MATHEMATICS

OXFORD MATHS 7

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obook pro

OXFORD

AUSTRALIAN CURRICULUM

Sample chapter

Oxford Maths 7–10 Australian Curriculum utilises an innovative suite of print and digital resources to guide students on a focused mathematics journey. The series makes maths accessible to students with differing levels of understanding, increasing engagement by giving learners the opportunity to achieve success at their own skill level while also providing comprehensive syllabus coverage.

Key features of Student Books

> Complete access to all digital resources available on Student obook pro.
> Australian Maths Trust (AMT) spreads offer unique questions designed to challenge students and build engagement.
> STEAM projects encourage inter-disciplinary thinking.
> Semester reviews provide an opportunity to revise key concepts from each semester.
> NAPLAN practice allows students to revise numeracy skills for the National Assessment Program.
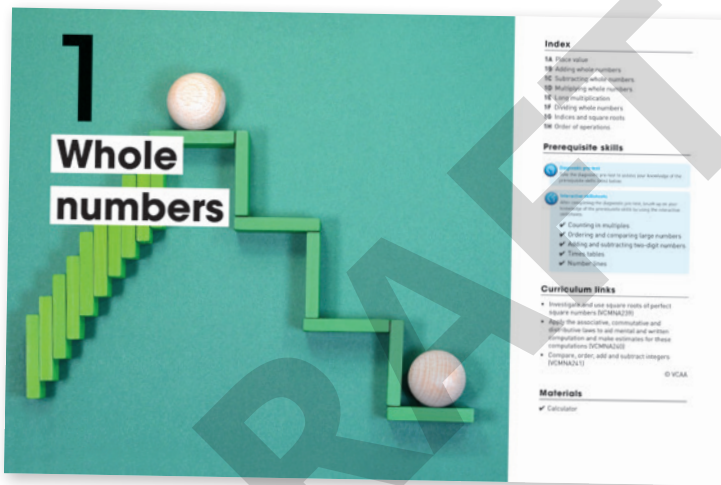
Each chapter opens with:
- **Prerequiste skills** with reference to an online diagnostic pre-test and interactive skillsheets.
- **Curriculum links** to all relevant content descriptions in the ACARA mathematics syllabus.
- **Materials** used to complete the exercises.

Learning intentions
- Signpost the foundational skills being developed in each section.

Inter-year links
- Provide easy access to support and extension material from each of the 7–10 Student Books as students build knowledge year on year.
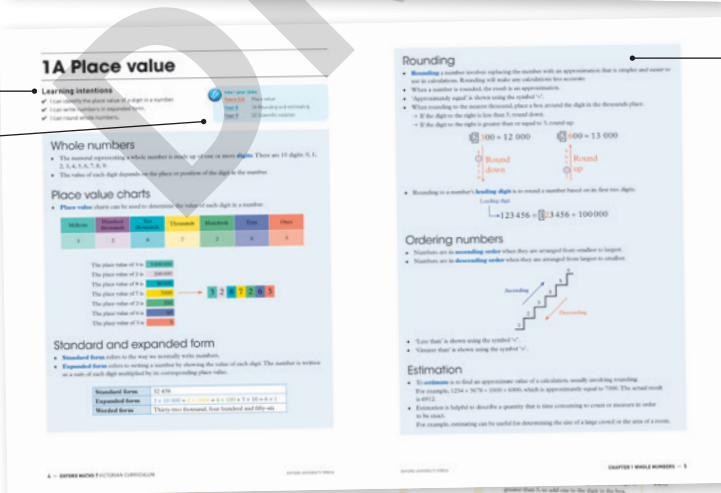
New theory
- Backed by the latest pedagogical research to promote engagement with the material.
- Filled with precise diagrams that bring key concepts to life, and aid understanding.

Worked examples
- Outline a step-by-step thought process for solving essential questions with direct reference to the exercises.
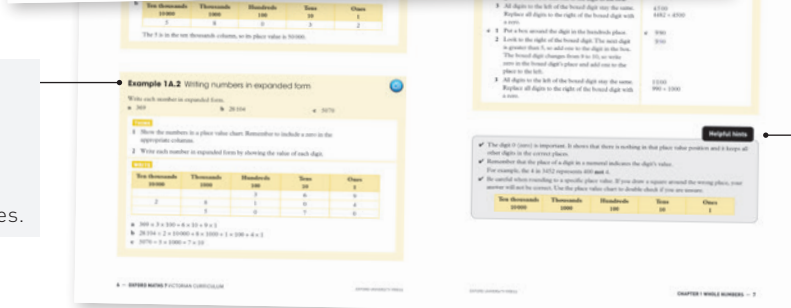
Helpful hints
- Provide additional strategies for tackling problems.
- Highlight important elements of the theory.
- Point out common misconceptions.

Differentiated learning pathways

- Each exercise is separated into three pathways, tailoring for students of all skill levels.
- Each pathway can be assigned based on results of the diagnostic pre-tests that are recommended at the beginning of every chapter.

Understanding and fluency

- Basic exercises dedicated to practising key concepts.

Challenge

- Advanced exercises designed to build engagement and anticipate future learning outcomes.

Chapter summary

- Condenses all the theory from each section into one accessible revision page.

Integrated STEAM projects

- Take the hard work out of cross-curricular learning with engaging STEAM projects. Two fully integrated projects are included at the end of each book in the series, and are scaffolded and mapped to the Science, Maths and Humanities curricula. The same projects also feature in the corresponding Oxford Humanities and Oxford Science series to assist cross-curricular learning.

Problem solving and reasoning

- Comprehensive exercises bring together new ideas and provide engaging contexts from real-world problems.

Checkpoint

- A section in the middle of each chapter dedicated to summarising key skills and encouraging memory retention.
- Reference to an online checkpoint quiz to gauge student progress.

Chapter reviews

- