal values. Repeat for division as well.

Play games where students have to get three or four in a row (a variety of noughts and crosses) using the ideas of equivalence between fractions, decimals and percentages. Let the students play in pairs. Give each pair a prepared grid with suitable families of fractions on it. For example:

\[
\begin{array}{|c|c|c|c|}
\hline
\frac{1}{10} & 20\% & \frac{1}{2} & \frac{45}{100} \\
\hline
\frac{6}{100} & 30\% & \frac{4}{100} & 16\% \\
\hline
\frac{9}{100} & \frac{8}{10} & \frac{3}{5} & \frac{4}{10} \\
\hline
45\% & 80\% & \frac{55}{100} & \frac{28}{100} \\
\hline
\end{array}
\]

To play, the students take turns to claim squares by offering an equivalent fraction (or decimal or percentage). To re-use the boards, let them place counters on the squares they claim. The aim is to make a row of three (or four) and at the same time to prevent your partner from making a row or three (or four).

5. **Calendars and time**

The patterns on calendars provide many opportunities for mental skip counting and pattern work. Use the fact that the dates each month on a calendar offer a number of sequences. In a row, the difference is easy, because the dates count up in ones. The columns offer numbers with a difference of 7 and on diagonals, the difference is either 6 or 8. The sum of 3 consecutive numbers will be 3 times the first number + 3 times the difference between them. Provide a blank calendar for a month with some dates filled in and let the students work on the missing ones (and only those). For example, fill in the 1st and then let the students work out the dates going diagonally.

Prepare a table like this one for display in the classroom:
<table>
<thead>
<tr>
<th>$\frac{1}{2}$ hour earlier</th>
<th>Time</th>
<th>15 minutes later</th>
<th>$\frac{3}{4}$ hour later</th>
<th>24-hour time</th>
<th>Time in place that is 4 hours ahead of us</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.15 pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.30 am</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Half past five in the afternoon</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 to 6 in the morning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 past 9 at night</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Midnight</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Point to different blocks on the table and let different students give the missing values.

6. **Shape, space and measures**

Use a variety of solid objects (a few boxes, a can and ball) to build a small tower in the classroom. Give the students questions to answer. For example:

How many faces are there altogether in this structure? How did you work this out?

How many corners (vertices) are there? How did you work this out?

Prepare an overhead transparency with a set of angles on it. Give the size of each angle in degrees and ask the students which angles can be put together to fit onto a straight line. The example below is an easy one as it only uses multiples of five and ten. To make it more difficult, include combinations such as $124 + 56$ or $38 + 142$. Jumble the angles so the students have to think about how to combine them to make 180.
Play a missing angle game. Explain that you know 1 angles on a line and ask the students to find the size of the other one. (In other words, the value needed to make the sum total 180). For example:

90 + []
50 + []
34 + []

Practise converting measures as well as multiplying and dividing by multiples of ten using tables like these ones. Prepare a variety of different tables and hand them out at random for students to complete.

<table>
<thead>
<tr>
<th></th>
<th>→ × 10</th>
<th>← ÷ 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>40</td>
</tr>
</tbody>
</table>

Draw several different types of triangles (acute and obtuse angled scalene, right angled scalene, acute and obtuse angled isosceles, equilateral) on the board and give their perimeter in different units. First identify the type of triangle and then let the students work out possible dimensions for the sides. To do this they need to calculate but also to apply the properties of the different triangles.
1 Place value and number operations

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Student Book pp 5–15</th>
<th>Workbook pp 4–12</th>
</tr>
</thead>
<tbody>
<tr>
<td>5Nn2 Know what each digit represents in five- and six-digit numbers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5Nn3 Partition any number up to one million into thousands, hundreds, tens and units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5Nn6 Round four-digit numbers to the nearest 10, 100 or 1000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5Nn8 Order and compare numbers up to a million using the &gt; and &lt; signs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5Nc18 Find the total for more than three two- or three-digit number using a written method</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5Nc27 Begin to use brackets to order operations and understand the relationship between the four operations and how the laws of arithmetic apply to multiplication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Various problem-solving activities are also included in this chapter</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Vocabulary

Add, subtract, total, greater than, less than, inverse, place value, digit, round, brackets.

Resources needed

Large flashcards showing a selection of numbers to 1 million; 0–9 digit cards and, if available, place value cards; 0–9 dice.

Mental warm-up activities

Select suitable activities from the place value and number sense section of the mental warm-up activity bank.

Concepts that may be unfamiliar in this topic

Place value in larger numbers

Students have previously only been expected to read and write numbers up to 10 000. It is sometimes difficult for students to extend their understanding of place value to include ten thousands and hundred.
thousands. To help them, it is useful to spend some time reviewing what they already know, including how to write numbers with four or more digits. Make sure the students know that we write numbers with four or fewer digits with no spaces. For example, 1000, 2340. Once the number has more than four digits, the convention in books is to print it so that the digits are grouped in threes from the right. So twelve thousand is written as 12 000 and two hundred and forty five thousand, three hundred and fifteen is written as 245 315. Make sure students understand that this is basically a printing convention to make it easier to read longer numbers. You may also like to point out that conventions differ and that the American style is to use commas to separate groups of digits (for example 123,456). Use place value tables to reinforce the names of the place values and give students lots of practice in reading large numbers.

**Rounding to 1000**

Students have previously rounded numbers to the nearest 10 and 100. Now they need to extend their understanding to another place value. If they understand the concept of rounding by looking at the place to the right of the one they round to, this should not be a problematic topic for them.

**Compare and order numbers in a larger number range**

Students have already compared pairs of numbers (up to 4 digits) using the < and > signs. They should also be confident locating numbers on blank number lines. This year they will need to work with larger numbers. Remind them that a whole number with more digits is automatically larger than another number with fewer digits, no matter what the digits are. Teach them to compare digits from left to right when the numbers they are comparing have the same number of digits. For example to compare 13 487 and 13 593, the ten thousands are the same, the thousands are the same, the hundreds are different. 5 hundreds > 4 hundreds, so 13 487 < 13 593. Reinforce the idea that the sign can be read from left to right and from right to left and that the open end is always towards the larger number. The small point of the sign always faces the smaller number.

**Adding list of numbers using written methods**

Students should already be able to add small numbers using grouping strategies. This year they will learn to add lists, by grouping and adding in chunks and checking with a calculator to make sure the answer is correct. As students become more comfortable with written methods, they may choose to move towards vertical methods. When adding sets of four or more numbers, it is often quicker to use a jotting strategy than any other written method. Many students will be able to draw arrows joining the numbers they are adding together and to get a solution in a shorter time that it would take them to rewrite all the numbers into a column format. For example:

\[21 + 43 + 32 + 19 + 57 \rightarrow 100 + 40 + 32 \rightarrow 172\]

**Order of operations and arithmetic rules**

The order of operation rules and the laws of arithmetic become more important as students begin to solve more complicated problems and perform calculations with more than one operation. It is often easier for
students to learn and use these rules if they see them as a set of rules to be obeyed. For example, in some countries you have to drive on the left-hand side of the road. It is a rule that all drivers have to follow to avoid confusion and accidents. In other countries, the rule is different, but it still needs to be obeyed. Similarly, mathematicians have made rules to avoid confusion and ‘accidents’ such as wrong answers. Scientific calculators apply these rules automatically in most cases, but simple arithmetic calculators, including the ones on most mobile phones do not. We have to tell the calculator what to do using brackets. Students enjoy investigating order of operations using a calculator and this helps them to reinforce and internalise the concepts.

**Teaching ideas**

**Practical activities**

- Ask a group of students to stand up. Give each student a card showing a number less than 10 000. Get the rest of the class to instruct the group, so they stand showing the numbers in order from smallest to largest or largest to smallest. Give another student another number card and ask them to position themselves in the line. Ask students to say a number that could lie between two of the numbers in the line.

- Give students a set of place value cards or several sets of 0–9 digit cards. Say numbers less than 10 000 and ask the students to lay out the cards to show that number. Extend this to five-digit numbers (hundred thousands) and six-digit numbers (millions).

- Draw a place value chart on the board. Put numbers into the chart and use it to help students say the numbers aloud. Say a number and ask students to come up and write the number in the chart.

- Ask a student to pick out up to six digit cards and stick them on a board in a line for the rest of the class to see. Select another student to say aloud the number that has been made.

- Give a group of students a set of up to six cards with a mixture of digits on them. Ask them to arrange the cards to make the smallest or largest number they can. Can they make other numbers? Can they order the numbers they have created? How many different numbers can they make?

- Draw a line of five boxes on the board. Ask students to make a copy of this on paper. Explain to the students you are going to roll a 0–9 die five times (if a die is not available pick a card from a set of digit cards and then return it to the pack and shuffle). Each time they must select a box to put the number in. Once placed the number cannot be moved. The aim is to have created the largest number when all six boxes have been filled. Discuss with students the strategies they used to make decisions about where to place numbers. Repeat, trying to make the smallest number.
Write a multiple of 10 on the board. Tell students you are thinking of a number that when rounded to the nearest 10 is the number on the board. Invite students to tell you what the number could be. Repeat with multiples of 100.

Write additions of several three- or four-digit numbers on the board along with a choice of answers, one correct the others not. Ask students to tell you which answer must be the correct one by estimating using rounding.

**Using the Student Book and Workbook**

Student Book pages 5 to 10 deal largely with place value. Work through the practical activities suggested above before having students work through these pages. You will need to work through the examples given in order to model:

- how to set out place value boxes
- writing numbers as numerals and words.

Before students work through Student Book page 7, remind them of the < and > signs, which they have used at earlier stages.

Student Book page 11 deals with the addition of multiple numbers. Give students practice with adding several numbers mentally before letting them work through this page.

Give students two numbers to add. They can use materials such as abaci, base-10 apparatus or counters. Then ask them to check their answer using subtraction. Ask them to explain what they did. Discuss how addition and subtraction are the reverse of each other. Work similarly to show the relationship between multiplication and division. Then have students work through Student Book page 12 and Workbook page 8.

Student Book pages 13 and 14 presents the order of operations. Write this calculation on the board and ask the students to try and solve it:

\[
25 \div 5 + 3 \times 6 - 2
\]

Ask the students to share their answers. Did they all get the same answers? Ask them to compare their answers and to work out who got the answer correct. Go through the example at the top of Student Book page 13 and write the mnemonic BODMAS on the board like this:

Brackets
Of
Division
Multiplication
Addition
Subtraction
Explain to the class that certain operations have to be done before others. Use a real-life example to illustrate this. For example: 8 children come to a party. Each child gets one chocolate and 2 lollipops in their party pack. How many sweets do I use altogether to make the packs?

Draw the 8 party packs on the board, and add up how many sweets would be used altogether (24). Then ask the children what number sentence we could use to work this out quickly. Elicit the number sentence: \((2 + 1) \times 8\)

Point out that the brackets tell us to do that part of the division first. Use this and similar examples to illustrate the principle of BODMAS.

- First we do brackets and division involving ‘of’. Give them examples of each, for instance \((4 + 3 + 5)\) or \(\frac{1}{2}\) of 20.
- Second, we do division and multiplication from left to right.
- Finally we do addition and subtraction from left to right.
- Point out that we can use brackets to ‘promote’ operations that are supposed to come later. So if you need to work out the addition part of a sum first (as in the party example above), it should appear in brackets.

You can also point out that BODMAS is just a way of helping us to remember the order of operations. It doesn’t matter if you do subtraction before addition or after. However addition and subtraction must come after the other operations.

There are other mnemonics to remind the students of the order of operations. For example, some people use the word PEMDAS (please excuse my dear aunt Sally) to remember that they need to do parentheses (another word for brackets) then any exponents (powers, of etc.) before they multiply, divide, add and subtract.

Work through the first question with the class before having them complete the sums on their own. Workbook pages 9–12 give the students practice at inspecting number sentences and engaging with the order of operations in order to solve the problems.

Use the problem-solving activity on Student Book page 15 to consolidate order of operations and to explore different methods of solving the same problem. Discuss results and ideas with the class.

**Assessment questions to ask**

- Can you put the correct sign, < or >, between these numbers?
- How do you order a set of numbers? Which part of each number do you look at to help you?
- What is the value of each digit in this number?
• What is the sum of (a group of numbers)?
• Mindy says $6 + 2 \times 3 = 24$ and Mandy says $6 + 2 \times 3 = 12$. Who is correct? Why? (and other similar questions)

**Common errors and misconceptions**

Some students really struggle to fully understand the concepts related to place value and many students struggle particularly to interpret and use zero as a placeholder to represent no units, hundreds and so on. Students will benefit from ongoing revision, mental maths and work with base ten pieces and place value cards and charts to consolidate these fundamental ideas.

Some students get confused with thousands when you ask them to work with block apparatus because they can see that single blocks are ones, long sets of ten are tens and flats are hundreds. When they are faced with the cube that represents a 1000, they cannot see the thousand smaller units and they may see the block representing 600 because there are six faces with 100 blocks on each. You may need to build cubes with a set of 10 hundred flats to show them that each layer has one hundred blocks but that they cannot see the inside blocks once they layer them.

Reading numbers and writing numbers when given a number in words can cause difficulty for students. They will need lots of practice to reinforce the idea that we read numbers in groups of three from left to right. This is confusing particularly if you only work with the numbers in increasing place value (units, then tens, hundreds, etc.). And it is one of the arguments for encouraging students to add by partitioning and then adding the larger place values (for example $234 + 435 = 200 + 400 + 30 + 30 + 4 + 5 = 500 + 60 + 9 = 569$) rather than column algorithms which may be confusing when the students are still trying to learn how to read and write numbers.

### 2D shapes and symmetry

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Student Book pp 16–22</th>
<th>Workbook pp 13–19</th>
</tr>
</thead>
<tbody>
<tr>
<td>5Gs1</td>
<td>Identify and describe properties of triangles and classify as isosceles, equilateral or scalene</td>
<td></td>
</tr>
<tr>
<td>5Gs2</td>
<td>Recognise reflective and rotational symmetry in regular polygons</td>
<td></td>
</tr>
<tr>
<td>5Gs3</td>
<td>Create patterns with two lines of symmetry, e.g. on a pegboard or squared paper</td>
<td></td>
</tr>
</tbody>
</table>
Vocabulary

Polygon, triangle, square, rectangle, parallelogram, rhombus, trapezium, kite, pentagon, hexagon, heptagon, octagon, nonagon, line of symmetry, symmetrical, reflection, rotation, rotational symmetry, order, acute, right-angled, obtuse, scalene, isosceles, equilateral, classify.

Resources

Small mirrors, coloured pencils, card, push pins, scissors, squared paper.

Mental warm-up activities

Select suitable activities from the warm-up activity bank. Remember the students will not be doing calculation in this chapter, so try to select some activities that reinforce number facts and mental calculation skills.

Concepts that may be unfamiliar in this topic

Two-fold symmetry

In Stage 4 students explored the idea of line symmetry with one horizontal or vertical mirror line. Now they will move onto working with oblique lines and two-fold symmetry. Students who struggle with spatial reasoning may find this topic challenging, but the ongoing use of mirrors and folding to check that parts of shapes are mirror images of each other will help them to develop confidence in this concept. Use of locally appropriate and culturally specific patterns such as rangoli, architecture, tiling designs, fabric and carpet patterns, and jewellery and beaded designs will provide useful contexts and help to cement these ideas.

Rotational symmetry

Rotational symmetry is a new idea for students. Most young learners don’t find this difficult as long as they are allowed to physically manipulate (turn) shapes to see how many times they fit onto each other in a rotation. In fact, even at higher levels, many students will still trace and cut out shapes when they are required to rotate them. For this reason, we suggest that you work through the practical activities with the class, even though these may take up more than one lesson.

Classifying triangles

Students already know that a triangle is a three-sided flat shape. In this chapter they are going to learn that there are different types of triangles and that we can classify these mathematically using the properties of their angles and sides. There is quite a lot of technical vocabulary involved here and you may need to develop some activities to help students learn the names of the triangles and the names of acute and obtuse angles.
Teaching ideas

Practical activities

Display various shapes in different positions and orientations and have the students name them. Encourage them to give the correct names (for example, make sure the students use the word rhombus and not the incorrect term diamond and make sure they give the most accurate name for all quadrilaterals rather than just calling them quadrilaterals). Ask the students to divide the shapes into two groups and then to say what properties they used to group them. For example, they may make a group of shapes with four sides and shapes with any other number of sides. Repeat this for three and four groups to encourage them to look at different properties of the shapes.

Ask the students to look at shapes around the room – for example, doors, windows, etc. and identify which are symmetrical and where the lines of symmetry lie.

Let the students work in groups to cut out a range of different shapes. You could provide them with a printed sheet of shapes or you could give them old magazines and let them create their own shapes. Once they have done this, let them fold their shapes in half to decide which are symmetrical and which are not. Share any interesting shapes and ideas as a class.

Let the students work in pairs to cut and fold pieces of paper to explore symmetry patterns. Here are a set of instructions you could print and use:

Fold a piece of paper in four. Cut off the corner.

Unfold the paper.

How many lines of symmetry does the hole in the paper have?
What is the shape of the hole?

Now fold a piece of paper like this and cut off the corner.

Describe the shape of the hole.

How many lines of symmetry has the hole got?

Fold and cut paper to make different shaped holes. Try to predict how many lines of symmetry the hole will have. Draw the lines of symmetry onto the piece you have cut out of the paper.

Give each student a square piece of paper or card and ask them to design a tile pattern with two-fold symmetry. Use these to make a classroom display. This is a good opportunity to explore cultural patterns. You can also use these tiles to demonstrate rotational symmetry when you deal with that concept.

Show the class a simple shape, such as the outline of an arrow pointing upward. Ask students to draw what this shape would be like after it is rotated clockwise a quarter turn (90 degrees). Let students compare their rotated shapes. Then ask them to show a half turn (180 degrees) rotation of the original figure. Repeat this using other simple shapes.

Let the students work with square and isometric geoboards and/or squared or isometric dot paper to make triangles according to your instructions. For example you could ask:

- How many different isosceles triangle can you make on a $4 \times 4$ square section of geoboard? Draw them on dotty paper.
- How many different isosceles triangles can you make on a $4 \times 4$ section of isometric geoboard? Draw them on dotty paper.
• How many different right-angled triangles can be made on a 4 × 4 square geoboard? Draw them on dotty paper.
• Can right-angled triangles be constructed on an isometric geo-board? Explain why or why not.

Let students work on geoboards or dotted paper. Tell them that you are going to describe some triangles. As you describe each triangle they should make it on the geoboard (or paper). Some examples are:

• This triangle is obtuse and one pair of sides are equal.
• This triangle has a right angle. It also has a line of symmetry.
• This triangle is acute angled with no lines of symmetry.
• This is an isosceles triangle with one side twice as long as one of the other sides.

Using the Student Book and Workbook

Once students have named and classified polygons, have them complete Student Book page 16 and Workbook page 13.

Show students a large symmetrical 2D shape cut out of paper, for example a circle or a rectangle. Remind students that if you fold the shape in half the fold line is called the ‘line of symmetry’. Hold a mirror over the fold line to show how the other half of the shape is reflected in the mirror. Emphasise the language of reflection – for example, reflective symmetry, line of symmetry, image. Complete Student Book page 17. Ask students to write their names using similar lettering, asking them which letters of their name have lines of symmetry. Give students small mirrors so that they can work through Workbook pages 14 and 15.

Work through Student Book page 18 slowly with the class. Allow them to trace, cut out and fold the patterns in the teaching box if necessary to demonstrate that the shape is symmetrical along both lines of symmetry. If not, demonstrate this using a mirror as before. Encourage the students to place their rulers on the diagram of the rug to show where they think the lines of symmetry are. Allow them to check with a mirror. Let the students work independently or in pairs to complete Workbook page 16. Spend some time sharing the two-fold patterns that the students make at the end of this activity.

Show students a shape like the one shown at the top of Student Book page 19. Turn the shape to demonstrate how it fits onto its own outline. Explain that this is a different type of symmetry called ‘rotational symmetry’. Explain that ‘rotation’ means turning. Students can then complete Student Book page 19 as well as Workbook pages 17 and 18.

Student Book page 20 is a practical cutting and making activity in which the students explore further the ideas of rotational symmetry. Let them work in small groups to discuss and carry out the tasks. Then have a class discussion about what they discovered.
Work through the vocabulary and examples on page 21 with the class. Explain to them that they can use the grid squares to work out whether angles are less than a right angle (acute angles form inside the corner of a square), right-angled (right angles fit the corner of a square exactly) or more than a right angle (obtuse angles are bigger than the corner of a square on the grid). Similarly, they can use the lengths of sides of the squares to work out whether the sides of a triangle are the same length or not. Reinforce the vocabulary and encourage the students to use it. Let them complete the activity on their own in groups.

Once you are sure the students know the correct names for different types of triangles, let them work on their own to complete Student Book page 22. Check their work before using Workbook page 19 to assess how well they understand the concepts in this lesson.

**Assessment questions to ask**
- How many sides does this shape have? How many corners?
- Where is the line of symmetry for this shape?
- How far (quarter-turn, half-turn, full turn) must we turn this shape before it fits onto its own outline?
- This shape has two lines of symmetry. Can you show me where they are?
- What is the correct name for this triangle?
- What type of angle is this?
- How can you tell if a triangle is isosceles?
- Is this triangle right-angled? How can you tell?

**Common errors and misconceptions**

Students may think that reflective and rotational symmetry are related. Let students investigate various shapes and patterns to find out their rotational and reflective symmetry. They should notice that some shapes and patterns may have rotational symmetry but not reflective symmetry. Others may have reflective but not rotational symmetry. Others may have both or neither.

Students often get confused by the fact that a shape fits onto itself after a complete revolution and they think it has rotational symmetry of order 1. Make sure they understand that every shape will do this, so it is not considered to have rotational symmetry if it only fits back onto itself after a complete revolution. Many students find it very difficult to picture rotations in their heads. Encourage them to use thin scrap paper to trace shapes and then move them on to see the rotations. In fact, many students still do this at IGCSE and higher levels.
3: Time

<table>
<thead>
<tr>
<th>Objectives</th>
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</tr>
<tr>
<td>5Mt2 Tell and compare the time using digital and analogue clocks using the 24-hour clock</td>
</tr>
<tr>
<td>5Mt3 Read timetables using the 24-hour clock</td>
</tr>
<tr>
<td>5Mt4 Calculate time intervals in seconds, minutes and hours using digital or analogue formats</td>
</tr>
<tr>
<td>5Mt5 Use a calendar to calculate time intervals in days and weeks (using knowledge of days in calendar months)</td>
</tr>
<tr>
<td>5Mt6 Calculate time intervals in months or years</td>
</tr>
</tbody>
</table>

Vocabulary

Ante meridiem (a.m.), post meridiem (p.m.), noon, midnight, afternoon, seconds, minutes, hours, days, weeks, months, years, digital, analogue, calendar, time interval, duration.

Resources needed

24-hour digital and analogue clocks and watches; local bus or train timetables; coloured pencils; blank analogue and digital clock faces for students to fill in; a large calendar for the current year.

Mental warm-up activities

Select suitable activities from the place value and number sense section of the mental warm-up activity bank.

Concepts that may be unfamiliar in this topic

24-hour clock

Students have previously only been expected to work with the 12-hour time format. However, the increase in exposure to digital time on phones, computer screens and other electronic appliances means that most children have probably been exposed to the idea of 24-hour time and all you will need to do is to formalise their understanding and help them to use this format in mathematical contexts.
Calculate time intervals in different units

Previously, the students have chosen appropriate units and used them to measure and record time intervals. This year they will need to work with given times to calculate time intervals in mixed units (for example, hours and minutes). Using a time line to show the passage of time is very useful for helping students bridge units and deal with the non-decimal nature of time. If students really struggle with this, a clock face that they can physically manipulate will provide a useful aid for calculation.

Teaching ideas

Practical activities

- Spend some time revising, saying and writing times based on analogue and digital clocks. Reinforce the idea that twenty to four can also be written as 3.40. Some students may find this confusing because the twenty and the four do not appear in the digital time. Use a clock face and a digital clock to show times and get the students to set times based on your instructions.

- Display a series of digital times on cards, for example 5:15, 3.05, 6.40 and so on. Ask questions such as: how would you show this time on an analogue clock? How do you say this time? Can you say it in another way? Then let the students arrange the times in order from earliest to latest or vice versa.

- Review the language of time. Explain that a.m. stands for ‘ante meridiem’, which is Latin for ‘before noon’ (and after midnight) and p.m. stands for ‘post meridiem’ meaning ‘after noon’ (and before midnight).

- Ask how many hours there are from midnight to midnight. Introduce the idea of a 24-hour clock, with the day beginning and ending at 00:00 (24:00). Ask the students where they have seen 24-hour time. Answers might include DVD/video recorders, timetables, oven timers or their own watches. Show the students examples of 24-hour clocks, watches and displays. Consider each hour in turn, starting at 00:00. Discuss what students are usually doing at each hour. Show how, after 12 noon, 24-hour time continues to 13:00, 14:00, and so on. Show them some of the ways they may see 24-hour time recorded (for example, 1324, 1324 hours, 13:24, 13.24). Emphasise that the dots in this notation are not decimal points. It will avoid confusion if, in your class, you record 24-hour times as, for example, 13:24.

- Explain that all 24-hour time is written as four digits. They should put a zero to the left of times between midnight and 9 a.m., for example 00:00 and 09:52.

- Write various 12-hour and 24-hour times for the students to show on both analogue and digital clock faces.
Introduce the idea of a 24-hour clock. Discuss with the class where they are likely to see times given in 24-hour format. Some answers are timetables, bus and train stations, airports, and digital displays on appliances. Explain that the 24-hour clock only really affects times after 12 noon. It may help to draw a time line showing hours marked in 12-hour format from 11 am to 12 pm and then write the 24-hour format times below these in the matching positions. Spend some time talking about how you read or say times in the 24-hour format. Encourage the students to read a time such as 19:00 as ‘nineteen oh oh’ or ‘nineteen zero zero’ rather than ‘19 hundred hours’ to prevent them getting the misleading idea that time is decimal and that there are 100 minutes in an hour.

As a practical activity, give the students a paper plate and let them design a clock-face showing 24 hour times.

Make a large timeline with hours and 5-minute intervals shown on it. Spend some time working with durations of events and time intervals to demonstrate how to use a time line to aid calculations. For example, start with a timeline marked from 2 p.m. to 5 p.m. and hours divided into 5-minute intervals. Show the class a time such as 2.15. Draw an arrow or place a marker on the timeline to show this time. Start with simple examples such as: what is the time 1, 2 or 3 hours hence, what was the time 15 minutes earlier, and so on? Move onto durations in hours and minutes, and do some examples that involve crossing or bridging the hour. Keep reminding the class that there are 60 minutes in one hour. Once they are confident, move onto problems such as a TV programme starting at 4.20 p.m. and ending at 5.40 p.m. How long was the programme? Demonstrate how to work this out on a timeline.

Display a large calendar for a whole year. Ask the class to explain what information they can get from a calendar. Spend some time discussing why people have calendars and what they use them for.

If you have not already done so, make a class calendar for the term. Draw up a grid (or download a blank one from the Internet, there are many available) for the term. Write the dates on the blocks. Spend time with the class marking holidays, feast days and other important national, community or school events. Ask students to tell you whose birthdays fall in this term. Add their names to the appropriate days on the calendar. Ask questions as you go to check understanding of terminology. For example, Sports day is on 7 November. How many weeks time is that? Which holiday comes up next? How many weeks is it till the end of the term? And so on.

Using the Student Book and Workbook

Once you have worked through the practical activities described above, students can work through Student Book page 23, and Workbook page 20. Spend some time reading timetables and asking
oral questions to make sure the students can read them before having them work through Student Book page 24. Discuss the bus timetable with the class and display this time line on the board.

Explain that the time line represents the journey of bus A12. Discuss where the other stops will fit onto the line. Redraw a similar line from 11 am to 4 pm and place the stops of bus C15 to make sure the students can work out the stops and make sense of the timetable.

Remind the students that they can work out how long something took and that this is called the elapsed time. Work through the examples on Student Book page 25 with the class to show them how to use a time line to solve time problems involving addition and subtraction. Let the students work independently to complete the activities.

Spend some time talking about track and field events such as the 100 m sprint race. Explain that the times are recorded by sophisticated clocks and given to decimal fractions (tenths and hundredths) of seconds. It is important that students realise that 48.1 seconds is 48 and 1/100th of a second, and that they can see distinguish between these times and times such as 3 minutes and 23 seconds which is not the same as 3.23 minutes! Work through the activity on Student Book page 26 and check the results before having the students work in groups to complete the investigation.

The world records given on Student Book page 27 were accurate in 2012. You may like to check, or get the students to check, that these are still up to date. The International Amateur Athletics Federation website (www.iaaf.org) keeps these records up to date and also gives the regional records for each event. Let the students work in pairs to solve the problems on this page.

Use Workbook page 22 to revise the vocabulary and units of time before asking the students to complete the activities on Student Book page 28.

**Assessment questions to ask**

- How do we write this time using 24-hour notation: five o’clock in the morning?, five o’clock in the evening?, twenty past seven in the evening?, and so on.
- What time is [name a given show from a TV guide] on? What time does it finish?
- What date will it be in [] days’ time?
• What will the date be three weeks from today?
• On what day does the [given date or occasion] fall this year?
• How many weeks have passed since [any date or occasion]?
• How many weeks in [] months?
• How many days in [] weeks?

**Common errors and misconceptions**

A typical error when using 24-hour notation is to mistake the second digit of the hour time for the hour time. So students may think 14:00 is 4 o’clock and that 15:00 is 5 o’clock, and so on. Emphasise counting on from 12. For higher-attaining students, you could explain that our time system is actually a base-12 rather than a base-10 system. This is why we count hours from 0 to 12, then 13 represents 12 + 1, 14 represents 12 + 2, and so on.

Students often unthinkingly try to use their calculators to find durations or time intervals. You need to stress that this does not work because time is not a decimal quantity. Continue to demonstrate time intervals and durations on clock faces and/or time lines to assist students in grasping these concepts.

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**4 Decimals**

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<th>4: Decimals</th>
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<th><strong>Workbook</strong> pp 23–24</th>
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<td><strong>Objectives</strong></td>
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<tr>
<td>5Nn4</td>
<td>Use decimal notation for tenths and hundredths and understand what each digit represents</td>
<td></td>
</tr>
<tr>
<td>5Nn7</td>
<td>Round a number with one or two decimal places to the nearest whole number</td>
<td></td>
</tr>
<tr>
<td>5Ml4</td>
<td>Round measurements to the nearest whole unit</td>
<td></td>
</tr>
<tr>
<td>5Nn11</td>
<td>Order numbers with one or two decimal places and compare using the &gt; and &lt; signs</td>
<td></td>
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</tbody>
</table>

**Vocabulary**

Decimal, tenth, hundredth, decimal place, decimal point, digit.

**Resources needed**

Place value cards; 0–9 digit cards; a decimal point card; a 0–9 die; flashcards showing different decimals with one and two decimal places each; calculators.
Mental warm-up activities

Select suitable activities from the place value and number sense section of the mental warm-up activity bank.

Concepts that may be unfamiliar in this topic

Extend decimals to hundredths, work out of context

Students have previously only been expected to work with decimals in context (money, measurements). In this chapter, and work that follows, they will be expected to work with decimals as fractional amounts with and without a context. You can build on what they already know from Stage 4 as you consolidate these concepts.

Rounding decimals to the closest whole number

Students should know how to round a money amount expressed as a decimal to the nearest dollar or pound. Now they need to be able to extend this understanding to round any decimal with one or two places to the nearest whole number, and any measurement with one or two places to the nearest whole unit.

Teaching ideas

Practical activities

Write statements on the board such as ‘10.31 is more than 10.19’. Ask students to say whether the statements are true or false and how they know.

Give students a set of place value cards or several sets of 0–9 digit cards and a decimal point card. Say decimal numbers and ask the students to lay out the cards to show that number.

Draw a place value chart on the board. Put numbers into the chart and use it to help students say the numbers aloud. Say a number and ask students to come up and place the number in the chart.

Draw a line of six boxes on the board, putting a decimal point before the last two boxes. Ask students to make a copy of this on paper. Explain to the students you are going to roll a 0–9 die six times (if a die is not available pick a card from a set of digit cards and then return it to the pack and shuffle). Each time they must select a box to put the number in. Once positioned a digit cannot be moved. The aim is to create the largest number when all six boxes have been filled. Discuss with students the strategies they used to make decisions about where to place numbers. Repeat trying to make the smallest number.
Use calculators to generate decimal number sequences, for example ‘start at 0.2 and go up in 0.3 intervals’. Discuss what happens when a place value position is bridged.

Give a group of students a flashcard each showing different decimals with two decimal places each. Ask the other students to give the group instructions in order to put themselves in position so the cards are in order from smallest to largest. Give another student a card and ask them to position themselves on the line. Repeat the exercise with decimals that have three decimal places.

Continue with these practical activities alongside the Student Book to ensure students are confident with equivalent fractions, ordering fractions and decimals, and considering place value.

Using the Student Book and Workbook

Draw a 0 to 1 number line on the board. Divide it into ten sections and mark on the tenths. Ask students where $\frac{1}{2}$ would go on the number line. Emphasise that halfway along the line is $\frac{5}{10}$. Highlight $\frac{1}{2} = \frac{5}{10} = 0.5$. Repeat for other fractions. Explain to students that because decimals are all about tenths and hundredths, if we can convert a fraction into one that has 10 or 100 as its denominator we can say what the fraction is as a decimal. So, for example, knowing $\frac{2}{5}$ is the same as $\frac{4}{10}$ means that we know $\frac{2}{5} = 0.4$. Repeat for other examples. Then talk to students about converting decimals to fractions. Ask students to position 0.6 on the number line. Ask them what this is as a fraction. Build on the students’ ideas to get from $\frac{6}{10}$ to $\frac{3}{5}$, highlighting that they should always put the fraction in its lowest form. Students can then complete Student Book page 29 and Workbook page 23.

The students can work through Student Book page 30 and Workbook page 24 to consolidate their understanding of place value to hundredths using number lines.

Work through Student Book page 31 with the class. Then draw a number line on the board going from 0 to 5. Mark out the tenths between each whole number. Remind students about the idea of rounding to approximate numbers and how they know how to round whole numbers to the nearest ten and hundred. Explain that you are now going to look at rounding decimals in a similar way. Mark 3.7 on the line. Ask students which whole number this is nearest to. Tell them that this means that 3.7 rounded to the nearest whole number is 4. Repeat for other examples. Mark 2.5 on the line and ask them...
what they think they should do. Remind students that when we round whole numbers, if they fall halfway between two numbers, we round up. Explain that we do the same with decimals, so 2.5 rounded to the nearest whole number would be 3. Now look at rounding to the nearest tenth. Use a number line from, say, 1.2 to 1.5, with the hundredths marked on. Ask students to position numbers such as 1.38 and then say which tenth they are nearest to. Highlight that when rounding to the nearest tenth, if the hundredths digit is five or more the tenth digit increases by 1, but if it is less than five the tenths digit stays the same.

Use the activities on Student Book page 33 to informally assess whether the students are able to work with and compare decimals with one and two places. Revise any concepts they seem unsure of.

**Assessment questions to ask**

- What is this digit in this number worth?
- How do you say this number?
- When ordering these decimals what did you look at first? Then what did you do?
- Which numbers do you find hardest to order? Why?
- Can you give me a number that lies between 3.2 and 3.3? How many answers do you think there are to this question?
- Can you give instructions to someone to explain how to round decimal fractions to the nearest whole number?

**Common errors and misconceptions**

There are many common misconceptions surrounding the concept of decimals. Some students see the numbers after the decimal point as a mirror of those before, thus thinking of 34.56 as ‘thirty-four point fifty-six’. This leads to incorrect comparison of numbers so that, for example, if students were to compare 34.56 with 34.7 they would feel 34.56 is larger, as ‘fifty-six is bigger than seven’. To avoid this it is important to use place value charts or notation cards to emphasise the value of digits in a number and regularly practise how to say numbers correctly. Another common error relates to sequences of decimals, for example ‘0.6, 0.7, ...’. When reaching 0.9 students often follow with 0.10, the line of thinking being ‘nine tenths, then ten tenths’. Time needs to be spent with students thinking about what is meant by ten tenths; diagrams often help to clarify this. Using a place value chart can show how 0.1 and 0.10 are the same.
### 5 Measurement

**Objectives**

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<th>Description</th>
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<tbody>
<tr>
<td>5Ml1</td>
<td>Read, choose, use and record standard units to estimate and measure length, mass and capacity to a suitable degree of accuracy</td>
</tr>
<tr>
<td>5Ml2</td>
<td>Convert larger to smaller metric units (decimals to one place), e.g. change 2.6 kg to 2600 g</td>
</tr>
<tr>
<td>5Ml3</td>
<td>Order measurements in mixed units</td>
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<tr>
<td>5Ml5</td>
<td>Interpret a reading that lies between two unnumbered divisions on a scale</td>
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<tr>
<td>5Ml6</td>
<td>Compare readings on different scales</td>
</tr>
<tr>
<td>5Ml7</td>
<td>Draw and measure lines to the nearest centimetre and millimetre</td>
</tr>
</tbody>
</table>

**Vocabulary**

Length, distance, millimetre, centimetre, metre, kilometre, mass, gram, kilogram, capacity, litre, millilitre, convert, estimate.

**Resources needed**

String; rulers; tape measures; calculators, various measuring instruments and containers with differently marked scales.

**Mental warm-up activities**

Select suitable activities from the mental warm-up activity bank. It may be useful to focus on multiplying by 10 and 100 as this will help students when they convert measurements.

**Concepts that may be unfamiliar in this topic**

**Convert from larger to smaller units**

Students already know how to multiply by 10, 100 and 1000. This skill forms the basis of the converting from a larger to a smaller unit of measurement. Make sure the students understand that they need to multiply because there will be a greater number of the smaller units in the same measure. It will be useful to show the students place value charts using measurements.
Interpret un-numbered divisions on scales

Students need to begin to understand that measuring scales can be marked (gradated) in different intervals and units. In this chapter they will learn to work with different scales to work out what the divisions mean even if they are not marked. There are three steps involved in making sense of scale:

• count the number of small divisions (intervals) between two numbered marks
• work out (by division, repeated subtraction or counting on) what measurement each small division represents
• work out the measurement represented by a particular mark.

Give the students the opportunity to apply these steps to reading a number of different scales.

Compare readings on different scales

Students need to understand that an amount such as $\frac{1}{2}$ litre will appear differently on a scale marked in millilitres and a scale marked in litres. It is useful to demonstrate this practically if possible.

Draw and measure lines accurately in centimetres and millimetres

Although students have measured lengths before, this is the first time they are expected to accurately draw lines of a specified length given in set units. You will need to make sure students have clearly marked rulers and sharp pencils and that they know how to measure from the 0 marking on a scale and not from the edge of the ruler.

Teaching ideas

Practical activities

Encourage the students to bring a range of marked containers to school and use these to revise basic units of mass, capacity and length. Spend some time doing practical measuring tasks: for example, how many of these small containers would it take to fill this larger one? What does 250 ml look like in this half litre bottle? Compare it to 250 ml in this 2 litre bottle? And so on.

Write a length on the board, for example, 5.6 cm. Ask students to use a straight edge to draw a line they think is about this length. Using a ruler, ask students to measure their lines and see how accurate their estimate was. Points could be awarded for degrees of accuracy – for example, 2 points if you were within 5 mm, 3 points if you were within 2 mm, 5 points if you were within 1 mm. After ten goes, see who has the most points.

Ask students to suggest lengths that would be measured in millimetres, centimetres, metres and kilometres.

Write distances on the board – for example, ‘the length of a pencil’, ‘the distance between these two towns’, etc. Ask students to say a sensible unit to use for measuring the distances.
Continue with these practical activities alongside the Student Book to ensure students are confident with the metric units for measuring distance.

Ask students what units they know for measuring length. If they have suggested ‘centimetre’ as an answer, ask them if they know of a smaller unit. Ask students to look at their rulers and notice that a centimetre is broken up into ten smaller divisions. If no one knows what these are called, introduce the term ‘millimetre’. Ask students to suggest things that we would need to use millimetres to measure. Encourage them to think of not only small things but also situations where large things need to be measured very accurately – for example, in building work. Write 5 cm 6 mm on the board. Ask students how many millimetres that is in total. Encourage students to explain how they worked it out, for example, ‘there are 50 mm in 5 cm so it is 50 + 6, which is 56 mm’. Repeat for other examples and units of mass and capacity.

Ask students how many centimetres are in a metre. Ask: ‘Knowing there are 10 mm in every centimetre, how many millimetres must there be in a metre?’ Having established the answer, ask students what fraction of a metre a millimetre must be. Draw a place value chart going from metres to millimetres on the board. Use this to practise converting measurements.

On the board write kilometres, metres, centimetres and millimetres. For each, ask students to think of things that would be best measured in that unit. Record suggestions encouraging students to explain how they made their decisions. Ask students how many metres are in a kilometre. Having established the answer, ask students what fraction of a kilometre a metre must be. Draw a place value chart going from kilometres to metres on the board. Use this to practise writing metres as kilometres and vice versa.

Using the Student Book and Workbook

Let the students work in pairs to complete Student Book page 34. Once you have done some teaching around units of length and how to covert them, have the students complete the conversions on Workbook page 25. Spend some time checking these and discussing how students worked out the answers to make sure they understand this concept. Use Workbook page 26 to revise and reinforce measuring in centimetres and millimetres. Check that students are able to do this as they will need to apply these skills later in the chapter when they draw lines of given lengths.

Remind the students that they can convert units of mass in the same way as they converted units of length. Let the students work in pairs to complete Student Book page 35.
Use Student Book page 36 to informally assess students’ understanding of converting larger to smaller units. Let them work independently to complete the activities before checking them as a class.

Spend as much time as necessary teaching the students how to read and make sense of different measuring scales. As well as the examples in the book, try to show the class weighing scales, measuring jugs, tape measures and other marked scales to demonstrate this. Let the students work in pairs to discuss the activity on Student Book page 37.

Let the students work on their own to complete the measuring scale activities on Student Book page 38. Use Workbook page 27 to assess that they are able to do this. Once you are sure they are able to do this, let the students work on their own to complete Workbook page 28. Mark this in pairs and discuss any problems students may experience.

Revise how to measure the length of a line using a ruler by working through the examples on Student Book page 39. Let the students work together to complete the activities. Encourage them to help each other if they struggle.

Let students work independently to complete the measuring and drawing activities on Student Book page 40. Observe them as they work and assist anyone who needs help.

**Assessment questions to ask**

- What units would you use to measure this length/mass/capacity? Why?
- Can you give me an example of when we need to measure distances accurately using millimetres?
- Can you convert this measurement which is in metres to centimetres?
- Can you tell me how to read this scale?
- What is this measurement (on a scale)?
- How many mm/cm/ml/g in [ ] m/l/kg?
- How would you draw a 52 mm line?

**Common errors and misconceptions**

The charts that ask students to convert from millimetres to centimetres to metres to kilometres require them to work with a wide range of place values. Keep reminding them to work from one unit to the next unit up, for example, from millimetres to centimetres before converting to metres. This way the multiplications do not get too unwieldy.

Some students may still struggle with conservation of measure, particularly with liquids. Provide practical examples to help them see that 250 ml of liquid will fill a small container, but look like a very little amount in a much larger container.
6 Counting and calculating

<table>
<thead>
<tr>
<th>Objectives</th>
<th>5Nn1</th>
<th>Count on and back in steps of constant size, extending below zero</th>
</tr>
</thead>
<tbody>
<tr>
<td>5Nc8</td>
<td></td>
<td>Count on and back in thousands, hundreds, tens and ones to add or subtract</td>
</tr>
<tr>
<td>5Nc9</td>
<td></td>
<td>Add or subtract near multiples of 10 or 100, e.g. 4387 – 299</td>
</tr>
<tr>
<td>5Nc11</td>
<td></td>
<td>Calculate difference between near multiples of 1000, e.g. 5026 – 4998, or near multiples of 1, e.g. 3.2 – 2.6</td>
</tr>
<tr>
<td>Note: calculations with decimals are covered in Chapter 16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Vocabulary
Add, subtract, count on, round off, count back, estimate, difference, near multiple, compensate.

Resources needed
Calculators; scrap paper; large number lines to demonstrate calculations.

Mental warm-up activities
Select suitable activities from the calculation section of the mental warm-up activity bank.

Concepts that may be unfamiliar in this topic
Counting on in different-sized and progressively bigger chunks
This concept is not strictly new to the students, but the aim is to develop more efficient methods of counting on by ‘chunking’ to reduce the number of ‘jumps’ and apply the mental strategies students have already mastered (such as counting in hundreds, using multiples of ten and so on).

Counting on or back to add and subtract
Students have previously focused on counting back to subtract. As they develop their understanding of the operation they should begin to realise that they can also count on to the find the difference between two numbers. The actual numbers involved and the way in which the problem is expressed will generally guide which method they choose.
Calculate using near multiples of 10, 100 and 1000

Students already know how to find the difference between pairs of near multiples of 100 (for example 304 – 296). This year they will extend their understanding and use rounding and compensation strategies to perform addition and subtraction on near multiples of 10, 100 and 1000. They need to be confident with place value to master this skill, so you may need to do some support and revision work if students find this concept difficult.

Teaching ideas

Practical activities

Ask students to generate number sequences using a calculator. They need to think of a start number and then choose a constant difference to go up or down. Enter the start number followed by + or – then =. By continually pressing the = key, the sequence can be generated. Discuss the different sequences created.

Give students opportunities to use calculators to check work they have done mentally or using a written method.

Write calculations on the board. Ask students to estimate the answer and then find the exact answer using a calculator. Encourage students to get into the habit of thinking about what a sensible answer to a question is first to avoid accepting any answer from a calculator, even a wrong one, due to a user error.

Tell the class: ‘I have $95. I give away $17. How can we work out what I have left?’

Explain that we can use a technique called counting on. Make up 17 in base-ten blocks. Count on from 17, adding base-ten blocks, and make notes on the board as you do.

17 \hspace{1cm} \text{Count on to the next ten: 18, 19, 20. +3 units. Now you have two full tens (20).}

20 \hspace{1cm} \text{Count on in tens until you reach 90 (the number of tens in 95): 30, 40, 50, 60, 70, 80, 90. +7 tens.}

90 \hspace{1cm} \text{Count on in ones until you reach 95: 91, 92, 93, 94, 95. +5 units.}

The difference between 95 and 17 is 3 + 70 + 5 = 78.

Demonstrate the technique of counting on using some different examples. Get students to work with base-ten blocks and then later practise the technique without the blocks.

Similarly, give the class subtraction examples and use counting back using base-ten blocks.
Ask: ‘A stationery store has 276 notepads in stock. They sell 57. How many are left?’

276  Count back 50: 266, 256, 246, 236, 226.


Again, have students practise this technique with some other examples.

Demonstrate the technique of rounding off and adjusting. Again, you can use the base-ten blocks. Set aside the ‘leftover’ blocks from the rounding off and add or subtract them again before you settle on the final answer.

Using the Student Book and Workbook

Work through Student Book page 41 as a class allowing time for discussion of strategies and methods students use to find the answers. When you are confident they are able to do this, let them work independently to complete Workbook page 29. If you like, they can check the answers in pairs and discuss any discrepancies.

Work through the examples on Student Book page 42 with the class to make sure they know how to use number lines and jottings to help them add. Activity 1 on this page specifically asks the students to use number lines, but they can use whichever methods they find easier to complete 2 and 3.

Demonstrate counting back and counting on using the same numbers to show the students that both methods work for subtraction. Let the students complete Student Book page 43 on their own. Use Workbook page 30 to assess that students understand this concept. By giving them the number lines they are forced to work in chunks and this helps them find effective methods of their own.

Work through Student Book page 44 with the class. Make sure they understand the compensation strategies involved in this method. If necessary demonstrate equivalence using concrete apparatus to help them see how this works. For example, adding 3 onto each side of a subtraction still gives the same result.

Let students work on their own using the strategies they feel most confident with to complete Student Book page 45.

Spend some time discussing the strategies students would use to solve the different calculations on Student Book page 46 before asking the students to complete these on their own.
Assessment questions to ask

- What is the difference between 166 and 78? 2941 and 199? 7253 and 187?
- How do you decide whether to use rounding off, or counting on or back?
- What is the total of 472 and 29? 1588 and 259? 3076 and 269?

Common errors and misconceptions

Students must pay attention to the correct place value of each digit, otherwise their calculations can get thoroughly confused. This is especially important when adding or subtracting two numbers that have a different number of digits – for example, a two-digit and a three-digit number, or a three-digit and four-digit number. If necessary they can make notes above the brackets of each expanded place to indicate ‘thousands’, ‘hundreds’, ‘tens’ or ‘units’, as shown in the example on Student Book page 6.

Students sometimes struggle with compensation and they may add when they need to subtract or vice versa. You may need to allow them to model calculations using base-ten blocks to help them truly understand this important concept as it forms the basis of later work in solving algebraic equations.

### 7 Position

<table>
<thead>
<tr>
<th>7: Position</th>
<th>Student Book pp 47–48</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objectives</strong></td>
<td>Workbook p 31</td>
</tr>
<tr>
<td>5Gp1</td>
<td>Read and plot co-ordinates in the first quadrant</td>
</tr>
</tbody>
</table>

**Vocabulary**

Co-ordinate, x-axis, y-axis, ordered pair, symmetrical, plan, map.

**Resources needed**

Chalk, string; small objects for co-ordinates activity; maps.

**Mental warm-up activities**

Select suitable activities from the place value and number sense section of the mental warm-up activity bank.

**Concepts that may be unfamiliar in this topic**

**System of numbered axes**

Students have previously worked with alphanumeric and numbered grids. Now they need to move onto a set of co-ordinate points given using two
numbers and a system of axes. The order of the numbers is important and the x-value is always given before the y-value (as in their alphabetical order). You may like to treat the grid as two overlapping number lines (one horizontal and one vertical).

**Reading and plotting co-ordinates**

Students need to be able to work with grid co-ordinates both to give the co-ordinates of a point and to draw the point when they are given the co-ordinates. Lots of practice at this stage will help them understand the concept.

**Teaching ideas**

**Practical activities**

Draw a grid on the ground outside. You can either use chalk or make the lines out of string. Put objects on the intersection of grid lines and have the students work in pairs. One student should say a set of coordinates and the other should walk to and identify the object in that position. If they identify it correctly, they may move it to another position and then have their turn to select a pair of coordinates for their partner. If they are not correct, the partner has another turn.

Demonstrate to the students how to draw a set of axes. If possible, use a projection of grid paper, or stick a piece of squared paper onto the board, and draw the axes onto that. Emphasise that the vertical line (line going up and down) is called the ‘y-axis’, and that the horizontal line is called the ‘x-axis’. Also show how the numbers increase from left to right and bottom to top. 0 is always at the intersection of the x- and y-axes. Give students some practice in plotting co-ordinates on your drawn graph.

**Using the Student Book and Workbook**

Work through the example on Student Book page 47 with the class to revise the idea of a numbered grid and to teach the new vocabulary used in this chapter. Let the students work together to complete the activities. When they have done so, let them work on their own to complete Workbook page 31. Allow them to check each other’s answers.

Students can work independently or in pairs to complete the map activity on Student Book page 48 as a fun consolidation of what they have learned.

**Assessment questions to ask**

- What do we call the horizontal line in a pair of axes?
- What do we call the vertical line in a pair of axes?
- At which number do the axes intersect (cross)?
- Find this point on your pair of axes.
- Show me where point \((x, y)\) is on your grid.
- What is at \((2, 3)\) etc.?

**Common errors and misconceptions**

It is important for students to know that the \(x\)-axis is the horizontal line and that the \(y\)-axis is the vertical line, and that the co-ordinates are given in the order \((x, y)\). Keep reminding them that the first number represents the point along the \(x\)-axis, and the second represents the point along the \(y\)-axis. Students may also sometimes identify the co-ordinate on the \(x\)- or \(y\)-axis, and forget about the second co-ordinate. If necessary, they can use two rulers (or any two straight-edged items, such as books or sheets of paper) to form a corner so that they can easily find the co-ordinate.

### 8 Multiplication and division facts

<table>
<thead>
<tr>
<th>8: Multiplication and division facts</th>
<th>Student Book pp 49–57</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objectives</strong></td>
<td><strong>Workbook pp 32–35</strong></td>
</tr>
<tr>
<td>5Nc3</td>
<td>Know multiplication and division facts for the (2\times) to (10\times) tables</td>
</tr>
<tr>
<td>5Nc4</td>
<td>Know and apply tests of divisibility by (2, 5, 10) and (100)</td>
</tr>
<tr>
<td>5Nc5</td>
<td>Recognise multiples of (6, 7, 8) and (9) up to the tenth multiple</td>
</tr>
<tr>
<td>5Nc6</td>
<td>Know squares of all numbers to (10 \times 10)</td>
</tr>
<tr>
<td>5Nc7</td>
<td>Find factors of two-digit numbers</td>
</tr>
</tbody>
</table>

**Vocabulary**

Factor, multiple, square number, divisibility.

**Resources needed**

Number lines; calculators; \(1–10\) dice; number tracks, beans or other counters; times-table fans; multiplication grids.

**Mental warm-up activities**

Select suitable activities from the mental warm-up activity bank. You may also choose to use the multiplication and division fact tests on Workbook pages 32 and 33 as the mental warm-up activities in this chapter.
Concepts that may be unfamiliar in this topic

**7× and 8× times tables**

Students should already know their times-tables facts up to the 6× table. They will now extend this to learn the 7× and 8× tables and associated division facts. They will also need to begin to use the 9× table in their work with multiples.

**Multiples of 6, 7, 8, and 9**

The concept of multiples is not new to the students but they will be expected to recognise and work with multiples in a higher range.

**Square numbers**

Students will be introduced to the term square number and learn to recognise the square numbers to 100.

**Finding factors of numbers**

Although the term factor may not be known to the students, finding factors relates to division facts and they should be fairly comfortable expressing numbers using pairs of factors. Breaking numbers into factors is important for later work on multiplication where students will learn that they can use factors to make multiplication easier. For example, instead of multiplying by 12 they could multiply by 6 and double the result (6 × 2 = 12).

**Teaching ideas**

**Practical activities**

- Students arrange beans (counters, etc.) in sets of six, seven, eight, nine and ten. They add up the number of beans in one set, two sets, etc. and report on their results.

- Students experiment with beads to prove to themselves that two sets of four contain the same as four sets of two. They should think of other examples like this.

- Students in pairs test each other on times tables up to 10. Students could use multiplication tables and/or times-table facts to test themselves or other students on their tables.

- Arrange a ‘times-table’ competition by dividing students into teams of four or five and getting them to write questions which they use to test other teams on their tables.

- Get students to make ten groups of seven using counters. Ask the class how many counters are in one group of seven, two groups of seven, etc. Write the total down on the chalkboard each time. Ask students if they can see a pattern. Reinforce the pattern obtained by counting in sevens using a number line. Show students that, starting at zero and jumping 7 each time, they get the same pattern of numbers as when they added the sets of seven together. Summarise the 7 times table with a whole-class session.
Get students to make ten groups of eight using counters. Ask the class how many counters are in one group of eight, two groups of eight, etc. Write the total down on the chalkboard each time. Ask students if they can see a pattern. Reinforce the pattern obtained by counting in eights using a number line. Show students that, starting at zero and jumping 8 each time, they get the same pattern of numbers as when they added the sets of eight together. Summarise the 8 times table with a whole-class session.

Make up 16 using base-ten blocks or 16 counters. Ask whether you can divide 16 by 2. Ask the students how they know that they can divide 16 by 2. Let them work with the blocks to show how to divide the blocks into pairs. Give various larger numbers (some odd) and ask the students if they can be divided by 2. Discuss what the class knows about multiples of 2 (they are all even, they end with 0, 2, 4, 6, or 8). Together with the class use this information to reach a rule for determining whether a number is divisible by 2. You can repeat this for the other divisibility rules.

Give students various sets of objects and ask them to double the number. For bigger numbers, use examples such as money amounts, gram and litre amounts, and so on.

Roll a 1–10 die to generate two one-digit numbers. Ask students to say the product as quickly as they can.

Set a context for the students to need to explain how to do multiplication and division questions. For example, an alien is visiting the school and wants to know how we do maths on Earth; a student in the class has been unwell and now needs to catch up on the work they missed; a time capsule is being buried for future generations and we would like to include an example of how to do multiplication and division. Ask students to work together to write a clear explanation of how to approach calculations.

Remind students what is meant by the term ‘factor’. Write a number, for example 24, on the board. Ask students to say factors of the number and record them. Ask students how we can be sure we have found all the factors of 24. Talk about starting from 1 and pairing this with the number it would be multiplied by to get 24, then going through 2, 3, etc. in a similar way until all factor pairs have been recorded. Illustrate factor pairs by drawing arrays for 24 or making them on a geoboard. Repeat for another example. Make sure students are aware that odd numbers can have several factor pairs as well as even numbers, for example 45.

Either provide students with a 100 square or ask them to draw one. Explain that you are going to try and discover which numbers have no other factors than 1 and themselves. Start by crossing out every
multiple of 2 but not 2, as all these numbers must have 2 as an extra factor so they are not what you are looking for. Ask students to suggest what they should cross out next and help them to establish they should next cross out all the multiples of 3 but not 3, and so on. Ask students why they did not need to cross out all the multiples of 4 or 6 and why they can stop once they have crossed out multiples of 7.

**Using the Student Book and Workbook**

Once you have done some revision and practical work on times tables, work through Student Book page 49 with the class. Make sure they understand how to find division facts from the multiplication tables. Let the students complete the activities on their own. Decide how you will use the tests on Workbook pages 32 and 33. If you decide to use these as the mental warm-up activities, you will need to schedule them into your lessons.

Use Student Book page 50 to teach and consolidate the 6 times to 10 times tables. Let the students work on their own to do the activities as quickly and correctly as they can. You can use Workbook pages 32 and 33 to test their recall if you have not decided to use these as the mental warm-up activities for the week.

Work through Student Book page 51 to revise the idea of multiples. Let the students work in pairs to discuss and complete the activities.

Use Student Book page 52 to consolidate work on multiples and to see whether the students can apply what they have learnt to solve related problems.

Demonstrate how some numbers can be organised to make a square. Show also that some numbers cannot be organised into a square. Work through the example on Student Book page 53 with the class and then let the students complete the activities in pairs.

Introduce the idea of factors and do some practical activities with the class before working through Student Book pages 54 and 55. Let students complete Workbook page 34 on their own.

Let students work in pairs or small groups to complete the problem-solving activities related to factors on page 56. They will need to apply their known facts and mental calculation skills to do these activities.

Work through the divisibility rules on Student Book page 57 once you have demonstrated and discussed this using practical apparatus. Let the students work in pairs to complete the activity. Once they have done so, let them work on their own to complete Workbook page 35 as a consolidation and assessment task.
### Assessment questions to ask

- What is $6 \times 3$ (or any other table facts)?
- Starting on 21 and making three jumps of 7 along a number line, what numbers do you land on?
- How many groups of eight are needed to make 40?
- Write another multiplication sentence that has the same answer as $6 \times 5$.
- What is the square of 5 (and any other number)?
- What are all the factors of (12 or any number)?
- Is 9 a multiple of 3? Is 10? (and so on)
- How can you tell if a number is divisible by 2 (or any other number from the rules)?

### Common errors and misconceptions

It is essential that students are familiar with their times tables. Rote learning of tables at this stage will provide students with a resource that will be useful throughout the rest of their lives. If tables are neglected at this stage students will be hindered in their progress later in their mathematics course.

The sign ‘*’ is commonly seen on calculators and computer keyboards. To avoid confusion in the future, students should be told that the signs ‘*’ and ‘×’ are used to represent the same thing.

There is a lot of terminology in this unit that students need to be familiar with and that they may find confusing – for example, finding factors instead of multiples and vice versa. To overcome this, have short regular activities where students have to use the terminology to describe numbers and their properties.

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### 9 Data handling 1

#### Objectives

| 5Dh1 | Answer a set of related questions by collecting, selecting and organising relevant data; draw conclusions from their own and others' data and identify further questions to ask |
| 5Dh2 | Draw and interpret frequency tables, pictograms and bar line charts, with the vertical axis labelled for example in twos, fives, tens, twenties or hundreds. Consider the effect of changing the scale on the vertical axis |
| 5Dh5 | Find and interpret the mode of a set of data |

Note: frequency tables and bar line graphs are covered in Chapter 17
Vocabulary
Data, bar graph, axis, scale, pictogram, symbol, key, mode.

Resources needed
No specific resources are needed for this chapter although it may be useful to find and display different kinds of graphs.

Mental warm-up activities
Select suitable activities from the place value and number sense section of the mental warm-up activity bank.

Concepts that may be unfamiliar in this topic
Drawing conclusions and asking questions about data
As students refine their understanding of graphs and other representations of data they need to begin to draw conclusions about what the data actually tells them. At this level, these can be as simple as ‘Most people have two brothers and sisters’ or ‘If I was the shopkeeper I would stock more oranges as they are the most popular fruit’. Students also need to begin to critically assess where data comes from and why it may be have been collected. Again, their questions are likely to be at a very basic level at this stage.

The mode of a set of data
The mode is the value that appears most often in a data set. It is one of the three main types of average (the others being the mean and median) that are generally used to summarise a set of data. It is a fairly easy concept to understand and find but students need practice finding the mode when the answer is a category (for example, black is the mode of hair colours in our class) and when it is a value (the mode of the marks in this test is 6).

Teaching ideas
Practical activities

Students could devise and carry out a survey of ten members of the class. For example, they could ask each student to choose their favourite drink from a choice of four. The student could present their results with blocks or Cuisenaire rods using a simple key of one block representing one student. Students should work in pairs. One student could make up and display the results of a survey, with different scale factors, using Cuisenaire rods of blocks and the other student must interpret the results.

Students could practice recording data on a tally chart or simple table from the results of a survey.

Students could devise and carry out a survey of all of the members of the class. They could record their data in the form of a tally chart and draw a bar graph using a suitable scale factor.
Using the Student Book and Workbook

Show students some examples of bar graphs from magazines or newspapers, and ask questions about these. Make sure students understand how to read a bar graph before they work through Student Book page 58.

Let the students work in pairs to complete the table on Student Book page 59. Check that they have added correctly to find the totals before they move on. Let them discuss the graph before they redraw it. Use Workbook page 36 to assess that students have some understanding of how the choice of scale affects the appearance of a graph.

Let the students work in pairs to discuss and complete the activities on Student Book pages 60 and 61 using the grid on Workbook page 37 to draw their graphs.

Teach the students the term ‘mode’ and work through the example on Student Book page 62 with the class to show how this average is obtained. Students can then complete the activity on their own.

Use the graph and survey activity on Student Book page 63 to tie up the concepts taught in this chapter and to assess that the students can read, draw and work with graphs.

Assessment questions to ask

• What is the best way to represent this data? Should we use a pictogram or a bar graph? Why?
• What units should we use on the y-axis?
• Which is the longest bar on this bar graph? What does it show us?
• Which is the shortest bar?
• What statements can you make about this graph just by looking at it quickly?
• How can you tell from a bar graph which item is the least popular?
• In bar graphs do the bars always go vertically?
• In a bar graph a bar 1 cm high represents 8 people. How high would a bar need to be to represent 24 people?
• How can the interval chosen for the scale make a graph look different?
• How do you know what the symbols on a pictogram represent?
• If a circle represents 8 people, how could you show 6/4/2 people?
• What is the mode?
• Can you find the mode of this data (supply data)?

Common errors and misconceptions

Some students may have difficulty deciding what kind of chart or graph to use for which data. Encourage them to look carefully at what is being compared. Unchanging amounts for different categories are easily represented as bar charts, whereas a constantly changing value, for example the temperature or pressure in a particular place, is more logically expressed as a line graph.
10: Numbers and number patterns

Objectives

<table>
<thead>
<tr>
<th>Objective</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5Nn1</td>
<td>Count on and back in steps of constant size, extending beyond zero</td>
</tr>
<tr>
<td>5Nn9</td>
<td>Order and compare negative numbers on a number line and temperature scale</td>
</tr>
<tr>
<td>5Nn10</td>
<td>Calculate a rise or fall in temperature</td>
</tr>
<tr>
<td>5Nn12</td>
<td>Recognise and extend number sequences</td>
</tr>
<tr>
<td>5Nn13</td>
<td>Recognise odd and even numbers and multiples of 5, 10, 25, 50 and 100 up to 1000</td>
</tr>
<tr>
<td>5Nn14</td>
<td>Make general statements about sums, difference and multiples of odd and even numbers</td>
</tr>
</tbody>
</table>

Vocabulary

Positive, negative, thermometer, temperature, degrees Celsius, below freezing, sequence, rule, pattern, odd, even.

Resources needed

Play money; number lines extending to negative values; thermometer to show the students; blank thermometer scales if possible; calculators; counters for making arrays.

Mental warm-up activities

Select suitable activities from the mental warm-up activity bank.

Concepts that may be unfamiliar in this topic

Order and compare negative numbers

Students have already worked with negative numbers in context and they should also be confident counting back through zero to negative values. In this section, the idea of directed (negative and positive) numbers is explored and extended. In addition, students will use number lines to count, order and compare negative and positive numbers. They will then apply what they know to calculate differences in temperature.

Recognise multiples of 25 and 50 up to 1000

Students previously learnt to recognise multiples of 5 (which end in 0 or 5) and multiples of 10 and 100 (which end in 0 or 00) up to 1000. Now they will extend their understanding to multiples of 25 (which end in 25, 50, 75 or...
00) and multiples of 50 (which end in 50 or 00). Remind them that multiples of 25 will all be multiples of 5 but only some will be multiples of 10 or 100. Similarly, multiples of 50 will all be multiples of 5, 10 and 25 but only those ending in 00 will be multiples of 100.

**Extend generalised statements about odd and even numbers**

Previously students should have come to the realisation that they can work out whether a sum or difference will be odd or even by looking at the numbers involved. For example, if you are adding two odd numbers your answer will be even. If you are subtracting an odd number from an even number, your answer will be odd. In this chapter, they will extend these general statements to include the results of multiplying odd and even numbers. You may need to demonstrate odd and even numbers using arrays of counters in groups to help students formulate their ideas.

**Teaching ideas**

**Practical activities**

- Play a banking game with the class using play notes. Let students take turns to be the banker who records all transactions. Give different students different amounts of play money. Instruct the students to deposit, withdraw and borrow money from the bank. Discuss what happens to your bank balance when you have no money in your account and you borrow from the bank. Make sure students realise that the bank will show a negative amount of money in such cases.

- Play games making jumps on number lines to remind students what happens when you count back through zero into negative figures.

- Display a large thermometer for the class. Use a pointer or counter to move up and down the scale to demonstrate increases and decreases in temperature. Let the students come up and move the counter to the next place based on given instructions. For example, set the counter at 12 °C and say things like, two degrees warmer, six degrees colder, a drop of 5 degrees, a decrease of 3 degrees, an increase of 5 degrees and so on.

- Display any number chart and play games in which the students have to find numbers based on counting back and/or forwards in given amounts.

- Let the students experiment with drawing increasing or decreasing shape patterns. Spend some time discussing how many shapes you need to make each new pattern. Introduce the idea of rules for patterning and encourage students to express these rules mathematically as far as possible.

**Using the Student Book and Workbook**

- Revise the concept of negative and positive numbers by discussing the example on Student Book page 64 with the class. Allow students to jot down the answers to the questions before checking and discussing these as a class.
Display a large number line extending to negative numbers and demonstrate how to count on and back bridging zero. Then have the students complete Student Book page 65 on their own. Use Workbook page 38 to assess that students can work with, order and compare positive and negative numbers.

Revise the concept of temperature reminding the class that this is a measure of how hot or cold it is. Temperature is measured using a thermometer and the measurements are read from the scale like any other measurements. Let the students work through Student Book page 66 to revise the basic concepts. Once they have done so, have them use the blank thermometers on Workbook page 39 to calculate and show temperature changes.

After doing some examples with the class, let the students work in pairs to discuss and complete the activities on Student Book page 67. Spend some time discussing their answers and help them describe the rules they discover as clearly as possible.

Let the students complete the activities on Student Book page 68 on their own. Observe them as they work to assist and identify any students who find these ideas too difficult. Model solutions and use calculators to assist as necessary.

Use counters and arrays to model odd and even numbers. Discuss how you can tell whether any number is odd or even by looking at the digit in the units place. Try to elicit from the class that numbers ending in 0, 2, 4, 6, 8 are even and those ending in 1, 3, 5, 7, 9 are odd. Stress that this applies no matter what the other digits are. Let the students work in pairs to complete the activities on Student Book page 69.

Assessment questions to ask
- Can you tell me what a negative number is?
- What is this temperature (shown on a thermometer scale or number line)?
- Can you show me where –3 (or any number) will go on this number line?
- If I am on the 2nd floor and I get in the lift and go down 4 floors, what level will I be on?
- What rule was used to make this pattern?
- Is there any other way of carrying on this pattern?
- What comes next in this pattern?

Common errors and misconceptions
Students sometimes get confused by the fact that –12 is smaller than –2 whilst 12 is greater than 2. Remind them that numbers get smaller as you move to the left on a number line. Demonstrate this with positive numbers first, then extend it to negative numbers as well. It may help to remind the students that someone who owes $12 (i.e. –12) has less money in reality than a person who owes only $2.
Some students find it easy to work with number sequences when they create their own but struggle to describe how a sequence or pattern works when it is given to them. It sometimes helps to let them physically build a given sequence using counters or by drawing dots so that they can work out what they need to do to get the next term in each case.

## 11 Angles and lines

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<td>Recognise perpendicular and parallel lines in 2D shapes, drawings and the environment</td>
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<tr>
<td>5Gs6</td>
<td>Understand and use angle measure in degrees; measure angles to the nearest 5°; identify, describe and estimate the size of angles and classify them as acute, right or obtuse</td>
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<tr>
<td>5Gs7</td>
<td>Calculate angles in a straight line</td>
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### Vocabulary

Angle, protractor, degree, parallel, perpendicular, acute angle, right angle, obtuse angle, sum of angles, angles on a line

### Resources needed

Protractors; rulers; set squares; pictures and objects that can be used to give examples of parallel and perpendicular lines; flashcards showing different angles.

### Mental warm-up activities

Select suitable activities from the mental warm-up activity bank.

### Concepts that may be unfamiliar in this topic

**Parallel and perpendicular lines**

This is the first time students are formally introduced to these terms although they have worked with both types of lines previously to develop their concepts of shape. Remind students that there are two parallel lines in the word parallel (i.e. the two letters l) to help them remember the difference between parallel and perpendicular.
Measuring angles in degrees

Previously the students have considered angles as turns (although they know they are measured in degrees) and ordered them by size without actually measuring them. In this chapter the students need to learn how to read and use a protractor (to an accuracy of 5 degrees). They may not find this difficult if you treat it like just another measuring scale.

Classifying angles by size

Students will learn the terms right angle, acute angle and obtuse angle. The major difficulty in this area is often remembering the correct terminology rather than classifying or identifying angles. Flashcards and constant use of the correct words will help the students memorise and internalise these key terms.

Calculating angles

Knowing that the angles on a line always add up to 180 degrees is a basic axiom which forms the basis of later work in geometry. Students can physically prove this axiom by cutting out and arranging angles on a line so they lie against a straight edge (known to be 180 degrees) or the scale of their protractor.

Teaching ideas

Practical activities

Show students how to draw perpendicular and parallel lines and ask them to draw patterns and pictures using the two types of line – for example, can they write their names using only perpendicular and parallel lines? Revise/introduce the terminology ‘parallel’ and ‘perpendicular’ and emphasise the key points – for example, parallel lines are always the same distance apart (that is, they never meet) and perpendicular lines are at right angles to each other.

Show the students a protractor and show them how to use it. Ask them to explain what we use it for, how we use it, and what the little divisions mean along the outer curve of the protractor. Students demonstrate how we use a protractor to measure and draw given angles (90°, 100°, 45°, and so on).

Ask students to look around the room and identify right angles and angles more or less than right angles.

Hand out flashcards showing different angles. Ask students to arrange themselves in a line showing the angles in order of size. Encourage students to talk about how they compared the angles.

Hold a flashcard up showing an angle. Ask students to draw a smaller/larger angle.

Hold two flashcards up showing angles of different sizes. Ask students to draw an angle that is smaller than one of the cards and larger than the other.
Using the Student Book and Workbook

Teach the word parallel and what it means and make sure the students can say and spell it before working through Student Book page 70 as a class. Discuss where else you might find parallel lines in real life. Let the students work independently to complete Workbook page 40.

Teach the word perpendicular and allow the students to find examples of perpendicular lines in the classroom. Let them use a set square or folded corner of paper to check that their guesses are correct. Let the students work in small groups to complete Student Book page 71. When they have done so, let them work independently to complete Workbook page 41. Discuss their answers and reasoning as a class.

You will need to spend time teaching the students how to use and read a protractor before you tackle Student Book page 72. It is helpful to model the correct use of this on an overhead projector or whiteboard using a real protractor. If that is not possible, you could use a video or animation to demonstrate the correct way to place and read the scale. Remind the students that the scale works in two directions. (Point out that this is not so different from many rulers which have from 0 to 30 cm on one side and 0 to 300 mm running in the opposite direction on the other side.)

Let the students work on their own to complete the measuring and drawing activities on Student Book page 73 to consolidate their skills. Make sure they realise that the length of the arms of an angle do not affect the measurement in degrees.

Teach the terms right angle, acute angle and obtuse angle. Let the students work on their own to complete Student Book page 74. Once they have done this, let them work in pairs to complete Workbook page 42.

Let the students work independently or in pairs to do the investigation on Student Book page 75. Discuss what they have learnt from this investigation as a class before asking them to complete Workbook page 43.

Assessment questions to ask

- Can you estimate the size of this angle?
- What important tips would you give someone to help them use a protractor properly?
- Can you label each of these angles: acute, obtuse, right angle or reflex?
- Can you find this missing angle without measuring? How did you do it?
- Can you explain what is meant by ‘parallel’?
- Can you explain what is meant by ‘perpendicular’?
• Can you point to an example of parallel lines in the classroom?
• Can you point to an example of perpendicular lines in the classroom?

Common errors and misconceptions
Many students struggle to use a protractor correctly. It is important to demonstrate how to line up a protractor properly and how to read the correct value. Encourage students to think about the answer they get and whether it makes sense – for example, if they have read 165° off their protractor, yet are looking at an acute angle, something must be wrong.

Some students may have difficulty remembering the terminology and definitions and thus make mistakes when asked questions. Keep offering opportunities to identify perpendicular and parallel lines and encourage students to say why they know which lines are which.

### 12 Fractions

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<tr>
<td>5Nn15</td>
<td>Recognise equivalence between (\frac{1}{2}), (\frac{1}{4}) and (\frac{1}{8}); (\frac{1}{3}) and (\frac{1}{6}); (\frac{1}{5}) and (\frac{1}{10})</td>
<td></td>
</tr>
<tr>
<td>5Nn17</td>
<td>Change an improper fraction to a mixed number, e.g. (\frac{7}{4}) to (1\frac{3}{4}); order mixed numbers and place between whole numbers on a number line</td>
<td></td>
</tr>
<tr>
<td>5Nn18</td>
<td>Relate finding fractions to division and use to find simple fractions of quantities</td>
<td></td>
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</tbody>
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**Vocabulary**
- Fraction, numerator, denominator, equivalent, improper fraction, mixed number.

**Resources needed**
- Fraction wall for each student; shapes that can be divided into parts; counters; beads or seeds to model amounts.

**Mental warm-up activities**
- Select suitable activities from the mental warm-up activity bank.
Concepts that may be unfamiliar in this topic

Extend understanding of equivalence

Students have worked with equivalent fractions previously, so they should understand the concept. In this chapter they will extend their understanding to work with family groups of fractions and recognise equivalence between them.

Change improper fractions to mixed numbers

In Stage 4 students ordered and compared mixed numbers but they may not have worked with improper fractions. At this level, it is useful to treat improper fractions as concrete amounts. For example, I cut the pizzas in half, keep a half for myself and now I have seven halves. How many whole pizzas is that? I cut pieces of card into quarters. I gave each group 9 quarters. How many whole cards can they make? This helps them understand that a numerator can be greater than a denominator and that improper fractions can be rearranged to make equivalent mixed numbers. Some students will grasp the division principle here and use it to convert from improper fractions to mixed numbers; others may find this too abstract and need to use diagrams and jottings.

Teaching ideas

Practical activities

Write on the board: $1 ÷ 4$. Then write $\frac{1}{4}$ and ask the students to identify its decimal equivalent, 0.25. They can do this either by generating an equivalent fraction with a decimal denominator, or they can check on a calculator. Draw their attention to the fact that the whole number 4 can also be written as an improper fraction: $\frac{4}{1}$. Explain that $\frac{1}{4}$ is the ‘reciprocal’ of $\frac{4}{1}$. Reciprocals are also sometimes known as ‘inverses’, because you invert the positions of the numbers in the fraction. $\frac{5}{1}$ becomes $\frac{1}{5}$, and so on. Work through page 83 of the Student Book with the class, emphasising the relationship between each whole number and its reciprocal.

Write a fraction on the board, for example $\frac{2}{3}$ or $\frac{4}{7}$. Ask students if they can remember the correct names for the top and bottom numbers of a fraction. Remind them of ‘numerator’ and ‘denominator’ if necessary. Ask students to explain what the numbers mean and use their responses to establish that the denominator is the number of parts into which the whole has been divided and the numerator tells us how many of these parts we have. Draw sets of shapes on the board divided into equal parts, for example, a shape divided into quarters and a copy of the same shape divided into eighths. Circle a fraction of one set, for example $\frac{1}{3}$, and ask students how much of the other set must be shaded to make the two diagrams look the same.
Draw a fraction wall, something like this:

```
  1  2  3  4  5  6  7  8  9  10
  11 12 13 14 15 16 17 18 19 20
  21 22 23 24 25 26 27 28 29 30
  31 32 33 34 35 36 37 38 39 40
```

Explain that the top row is one whole row. Each other row is divided into equal parts. Have the students determine the fractions represented by each part on each row. They can fill in the fractions on their own fraction wall.

Write a fraction on the board, for example $\frac{1}{4}$. Ask students to use the fraction wall to find a fraction that is the same. Remind students that these fractions are called ‘equivalent fractions’. Repeat until there are several pairs of equivalent fractions on the board. Ask students to look at each pair and see if they can spot anything about the numerator and denominator in each pair. Use students’ answers to work towards the idea that equivalent fractions can be found by multiplying or dividing the numerator and denominator by the same number. Work through Student Book page 77.

Display a fraction. Go round the class asking students to say an equivalent fraction and record their answers. How many can they give? Ask: are there any more? How do they know?

Divide the class into groups. Give each group a set of shapes cut into fractional parts and one whole shape for comparison, for example, one group may get circles cut into halves. Another group may get squares cut into quarters (diagonally) another group may get rectangles divided into thirds and so on. Try to provide quite a number for each group. Ask the students to grab some of the parts and then say how many they have. For example, I have three halves, I have ten thirds and so on. Explain how to write each amount as an improper fraction. Let students make different groups using the parts they have and write them as improper fractions.
Using the same shapes cut into fractional parts, let the students work out how many pieces make 1 whole (i.e. three thirds make one whole rectangle and so on). Then ask them to make another grab of pieces, express the result as an improper fraction and then say how many wholes and parts this is. Discuss the relationship between improper fractions and mixed numbers and let the students share the methods they used to convert from an improper fraction to a mixed number.

Revise making fractions of amounts. Arrange the class in groups and give each group a number of counters (24 is quite a useful number as it can be divided into halves, thirds, quarters, sixths, eights and twelfths). Ask the class to work out different fractions of the counters. For example, ask questions such as: what is half of 24? I want $\frac{3}{8}$ of these counters, how many is that? And so on. Repeat this with different amounts as necessary to make sure the students can find a fraction of an amount. Spend some time discussing how they can find a fraction of an amount without using counters.

**Using the Student Book and Workbook**

Use Student Book page 76 to revise fractions. Let the students work on their own or in pairs to complete the activities.

Once you have done some practical activities to revise equivalent fractions using the fraction wall, work through the examples using number lines to show equivalent fractions on page 77 in the Student Book. Let the students work in groups to complete the activities on this page. Once you are confident that they are able to find equivalent fractions, let them work independently to complete Workbook page 44. Check this and discuss how students worked to find the answers before asking them to complete Workbook page 45 as an informal assessment task.

Use Student Book page 78 and Workbook page 46 once you have done some practical activities on improper fractions.

Discuss the methods of changing improper fractions to mixed numbers shown on Student Book page 79 with the class. Let the students complete the activities on their own. Assist as necessary.

Use Workbook page 47 as a revision and consolidation activity to make sure the students can express an amount as a fraction. Then have the class complete Student Book page 80.

**Assessment questions to ask**

- Give me a fraction that is equivalent to $\frac{3}{5}$ but has a denominator of 10. How did you do it?
- Give me a fraction equivalent to $\frac{2}{3}$. 
• What fraction of our class are girls? boys?
• What fraction of this group of shapes are triangles?
• How would you change \( \frac{11}{5} \) to a mixed number?
• What is (any fraction) of this amount?

**Common errors and misconceptions**
Students often have difficulties with fractions. Many of these difficulties seem to arise from an over-reliance on the part of a whole model and this always being presented through shaded diagrams. It is important for students to see fractions as numbers that can be ordered on a number line and compared. They also need to be aware that the ‘whole’ can be a quantity and thus, for example, 12 out of 24 can be expressed as a fraction.

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### 13 Perimeter and area

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<td>Measure and calculate the perimeter of regular and irregular polygons</td>
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<tr>
<td><strong>5Ma2</strong></td>
<td>Understand area measured in square centimetres (cm(^2))</td>
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<tr>
<td><strong>5Ma3</strong></td>
<td>Use the formula for the area of a rectangle to calculate the rectangle’s area</td>
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<tr>
<td><strong>5Ml7</strong></td>
<td>Draw and measure lines to the nearest centimetre and millimetre</td>
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**Vocabulary**
Perimeter, area, square centimetre, formula.

**Resources**
Rulers; selection of regular and irregular shapes; calculators; string for measuring curved sides.

**Mental warm-up activities**
Select suitable activities from the mental warm-up activity bank. You might like to include some work on mentally doubling numbers as this will help students find the perimeter of rectangles. Similarly, you may wish to revise multiplication facts and square numbers as you work with area of shapes.
Concepts that may be unfamiliar in this topic

Using a formula to find the area of a rectangle

Previously students found the area of shapes by counting squares on a grid. Now they are going to extend that learning to find more efficient methods of finding area of rectangles using the simple formula Area = length \times breadth. Remind them that their answer should be given in square units. If students ask, you may also need to discuss the fact that a square is the same as a rectangle with equal sides, so the same formula applies, it is just that the length and breadth are equal.

Teaching ideas

Practical activities

1. Revise measuring accurately in centimetres and millimetres by repeating any of the practical activities detailed in Chapter 5.

2. Remind the students that the perimeter is the distance around the boundaries of a shape. Let the students find the perimeter of some large areas in the school grounds (regular shapes and irregular shapes) by pacing them out and giving the perimeter in steps or paces.

3. Arrange the class into groups. Hand out a number of small shapes to each group. (Try to use plastic or cardboard shapes but if this is not possible, prepare a sheet with a number of shapes on it to distribute to the class.) Let the students draw around each shape to show its perimeter on paper. Then have them measure the perimeter in centimetres and/or millimetres. If you let the students measure in centimetres, you can also use this activity to revise converting from a larger to a smaller unit of measure.

4. Revise finding area of shapes using a grid of square centimetres. If possible, prepare an acetate sheet (overhead transparency) or slide with a grid on it for each group. Let them superimpose this on a sheet of shapes to find the dimensions of the sides and the area in square centimetres.

5. Draw rectangles in different orientations on the board. Label some of the dimensions, for example some or all of the sides. Ask students for which rectangles they could find the area with the information they have and which they need to have more information.

6. Ask students to find the area of the classroom and objects within the room, for example, the top of a desk, the cover of a book, etc.
Give each group a set of cuboid boxes or containers. Ask them to choose the face that they think has the largest (or smallest) area. Place a sticker on this face, or mark it somehow. Let the students measure the length and breadth of all the faces and calculate their area to see whether the face they selected originally is actually the one with the largest (or smallest) area.

**Using the Student Book and Workbook**

You can use Workbook page 48 to revise perimeter and measuring. Let the students work on their own and have a class discussion about how they worked out the solutions.

Let the students work on their own to complete and check Student Book page 81.

Use Student Book page 82 to check that the students are able to calculate the perimeter of different shapes and that they can work out missing dimensions given the perimeter of a shape.

Once you have revised the concept of area, let the students measure the sides and apply the formula to find the area of the rectangles on Student Book page 83. If the students struggle with this, let them check their answers using a grid printed on acetate sheet.

Introduce the term formula and explain to the class that this a ‘rule’ that works for every rectangle, no matter what its dimensions are. Work through a few examples similar to those in the table on Student Book page 84 before asking the class to complete these activities.

Use Workbook page 49 to consolidate the concepts dealt with in this chapter and to check that the students understand the difference between perimeter and area of shapes.

**Assessment questions to ask**

- What information do you need to calculate the area of a rectangle?
- What information do you need to calculate the area of a square?
- What is the area of a 3 cm × 5 cm rectangle? A 30 m × 50 m rectangle? What pattern do you notice about these two answers? Explain it.
- What is the formula for calculating the area of a rectangle?
- If I draw a rectangle on squared paper, what other way is there to calculate the area besides using the formula?

**Common errors and misconceptions**

Students may forget to include the units when they calculate area. Continue to remind them to do this and refer back to the square grid to reinforce the idea of a square unit.
14: Multiplication and division strategies

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<td><strong>5Nc21</strong></td>
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Note: work on decimals can be found in Chapter 16

**Vocabulary**

Multiple, place value, placeholder, product, division, inverse, double, halve, factors, compensating.

**Resources**

Multiplication tables; place value cards and charts; calculators.

**Mental warm-up activities**

Select suitable activities from the mental warm-up activity bank.

**Concepts that may be unfamiliar in this topic**

**Multiplying and dividing by 100**

Students should know how to multiply and divide any number by 10 and explain the effect. Now they are going to extend this by working into a higher number range. Once you are sure the students understand the effects.
of multiplying by 10, it is fairly simple to demonstrate that multiplying by 100 moves the digits two places to the left (remind the class that 100 = 10 \times 10, so in fact you are multiplying by 10 twice, and therefore you move two places). Repeat this for division, being aware that all answers at this stage are likely to be whole numbers or decimals with one decimal place at most.

**Multiplying by 19 or 21 using rounding and compensation**

Students know how to multiply by 2 using table facts or doubling, they also know how to multiply by 10 and this makes it easy for them to multiply by 20 if they consider 20 as a product of its factors 2 \times 10. In this chapter, they will learn to use this strategy to multiply by 19 and 21 by rounding these numbers to 20 and then compensating. For example, 19 \times 8 = 20 \times 8 - 8; 160 - 8 = 152. Similarly, 21 \times 8 = 20 \times 8 + 8 = 160 + 8 = 168. This is an important strategy that can be extended to any near multiples of 10 once the students have grasped the concept.

**Multiply by 25 by multiplying by 100 then dividing by 4**

This is a useful strategy for finding multiples of 25 using equivalence. Once students know that 100 ÷ 4 = 25 they can use that fact to multiply by 25. For example, 12 \times 25 = 12 \times 100 ÷ 4 = 1200 ÷ 4 = 300. This is much easier than the long multiplication algorithm the students may otherwise need. For numbers that are less easy to divide by 4, remind the students that they can halve and then halve again to find the answer because 4 = 2 \times 2.

**Using factors to multiply**

As students begin to work with larger numbers and to multiply by two-digit numbers, they need to realise that they can use factors to simplify their calculations. For example, to multiply by 15 you can multiply by 5 then 3 or vice versa. This concept will be used in various strategies and it can demystify multiplication for many students, so spend time making sure the students understand how it works and that they can use it.

**Multiplying by two-digit numbers**

In Stage 4, students focused on multiplication by one-digit numbers. This year they will extend their skills and strategies (using the methods outlined above) to develop a range of efficient methods for multiplication by two-digit numbers. They will build on this work in later chapters.

**Teaching ideas**

**Practical activities**

Revise multiplication by 10 using place value charts and calculators. Record the results and make sure the students understand that to multiply by 10 we move the digits one place to the left. Next, ask what happens when you multiply by 10 and then multiply by 10 again? Discuss the results. Explain that this is the equivalent of multiplying by 100. Do some examples with the class to establish the fact that to multiply by 100 you move the digits two places to the left.
Remind students that division is the inverse of multiplication and repeat the activities you did before for division to establish the inverse rules.

Set a problem that leads to multiplication by multiples of 10. For example, a book has 48 pages. How many pages would there be in 30 books? You can use cards or sticky notes to model this for the class:

\[
\begin{array}{cccccccccc}
48 & 48 & 48 & 48 & 48 & 48 & 48 & 48 & 48 & 48 \\
48 & 48 & 48 & 48 & 48 & 48 & 48 & 48 & 48 & 48 \\
48 & 48 & 48 & 48 & 48 & 48 & 48 & 48 & 48 & 48 \\
\end{array}
\]

This shows that 30 books are the same as \(3 \times 10\) books and leads to the solution \(48 \times 10 = 480\), \(480 \times 3 = 400 \times 3 + 80 \times 3 = 1200 + 240 = 1440\). Having found that solution, you might like to ask the class to suggest how they could find the number of pages in 60 books (double the answer) and 90 books (multiply the answer by 3) or 15 books (halve the answer).

If the students are ready, you could use the same strategy to investigate multiplication by any two-digit number. For example, how many pages in 33 books. Show by demonstrating that 33 can be partitioned into 3 books and 30 books, and the resulting products can be added together to find the answer.

Revise doubling and halving using piles of counters or seeds. Then show the students some examples in which you halve larger numbers by partitioning them. Stick to even numbers at this stage. For example to halve 2800 you would write it as \(2000 + 800\), halve each amount to get \(1000 + 400\) and add the results to get 1400. Repeat for doubling.

Use the modelling method above to demonstrate how you can break a number into its factors to make it easier to multiply by that number. For example, if you have to multiply 9 by 16, you can model this as 16 arranged in three groups of three, or 9 arranged in 2 groups of 8, or 4 groups of 4.

Using the Student Book and Workbook

Work through the examples on Student Book page 85 with the class. Let the students work independently to complete and check the mental calculations before asking them to solve the worded problems. Let the students complete Workbook page 50 as a fun consolidation activity.

Work through Student Book page 86 with the class to teach and consolidate division by 10 and 100. Make sure the students understand that to find one tenth they have to divide by 10 and to
find one hundredth they have to divide by 100. Once the class has completed the activities, let the students work in pairs to play the flow-diagram game on Workbook page 51.

Work through the examples on Student Book page 87 with the class before asking them to complete the activities. Observe them as they work to see what strategies they use and suggest alternatives where necessary.

Once you have done some practical revision work on doubling and halving, work through the examples on Student Book page 88 with the class. Let the class work through the activities on that page. Use Workbook page 52 to check that the students understand the concepts and that they can apply them in the context of prices and money amounts.

Revise finding factors of numbers before working through Student Book page 89 with the class. This is a fundamental concept and you need to make sure the students understand it before moving on.

Teach the rounding and compensation methods of multiplying by 19 and 21 using the teaching text and examples on Student Book page 90. Supplement these with other examples if necessary to make sure the students understand how this works. Let them work in pairs to complete the activities as the discussion will help them internalise and understand the ideas.

Use the teaching text and examples on Student Book page 91 to reinforce the fact that $100 = 4 \times 25$ before showing the students how to use this method of multiplying by 25. Let them work on their own to find the answers using the methods they feel most comfortable with (remember they can also find the answer using factors $(5 \times 5)$ and by splitting 25 into 20 and 5, and allow for alternative methods).

**Assessment questions to ask**

- What is [ ] multiplied by 10/100?
- What do I get if I divide [ ] by 10/100?
- I divided a number by 100 and got an answer of [ ]. What was the original number?
- What is one tenth/one hundredth of [ ]?
- Can you tell me an easy way of multiplying by 25?
- Is multiplying by 3 and then multiplying by 10 the same as multiplying by 30? Why or why not?
- What are the factors of [ ]?
- How can we use factors to make multiplication easier?
- Which of these mean the same (give examples of multiplications using numbers and factors, for example $16 \times 8; 8 \times 2 \times 8, 4 \times 4 \times 4 \times 2$, and so on)
Common errors and misconceptions

Some students may still struggle to recall multiplication and division facts, particularly for the 7 and 8 times tables which they have only learnt this year. Allow the students to use table grids as a memory aid and reference if necessary whilst practising recall of facts on an ongoing basis.

The rules for multiplying and dividing by 10 and 100 may confuse students who struggle with their understanding of place value. Use manipulatives such as place-value cards and tables and base-ten blocks to model calculations. You may also like to get the students to use a calculator to do a number of examples as they seem to trust in the technology and this makes them more able to internalise the patterns, even if they don’t express the rule well in mathematical terms.

15 Transformations

<table>
<thead>
<tr>
<th>15: Transformations</th>
<th>Student Book pp 92–94</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Workbook pp 53–54</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Objectives</th>
<th>5Gp2</th>
<th>Predict where a polygon will be after reflection when the mirror line is parallel to one of the sides, including when the line is oblique</th>
</tr>
</thead>
<tbody>
<tr>
<td>5Gp3</td>
<td></td>
<td>Understand translation as movement along a straight line, identify where polygons will be after a translation and give instructions for translating shapes</td>
</tr>
</tbody>
</table>

Vocabulary

Reflection, flip, mirror line, symmetry, translation, slide, transformation, straight line.

Resources needed

Small mirrors (such as mirror tiles); squared paper; card; scissors.

Mental warm-up activities

Select suitable activities from the place value and number sense section of the mental warm-up activity bank.
Concepts that may be unfamiliar in this topic

Transformations – reflections and translations

Students have not formally learned about transformations before this stage. You will need to spend some time developing both the terminology and the concepts involved in this chapter to make sure they are able to reflect shapes and identify the mirror line for a shape and its reflection and that they are able to show where a shape will be after a single translation (movement up and down or to the left or right).

Teaching ideas

Practical activities

Ask students to create patterns using a chosen shape and performing transformations. Encourage students to explain how they created their patterns using the correct terminology.

Draw a grid on the board. Draw a shape on the grid and then perform a transformation on it and draw the new shape. Ask students to describe the transformation.

Draw a shape on the grid and the same shape at a different position. Ask students to take it in turns to perform a transformation on the original shape until it lies on top of the second shape. What is the fewest number of transformations they need to use?

Ask pairs of students to sit opposite each other with a screen, for example an open file, between them. Give each student squared paper. One student must draw a shape on their paper and move it using one or more transformations. They must then describe to their partner where to draw the shape and how to move it to its new position. Once their partner has followed the instructions both students reveal their work and see if it is the same.

Using the Student Book and Workbook

After you have worked through some of the practical activities described above, write the word ‘transform’ on the board. Explain that when we change the position of a shape on a grid, by moving its position or size, we call this change a ‘transformation’. Demonstrate an example of a reflection by drawing a shape, for example a scalene triangle, and then drawing its reflection on the other side of a mirror line. Work through Student Book page 92 with the class.

Let students work independently to complete the reflections on Workbook page 53. Allow them to use a mirror to check their work.

Using the example at the top of Student Book page 93, demonstrate how to slide (translate) a shape. A slide moves a shape along a vertical
and/or horizontal axis to a new position on a grid. Once you have worked through one or two examples, students can work through Student Book pages 93 and 94 and Workbook page 54.

**Assessment questions to ask**

- Look at the two positions of this shape. Can you describe the movement of the shape from position 1 to position 2?
- Which two movements are used to move this shape from A to B?
- Can you move this shape following these directions?
- What is the fewest number of movements you need to perform to move this shape from A to B?

**Common errors and misconceptions**

When reflecting shapes, students sometimes do not appreciate that each point of the image must be the same distance away from the mirror line in a perpendicular direction, and simply draw a copy of the shape on the other side of the line without thinking about the orientation of the image. Using a mirror to check their work can help prevent this.

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### 16 Working with decimals

<table>
<thead>
<tr>
<th>16: Working with decimals</th>
<th><strong>Student Book</strong> pp 95–99</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Workbook</strong> pp 55–57</td>
<td></td>
</tr>
<tr>
<td><strong>Objectives</strong></td>
<td></td>
</tr>
<tr>
<td>5Nc1</td>
<td>Know by heart pairs of one-place decimals with a total of 1, e.g. 0.8 + 0.2</td>
</tr>
<tr>
<td>5Nc2</td>
<td>Derive quickly pairs of decimals with a total of 10 and with a total of 1</td>
</tr>
<tr>
<td>5Nc10</td>
<td>Use appropriate strategies to add or subtract pairs of two- and three-digit numbers and numbers with one decimal place, using jottings where necessary</td>
</tr>
<tr>
<td>5Nc11</td>
<td>Calculate differences between near multiples of 1000, e.g. 5026 – 4998, or near multiples of 1, e.g. 3.2 – 2.6</td>
</tr>
<tr>
<td>5Nc16</td>
<td>Double any number up to 100 and halve even numbers to 200, and use this to double and halve numbers with one or two decimal places, e.g. double 3.4 and half of 8.6</td>
</tr>
<tr>
<td>5Nc19</td>
<td>Add or subtract any pair of three- and/or four-digit numbers, with the same number of decimal places, including amounts of money</td>
</tr>
</tbody>
</table>
Vocabulary
Decimal, whole, tenth, hundredth, place value.

Resources
Strips divided into tenths; number lines; 100 squares; play money (coins and notes); calculators.

Mental warm-up activities
Select suitable activities from the place value and number sense section of the mental warm-up activity bank.

Concepts that may be unfamiliar in this topic

Know pairs of one-place decimals that make 1
Students need to memorise the addition facts for one-place decimals that add up to 1. These facts will help them as they develop their calculation skills to include decimal amounts.

Derive pairs of decimals that make 10 and 1
Students need to use the addition and subtraction facts they already know together with their knowledge of place value to derive (not memorise) extended facts for one and two place decimals. Once students understand how this works, they should easily be able to do this. The concepts here are important for later work on adding and subtracting decimals with any number of places.

Extend calculation strategies to include decimal amounts
Students need to extend their known strategies for working with whole numbers to include decimal values. They will learn how to use similar strategies to add and subtract, double and halve decimal amounts paying attention to the decimal point and applying their knowledge of place value. They need a thorough grounding in these basic skills and concepts to prepare them for more advanced work at Stage 6 and higher levels.

Teaching ideas

Practical activities

Make a set of decimal cards (with values from 0.1 to 0.9 on them for each group). Let them play a game in which they put the cards face down and then take turns to turn two cards over. If they make 1 they remove the cards and keep them, if not, the next player turns two cards and tries to make 1 to remove them from the game. The player who makes most pairs of 1 wins.

Give each student a strip divided into tenths. They should cut it into two pieces and then try to find other students to combine pieces with to make ones.
Cut several strips into different numbers of tenths and hand them out to groups. Let them work to arrange the parts into whole strips.

Give each pair of students a 1–100 grid and counters. Let one student cover some blocks with the counters while the other one works out what fraction of the grid is covered and what fraction is uncovered.

Play a game involving money amounts. Let the students work with pretend coins to make amounts less than 1 dollar. For example, 27 cents. Have them write this as a decimal ($0.27) and then say what amount they would need to make a whole dollar. You can also do similar activities with length, mass and capacity.

Write several money amounts (with two decimal places) less than $10 on cards. Hand these out to students at random. Tell them this is the price of an item and ask them to make a card showing the amount they would get as change from $10. Discuss how they worked this out.

Display a piece of rope or string 1 m long. Put a washer or peg on the rope. Move this along and state a measurement, for example, 0.62 cm. Let the students take turns to work out what the measurement of the remaining piece of rope will be. Students can also play their own game like this using a metre stick or a tape measure marked in centimetres and millimetres.

Use decimal place value cards to make decimal fractions with one decimal place. Let the students take turns to halve and double the fractions you make. Let students explain their methods.

Use a measuring tape to demonstrate adding and subtracting decimal amounts. For example, show a measurement of 0.8 m and say something like: ‘I want a length that is 0.4 metres longer than this, what will that be?’ Or, ‘This is 1.3 metres. What is 0.5 metres less than this?’ Relate this to a number line and let the students explain how they can find sums and differences of decimal amounts.

Using the Student Book and Workbook

Revise addition and subtraction facts to 10 before working through the examples on Student Book page 95 with the class. You may like to chant and repeat the decimal facts to help the students memorise them before asking them to complete the activities. If students struggle with the chocolate bar activity, let them model the pieces using squared paper or counters and combine them to make whole bars.

Once you have done some practical activities with the class work through the material on Student Book page 96. The focus here is on 100 hundredths making 1 whole. You may need to remind
the students of this fact. Let them work through the activities independently before letting them work in pairs to solve the grid problem on Workbook page 55.

After doing some work with money amounts and/or measurements to make amounts equivalent to 10, work through Student Book page 97 with the class. Make sure they are able to read and understand the number lines. Let the students work on their own to complete the activities, letting them check their answers using a calculator. Use Workbook page 56 to consolidate the concepts and to check that the students can derive these decimal facts.

Work through Student Book page 98 with the class paying attention to the position of the decimal point when you double or halve a decimal.

Work through the different methods of adding and subtracting on Student Book page 99 with the class. Discuss each method and encourage students to suggest any other methods they think will work. Let students use whichever methods they feel most comfortable with to complete the activities.

Workbook page 57 requires the students to apply what they have learnt about calculating with decimal fractions to solve magic square puzzles (problem solving). Students can use calculators to complete these activities, but if they work mentally you will be able to assess how well they have grasped the concepts in this chapter.

Assessment questions to ask

- What do I need to add to [ ] to make 1?
- Can you find the length of the bit required to make 1 metre?
- How much change will I get from $10 if I buy something that costs [ ]?
- What is 1.34 + 0.25? (and similar examples)
- How much do I have to take from 1.6 kilograms to get 0.8 kilograms?
- What is double 0.9?
- What is half of 4.8 litres?
- I want to cut a length of rope that is 5.86 m long into 2 equal pieces, how long should each piece be?

Common errors and misconceptions

The most common errors students are likely to make relate to the position of the decimal point or omission of the decimal point altogether. Remind them to estimate before they calculate and to think about what the quantities mean. For example, if you are working with two amounts that add up to $10 your answer cannot be more than $10.


### 17 Data handling 2

<table>
<thead>
<tr>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>5Dh1</td>
</tr>
<tr>
<td>5Dh2</td>
</tr>
<tr>
<td>5Dh3</td>
</tr>
<tr>
<td>5Dh4</td>
</tr>
</tbody>
</table>

**Vocabulary**

Frequency table, tally, bar-line graph, line graph, axis, scale, estimate.

**Resources**

Samples of different types of graphs to show the class.

**Mental warm-up activities**

Select suitable activities from the mental warm-up activity bank.

**Concepts that may be unfamiliar in this topic**

**Bar-line graphs**

The term bar-line graph will be new to the students, but the concept of showing data using a bar on a graph is not. They should easily be able to see that bar-line graphs are really just bar graphs in which the bar is thin enough to be called a line.

**Line graphs**

Students have not previously worked with line graphs. These graphs are generally used to show numerical data which changes over a period of time. The data points are plotted and then joined to each other. You may want to
move to this concept using the points at the top of the lines on the bar-line graph. In statistics, line graphs are normally used to show measurements such as temperature or height (continuous data) and in these cases, all points on the line have a value. Where a line graph is used to show discrete data, such as the number of children absent each day for a week, only the points plotted for each day have a value. In statistical terms, such data would be better represented as a bar or bar-line graph. The slope and direction of the line gives information about how the data changes.

**Teaching activities**

**Practical activities**

- Revise tallying using a section of text from the student’s textbook. Ask them to count the number of full stops or capital letters using tallying. Make sure the class know that every fifth tally is a strike through and that they can count tallies by skip-counting in fives.

- Show the class a range of different graphs and ask them to say what is shown and how they think the graph was drawn. Try to include pictograms, bar graphs, bar-line graphs and line graphs. Compare these in terms of what they look like and how they are read.

- If possible, record the temperature in the classroom each day for a week using a thermometer and record the data. Use this to draw a line graph to show the class how this is done.

**Using the Student Book and Workbook**

- Use the frequency table activities on Student Book page 100 to revise the concept of a frequency table and to make sure the students are able to interpret and draw up frequency tables.

- Introduce and discuss the idea of grouping the results. Test results are useful as an example. Tell the class to imagine they each got a different mark out of 100 for a test. How would you record this on a frequency table? If you recorded each mark, you would have a very long table with so many rows it would not fit onto a page. Explain that you can make this simpler by grouping the marks 0–20, 21–40 and so on. Point out that the groups are the same size and that they do not overlap. Work through Student Book page 101 with the class. Let the students work independently to complete the two activities on Workbook page 58. Check their work to see that they can draw up an ungrouped and a grouped frequency table.

- Discuss the example on Student Book page 102 with the class. Make sure they can see that the two graphs show the same data and that they are read in the same way. Let the students use the grids on Workbook page 59 to complete the tasks on this page.
Introduce the idea of a line graph and show the class some examples before working through Student Book page 103 with the class. Check as the students complete the activities to make sure they are able to find information on a line graph.

Work through Student Book page 104 with the class. Check and discuss their answers. Then, let the students work independently to complete the activities on Student Book page 105. Observe them as they work and help where necessary. They should draw their graphs on the grids on Workbook page 60.

Spend some time working through the example on Student Book page 106. Let the students work in pairs to complete the two interpretation activities on page 107. Discuss the results as a class.

Assessment questions to ask

- Can you tell me what type of graph this is?
- What do these tallies add up to?
- How could you group this data to make a smaller table?
- Why should the groups not overlap?
- How many children got a mark of []? (interpreting a table)
- How many pieces of data were collected altogether?
- What is the heading of this graph?
- What scale is used on the vertical axis?
- How many children were absent on Tuesday? (answer questions about a graph)
- How are these two graphs similar/different?
- What does this graph show?
- Why does the line on this graph slope down to the right?
- What is wrong with this graph?

Common errors and misconceptions

Some students may forget to label graphs or fail to see the importance of labelling their graphs. If they do this, present them with some unlabelled graphs and ask them to answer questions about the graph. Once they realise this is not possible without the labels, they may see the need to add labels to their own graphs more clearly.

Students may also have difficulty deciding what type of graph to use for different sets of data. Encourage them to look carefully at what is being compared. Unchanging amounts for different categories are easily represented as bar graphs, whereas constantly changing values such as temperature, height of plants, depth of water, etc. are more suitably represented as line graphs.
18 Division strategies

| Objectives |  
|---|---|
| 5Nc20 | Multiply or divide three-digit numbers by single-digit numbers  
| 5Nc23 | Divide three-digit numbers by single-digit numbers, including those with a remainder (answers no greater than 30)  
| 5Nc24 | Start expressing remainders as a fraction of the divisor when dividing two-digit numbers by single-digit numbers  
| 5Nc25 | Decide whether to group (using multiplication facts and multiples of the divisor) or to share (halving and quartering) to solve division problems  
| 5Nc26 | Decide whether to round an answer up or down after division depending on the context |

**Vocabulary**

Remainder, divide, share, equal groups.

**Resources needed**

Base-ten blocks; calculators; number lines; coloured rods.

**Mental warm-up activities**

Select suitable activities from the mental warm-up activity bank.

**Concepts that may be unfamiliar in this topic**

**Dividing three-digit numbers by single-digit numbers**

Students have already dealt with division as repeated subtraction and they should be using ‘chunking’ to subtract larger numbers when they are dividing a two-digit number by a one-digit number. Now they are expected to extend these methods to divide larger numbers. Students who are confident with their methods and who understand the division process should not have any difficulty with this.

**Expressing remainders as fractions**

Previously students have only been expected to write a remainder and decide whether or not to round up or down in the context of specific problems. Now they are going to deal with problems in which the remainder can be a part
(fraction) of the whole. For example, if you divide 25 cakes among 3 people you will give them each 8 cakes. There will be one cake left over; this can also be divided among the three people to give them each an additional \( \frac{1}{3} \) of a cake. It is easier for students to understand this if you demonstrate using display items (such as diagrams of cakes, or lengths of string).

**Teaching ideas**

**Practical activities**

- Start by informally revising the division of two-digit numbers. Students should be able to do this mentally, particularly when both digits are even. Discuss the connection between halving and dividing by two. Students divide by five by quickly skip counting in fives, keeping count of the number of fives, until the number is reached.

- Students explore the division of multiples of ten using a calculator. For example, let them calculate \( 8 \div 4 \) followed by \( 80 \div 4 \), then \( 800 \div 4 \), and so on. Similarly, they could work with \( 6 \div 3 \), then \( 60 \div 3 \), then \( 600 \div 3 \), and so on.

- Reinforce the equal-grouping aspect of division by modelling the division problems using number lines or coloured rods. Students draw a line and label the left-hand end ‘0’ and the right-hand end with the number they are dividing. They could also mark 10, 20, 30, and so on, along the line. They need not measure out these calibrations, as the line is really just a mental aid.

- Using mental calculations and their knowledge of the tables, students skip count in equal intervals until they are just below the target number. Then they count on for the remainder.

- You may also wish to use coloured rods for this work. Use tens and units rods to represent the number being divided. Use other rods to represent the divisor. Share out the divisor rods equally along the number to be divided.

- When working with sharing or equal grouping, encourage the students to record in their own ways, and to compare and discuss their methods.

- Put students into groups. Assign each group a specific factor and give them some time to investigate what rule might be applied for testing a big number to see if it can be divided by that factor. For example, one group investigates the rule for numbers that can be divided by 4. Another investigates the rule for numbers that can be divided by 5, and so on. As a class, go through their findings, and test the rules they have developed.

- Give students a word problem that involves dividing a three-digit number by a one-digit number. For example, ask: ‘A farmer harvests 943 melons. She can fit 9 melons into each box. How many boxes
can she fill with the melons harvested?’ Students first make up the number sentence that tells us the question: $943 \div 9$. Then they suggest strategies for finding the answer.

**Using the Student Book and Workbook**

- Revise mental division facts and division by 10 and 100 using Student Book page 108 and Workbook page 61. It is essential that students have good recall of these facts as their written methods rely on them.

- Revise division as repeated subtraction with the class using smaller numbers. Use the examples on Student Book page 109 to revise and reinforce the idea of subtracting in chunks. Let the students complete the calculations on their own and then discuss how they solved each problem. Make sure the students understand that they can get the same answers by subtracting in different ways. Use Workbook page 62 to check that they are able to work out the methods and that they can see how to subtract in chunks.

- Discuss remainders with the class. Remind them that when a number is divided by a number that is not a factor of that number, there will be a remainder. Work through the examples on Student Book page 110 with the class focusing on the compact method as a more efficient and shorter way of finding the solution. Let the students complete the calculations on their own.

- Explain that it is sometimes possible to divide the remainder further to get a fractional answer. Use the cake example on Student Book page 111 to demonstrate this. Spend some time discussing the nature of quantities that could be divided further (solid items, lengths, etc.). Let the students discuss the problems and decide what they will do with the remainders before asking them to solve them. Use Workbook page 63 to assess their ability to divide the remainder.

- Set Student Book page 112 as an activity for students to discuss and solve in pairs. Observe students as they work to see which methods they use. Let the students complete Workbook page 64 on their own. Allow them to use a calculator to check their answers.

- Work through Student Book pages 113 and 114 with the class to consolidate and reinforce division strategies. Allow students to share methods they use.

**Assessment questions to ask**

- Can you explain to me the method you used to find your answer?
- In this money problem, my calculator gives me an answer of 3.2. What does this mean?
- Which of these calculations are correct/incorrect? What has this person done wrong? How could you help them to correct it?
• What clues can you look for in word problems to help you know whether to multiply or divide?
• Can you make up a word problem that could be solved using multiplication/division?

Common errors and misconceptions

Students may make mistakes in calculations due to mental arithmetic errors – for example, incorrect times tables, errors in addition or subtraction. Encourage students to always check their calculations and also estimate to consider whether an answer is likely to be correct.

Some students may struggle with written methods due to not understanding how they work or incorrectly remembering the stages. To help students, always encourage them to ‘have a conversation in their head’ about what they are doing at each stage of the calculation and model this with examples. Give students examples of correct and incorrect worked examples and ask them to mark them and identify where mistakes have been made. Allow and encourage informal methods and jottings to support students’ understandings as they work towards formal, written methods.

19 Shapes and nets

<table>
<thead>
<tr>
<th>19: Shapes and nets</th>
<th>Student Book pp 115–117</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objectives</strong></td>
<td>Workbook p 65</td>
</tr>
<tr>
<td>5Gs4</td>
<td>Visualise 3D shapes from 2D drawings and nets, e.g. different nets of an open or closed cube</td>
</tr>
</tbody>
</table>

Vocabulary

Solid, cube, cuboid, pyramid, prism, triangular prism, cylinder, face, vertex, vertices, edge, net.

Resources needed

Variety of different solid shapes to examine: these could include everyday items such as food boxes; flashcards showing names of 3D shapes; card; glue; scissors; geoboards or dotted paper.

Mental warm-up activities

Select suitable activities from the mental warm-up activity bank.
Concepts that may be unfamiliar in this topic

There are no fundamentally new concepts in this chapter. Students have already worked with nets of common solids. They will continue to develop their understanding and make progressively more accurate nets.

Teaching ideas

Practical activities

Display a variety of 3D shapes in front of the students. These could include everyday items like food containers. Ask students to name the shapes they recognise. Put flashcards showing shape names on a table and ask students to sort the shapes and place them next to the appropriate card. Ask students if they can think of any common objects that could be added to each set.

Hold a shape out for the students to see. Ask students to point to a face, an edge and a vertex. Ask questions such as: ‘How many faces does this shape have?’ ‘What shape is this face?’

Hide a shape behind a screen, for example an open book. Describe the shape to the students telling them, for example, how many faces it has and what shape the faces are. Ask students to guess what the hidden shape is. Repeat asking a student to select and hide a shape and give clues to the other students.

An alternative would be to have students ask questions about the shape to which you can give ‘yes’ or ‘no’ answers, for example, ‘Does it have eight faces?’ After each question, students can guess what the shape is. Repeat asking a student to select and hide a shape and answer the other students’ questions.

Remind students of the terms we use to describe triangles: equilateral, isosceles, scalene, right-angled, acute-angled and obtuse-angled. Ask them to recall what each term means. Give out geoboards and ask students to model these shapes. If you do not have geoboards, you can use dotted paper and have the students draw the shapes.

Ask students what the net of a shape is. Develop their answers until there is a clear definition.

Show students a selection of model prisms and pyramids. Ask them to sort the shapes into two categories and name each one. Ask students to describe the general features of a prism, for example, two opposite, identical faces, and of a pyramid.

Using the Student Book and Workbook

After doing some revision of 3D shapes and some practical activities, work through Student Book page 115 with the class to revise the basic
concepts and examine nets of cubes. Let the students build their own cubes using Workbook page 65. Assist as necessary to make sure they are able to put the cube together properly.

Work through Student Book page 116 with the class to revise the correct terminology for talking about solids. Do the activities orally as a class.

Use Student Book page 117 to revise and consolidate understanding of nets of cubes and also to make sure students are able to accurately draw and measure lines in centimetres. Allow students to work in pairs or small groups to do the practical activities on this page.

Assessment questions to ask

- How could you group these shapes into sets? What are the criteria for each of your sets?
- How many faces/edges/vertices does this shape have?
- Can you describe this shape to me?
- Can you draw me a net for a triangular prism/pyramid/etc.?

Common errors and misconceptions

Some students may have difficulty with the terminology used when talking about the properties of 3D shapes. Regularly use the correct terminology with them by playing games that involve students describing shapes or listening to descriptions to identify shapes.

When drawing nets, some students may find it difficult to do this accurately. Support students in using a ruler, positioning tabs, cutting out, etc. where required.

### 20 Ratio and proportion

<table>
<thead>
<tr>
<th>20: Ratio and proportion</th>
<th>Student Book pp 118–123</th>
<th>Workbook pp 66–69</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objectives</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5Nn21</td>
<td>Use fractions to describe and estimate a simple proportion, e.g. $\frac{1}{5}$ of the beads are yellow</td>
<td></td>
</tr>
<tr>
<td>5Nn22</td>
<td>Use ratio to solve problems, e.g. to adapt a recipe for 6 people to one for 3 or 12 people</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Various problem-solving objectives are also covered in this chapter</td>
<td></td>
</tr>
</tbody>
</table>
Vocabulary

Ratio, comparing, proportion.

Resources

Coloured beads and/or construction blocks.

Mental warm-up activities

Select suitable activities from the mental warm-up activity bank.

Concepts that may be unfamiliar in this topic

Ratio

Although students have previously explored simple ideas related to ratio and proportion, this is the first time they will formally learn about ratio and how it is expressed (for example, the ratio of water to squash is 3 parts to 1 part). Note that students are not expected to use the mathematical notation 3 : 1 at this stage.

Proportion

As with ratio, students have previously explored and developed proportional thinking (which is a key element of mathematical reasoning at the higher levels) but they have not formally worked with proportion. At this level, ratio is presented as a method of comparing two amounts (red shapes to yellow shapes) whilst proportion is presented as parts of the whole set. Similarly, the problems that students need to solve at this stage generally involve scaling amounts up or down in a fixed proportion (this involved working with equivalent fractions which are in fact two equivalent ratios) to work out how much of an ingredient (for example) you would need to make twice as many cakes and so on. Note that the terms ratio and proportion are often used interchangeably in daily life, so you may read an instruction such as ‘mix the two colours in the proportion 3 to 2’.

Teaching ideas

Practical activities

- Bring a bottle of squash or cordial to class. Let the students read the mixing instructions and practise measuring out correct amounts of concentrate and water in order to dilute the drink in the correct ratio.

- Ask students to make patterns with beads or blocks where the colours appear in given ratios. For example, the ratio of blue to yellow beads is 2 to 3. Make sure they understand that the position of the beads in the pattern is irrelevant as long as there are two blue beads for every three yellow beads. Explore different patterns and ratios.

- Ask the students to make up some problems involving ratio. Discuss their ideas and establish which problems make sense. Ask students to solve each other’s problems.
Get students to work in pairs to design a poster explaining ratio and proportion and giving examples of where these are used in everyday life. There are many different examples: the post office charges 50 c for every 100 grams posted; if you want to increase the ingredients for a recipe to feed twice as many people you have to double the ingredients; schools often talk about the teacher to student ratio; when there are more male students than female students in a class we can say the number of male students is disproportionate (as they should be equal); when items are enlarged or reduced by photocopying the scale is a ratio and the items are all enlarged or reduced in the same proportions.

**Using the Student Book and Workbook**

Use the examples on Student Book page 118 to introduce the idea of ratio. Let the students complete the activities and then have them work in pairs to complete Workbook page 66.

Introduce the idea of proportion by having the students colour the shapes on Workbook page 67 in the correct proportions. Discuss how they worked out what this meant, and relate their colour to ratio as well. For example, you coloured half of this shape blue and half yellow. What is the ratio of blue to yellow squares?

Once you think students understand the term proportion, work through the first activity on Student Book page 119 as a class. Let the students complete the second activity on their own.

Work through Student Book page 120 with the class to demonstrate how to make sense of ratios and how to express statements in words as ratios. This will help the students make sense of statements they come across in worded problems involving ratio.

Let the students work independently to complete Student Book page 121. Check their answers to make sure they are able to work with ratio and proportion.

Use Workbook page 68 to consolidate the ideas you have taught and to informally assess students’ understanding of ratio and unequal sharing.

Let the students work in pairs to complete the activities and carry out the survey on Student Book page 122. Check and discuss their answers and the methods they used to solve the problems.
Work through the example on page 123 with the class. This work involves the students making multiplicative comparisons (such as $1 \frac{1}{2}$ times as many) rather than additive (this costs $3$ more than that) and is an important part of developing mathematical reasoning. Let the students work through the first activity on their own. Check and discuss the answers before asking them to complete the problem-solving activity that follows. Use Workbook page 69 as a test to check that students have mastered these important concepts.

**Assessment questions to ask**

• There are 15 girls and 5 boys in a class. Can you give me a sentence describing this class using the word ratio?
• Can you write a question that has the answer 3 to 2?
• Can you give me an example of when I might use ratio in real life?
• This recipe is for 6 people. What do I have to do to the ingredients if I only want to make enough for 3 people? What if I want to make enough for 2 or 9 people?
• What proportion of this beaded necklace is silver beads?
• When or where do you think we use these ratios?
  – Use 1 litre to cover 5 square metres of wall (paint/varnish)
  – Mix one part flour to one part water (glue/dough)
  – Melt 100 g chocolate for every 200 ml of cream (chocolate sauce/pudding)
  – You will need 5 ml of butter per slice of bread (making sandwiches)
• Draw a set of shapes and shade them using three different colours. What proportion of shapes is each colour?

**Common errors and misconceptions**

Students may not see the connection between ratio and the parts of the whole, so they will not see a ratio of 3 to 5 means the whole is divided into two groups making $\frac{3}{8}$ and $\frac{5}{8}$. Lots of practical activities will help students develop the concept clearly.

Students may struggle to increase or decrease amounts in proportion because they don’t understand the concept of multiplicative reasoning. It is important to emphasise that doubling, halving, finding three times as much or a quarter as much all involve multiplying or dividing. Many of the ways in which we compare amounts and express change involve multiplicative reasoning, for example, this type of battery lasts three times longer than other brands. Students need to understand that this means it lasts 3 times as long as the other brands and not the time plus 3.
## 21 Percentages

### Objectives

| 5Nn16 | Recognise equivalence between the decimal and fraction forms of halves, tenths and hundredths and use this to help order fractions, e.g. 0.6 is more than 50% and less than \( \frac{7}{10} \) |
| 5Nn19 | Understand percentage as the number of parts in every 100 and find simple percentages of quantities |
| 5Nn20 | Express halves, tenths and hundredths as percentages |

### Vocabulary

Fraction, decimal, percentage, per cent, equivalent, hundredth

### Resources needed

Flashcards showing fractions less than one, decimals less than one and percentages.

### Mental warm-up activities

Select suitable activities from the mental warm-up activity bank.

### Concepts that may be unfamiliar in this topic

**Percentage (%)**

This is the first time students are formally introduced to the idea of percentage and the percentage symbol (%). It is very important that they realise the connection between percentages and fractions of 100 (hundredths) as this will allow them to connect their earlier understandings of decimal fractions to their work on percentages. Percentages make it very easy for students to compare fractions such as \( \frac{3}{5} \) and \( \frac{3}{4} \) using conversion factors.

**Expressing fractions as percentages and percentages as fractions**

The ability to translate between fractions and percentages is important because in real life we are faced with both. For example, we may hear that 18 out of 40 people like soccer and 23 out of 48 people like basketball. It is difficult to say which group is larger using these two fractions, but easy if you consider \( \frac{18}{40} \times 100 = 45\% \) and \( \frac{23}{48} \times 100 = 48\% \). Once students understand the basic equivalences, you may like to teach them to use the % key on their...
calculator to find percentages such as \( \frac{23}{48} \). To do this they would enter \( 23 \div 48 \) and then press the \% key to get an answer of 47.91666. They can round this to the nearest whole number using what they already know about rounding decimal fractions and get 48\%.

**Teaching ideas**

**Practical activities**

- Create a class poster showing percentages in use in everyday life.

- Demonstrate how to convert a fraction into a percentage by multiplying by 100. If necessary, clarify the method to the students by building on their previous knowledge that they need to find a denominator of 100 and then they will know the percentage. Taking the example, \( \frac{24}{40} \), an equivalent fraction with a denominator of 10 could first be found, then one with a denominator of 100. Comparing the two methods will show that they reach the same answer.

- Teach students how to find percentages of quantities converting the percentage into a fraction then finding the fraction of the quantity. Where sensible, encourage students to use mental methods, for example, if finding 60\%, find 10\% by dividing by 10 and then multiply by 6.

- Ask students to design a poster explaining how to find percentages of quantities and how to calculate what percentage one quantity is of another. Discuss the key points they included on their posters.

- Write a number in a circle in the middle of the board, for example 320. Draw ‘arms’ coming from the circle and label each with a percentage, for example, 10\%, 25\%, 5\%, 45\%, etc. Invite students in turn to write in the correct percentage. Encourage students to find their answers mentally and discuss the strategies they used, for example, ‘I found 10\% by dividing by ten and I knew 5\% would be half of that’.

- Hand out flashcards to students and ask them to order the cards from smallest to largest. Encourage students to explain how they made their choices, especially how they compared fractions or decimals with percentages.

- Show students a card and ask them to express the amount on the card in two other ways.

- Continue with practical activities alongside the Student Book to ensure students are confident with the relationship between fractions, decimals and percentages.

- Make sets of cards with percentages and equivalent common fractions and decimals. You will need one set per group of students. Use these to play a number of matching games such as ‘Snap’ where the students each get a number of cards which they play in turns. If the
card played is equivalent to the one on the top of the pile, the student who says ‘Snap’ first is allowed to take all the cards on the pile. Alternatively, spread all the cards face down and have the students take turns to turn over two cards. If they are the same, they may take the cards. If not, they turn them back over and the next student has a turn to find a matching pair.

Ask the students to develop their own game of dominoes using equivalent percentages, decimals and fractions. Give them time to discuss and plan their game, make the dominoes and play a game. Give groups a chance to explain their game to the class. Use these games to revise and consolidate the concepts taught.

**Using the Student Book and Workbook**

- Use the example and diagrams on Student Book page 124 to teach the term percentage and the symbol %. Let the students work in pairs to complete the activities. Then have them work independently to complete the colouring activity on Workbook page 70. Check their answers before moving onto Workbook page 71.

- Work through the equivalent fractions examples and table on Student Book page 125 with the class. Once you are sure they understand the concepts, have them complete the activities independently. Use Workbook page 72 to assess how well they are able to work with and compare equivalent fractions, percentages and decimals.

- Work through the examples on Student Book page 126 with the class. If they have forgotten how to find a fraction of an amount, repeat some of the practical sharing activities from that chapter to remind them how to do this. Let the students discuss and then complete the activities on this page.

- Teach the students how to change a fraction to a percentage, using a calculator if you wish. Let the students work through the activities on Student Book page 127 independently. Check the answers as a class and discuss the methods students used to find their answers. Use Workbook page 73 to assess how well learners can convert between different forms.

- Discuss the table on Student Book page 128 with the class. Work through the questions related to the table orally with the class. If you like, you could find the number of children in each category as well. Ask the students to complete the mixed activities on Workbook page 74 and use this to informally assess how well they have mastered the concepts in this chapter.

**Assessment questions to ask**

- What percentages can you easily work out in your head?
- ‘To calculate 10% of a quantity you divide by 10, so to find 30% of a quantity you divide by 30.’ Is this statement true? Why not?
Can you explain how you find a percentage of a quantity?
Can you explain how to find out what per cent 24 is of 36?

**Common errors and misconceptions**
If students are just taught a rule for finding percentages of quantities or calculating what per cent one quantity is of another, they are unlikely to remember it or use it correctly. It is important to discuss with students why the method works. This can be done by continually thinking about what we mean by percentage and building up rules together, using diagrams to illustrate the processes.

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**22: Probability**

<table>
<thead>
<tr>
<th>Objectives</th>
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</thead>
<tbody>
<tr>
<td>5Db1 Describe the occurrence of familiar events using the language of chance or likelihood</td>
</tr>
</tbody>
</table>

**Vocabulary**
Likely, unlikely, impossible, certain, even chance, chance, probability.

**Resources needed**
Large probability scale; flashcards with key vocabulary terms; flashcards with different events written on them; marbles and/or counters for each group.

**Mental warm-up activities**
Select suitable activities from the mental warm-up activity bank. Bear in mind that the students will not be doing any number calculation work in this topic, so you should try to include some calculation in the mental maths activities.

**Concepts that may be unfamiliar in this topic**
This is the first time that students formally deal with probability. However, the main focus at this level is on talking about the chance that something has of happening using everyday terms. Students who are not English speakers may be unfamiliar with the terms certain, likely, even chance, unlikely and impossible, and you may need to teach the words and their meanings before you start the activities.
Teaching ideas

Practical activities

Teach the key words for this topic. Display the words, let the students suggest meanings and then explain that in mathematics these terms have specific meanings. Give examples to show what each word means. For example, ‘If it is Monday today, we can be certain that tomorrow will be Tuesday’. Similarly, ‘If it is Monday today, it is impossible for tomorrow to be Friday’.

Make flashcards with everyday events on them. For example: I will eat bread today; I will do homework this evening; I will go to bed early tonight; It will rain later today; The sun will rise tomorrow morning; Our school football team will win their next match; I will make a mistake in my calculations; and so on. Choose some events that are certain and some that are impossible, and give a range of events in between. Display any card. Ask the students to say what the chances are of that thing happening. Discuss any disagreements. For example, one student may say it is unlikely she will make a mistake in her calculations because she is careful and accurate, another may say it is likely that he will make a mistake because he finds it difficult to add in his head.

Display all of the events on the flashcards. Let the class rank them in order from certain to impossible. Encourage the students to give reasons for their positioning of the events.

Using the Student Book and Workbook

Let the student’s work in pairs to complete Student Book page 129. Discuss their answers as a class and use their responses to make sure they understand and can use the key vocabulary.

Let the students work independently to complete Student Book page 130 and Workbook page 75. Once they have done so, let them compare their answers and discuss any disagreements as a class.

Students can complete Student Book page 131 in groups. Discuss the practical activity as a class afterwards to make sure the students understand that the colour that is most common in the collection has the greatest chance of being picked most often.
Objectives

<table>
<thead>
<tr>
<th>5Nc20</th>
<th>Multiply or divide three-digit numbers by single digit numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>5Nc21</td>
<td>Multiply two-digit numbers by two-digit numbers</td>
</tr>
<tr>
<td>5Nc22</td>
<td>Multiply two-digit numbers with one decimal place by single-digit numbers, e.g. 3.6 × 7</td>
</tr>
</tbody>
</table>

Vocabulary

Estimate, round, partition, multiply, product, decimal, decimal point.

Resources

Calculators.

Mental warm-up activities

Select suitable activities from the mental warm-up activity bank.

Concepts that may be unfamiliar in this topic

In this chapter students will build on the strategies they already know to extend their multiplication skills to larger numbers and decimals. You should continue to allow for mental strategies and different approaches to multiplication, including informal methods and jottings, but at the same time, you should introduce and model more compact and efficient written methods where possible. Students should not be forced to use these methods until they are comfortable and confident with them.

Teaching ideas

Practical activities

You may like to repeat some of the practical activities from Chapter 8 or 14 to revise multiplication strategies.
Write some two-digit by one-digit multiplications on the board. For each one put a choice of three answers, only one being correct. Ask students to look at the answers and without actually doing the calculation, say which answer is correct. Discuss how they decided (for example, by estimating, or using a known fact, or finding multiples of the multiplier).

Write criteria for solving a worded problem on the board. For example, must be solved by multiplying two one-digit numbers, must have a product less than 400, and so on. Let the students apply the criteria to develop worded problems that match each criterion.

Roll a die four times to generate two two-digit numbers. Ask the students to find the products as quickly as they can. Give different students a chance to explain how they found the answers.

Write sets of three related numbers on the board. For example: 45, 9 and 405. Let the students make all the possible multiplication and division calculations using the numbers (45 × 9 = 405, 9 × 45 = 405, 405 ÷ 9 = 45, 405 ÷ 45 = 9).

Using the Student Book and Workbook

Spend some time working through the different methods of finding 43 × 7 shown on Student Book page 132. Discuss the methods as you work and encourage students to suggest any other methods they use. Let students work on their own to complete the activities. Check their answers and discuss the methods they used to find the solutions.

Before moving onto multiplying three-digit numbers by one-digit numbers, discuss how the students would do this. Then work through the examples on Student Book page 133, relating the methods to what they have already done as you go. Let the students complete the activities on their own. Once they have done this, let them discuss and then solve the problems on Workbook page 76.

Student Book page 134 develops some methods for multiplying by a two-digit number. Remind them that they can break numbers into factors to make multiplication easier and that they can round and compensate when the number is close to a multiple of ten. Observe students as they complete the calculations and assist them as necessary. Use Workbook page 77 to consolidate and reinforce the ideas developed in this lesson.

Let students work in pairs to read and work through the examples and solve the problems on Student Book page 135. Have a class feedback session about how they worked and what they learnt from this activity.
Spend some time discussing the problems on Student Book page 136 with the class and allow students to suggest which strategies they would use to solve them. Have the students work on their own to solve the problems. Discuss answers and the strategies they found most helpful once they have finished the work.

Work through the example on Student Book page 137 to show students how to multiply a decimal by a single-digit number. Pay attention to the estimation element of this as it will help the students work out where the decimal point should be in their answers. Work through the first few questions of the activity as a class in the same manner to reinforce the ideas. Let the students work independently to solve the rest of the problems. Use Workbook page 78 to practise the skills.

Ask the students to complete Student Book page 138. Make sure they estimate before they calculate. Use Workbook page 79 as an informal assessment activity.

Have the students work in pairs to discuss and then solve the worded problems on Student Book page 139. Discuss the answers and how students worked these out as a class. Let them work independently to complete Workbook page 80 as consolidation and additional practise.

**Assessment questions to ask**

- Can you explain to me what method you used to find the answer?
- Which of these calculations are correct/incorrect (give students some completed calculations)? What has the person done wrong?
- What clues in world problems help you decide whether to multiply or divide to find the answer?
- Can you make a word problem that can be solved by multiplying a two-digit number by a two-digit number?
- In this money problem, my calculator says 3.2, what does this mean?

**Common errors and misconceptions**

Students may make mistakes in calculations due to mental arithmetic errors, for example incorrect times tables or errors in addition or subtraction when they compensate. Encourage the students to estimate first and then to check their work to decide whether the answer is reasonable or not.

Students may struggle with more compact column methods if they do not understand how they work. Remind the students to have a conversation in their heads about what they are doing and model this when you work through examples by telling the class what you are doing at each stage in the working.
Objectives
This chapter covers a range of calculation-related objectives as well as giving students a chance to apply problem-solving skills.

Resources
Calculators.

Mental warm-up activities
Select suitable activities from the mental warm-up activity bank.

Teaching ideas
Practical activities
If necessary, you can repeat some of the practical activities related to specific skills and concepts.

Using the Student Book and Workbook
Work through Student Book pages 140 and 141 with the class. Spend some time talking about what is required in each set of questions and then have students complete the activities. Observe them as they are working to see which students struggle with the more compact and formal methods. Use Workbook page 80 for additional revision practice.

Use Student Book page 142 to reinforce the importance of mental methods. This is also a good opportunity to discuss some of the methods that students know about. Mrs Devi uses Vedic methods to do her calculations. Chinese students may know how to apply mental abacus strategies and students from an African or Indian background may be able to use finger calculations to do mental calculations quickly and efficiently. Let the students work in pairs to complete the activities on this page. Use Workbook page 80 to round off the year with a mixed bag of calculations involving all four operations.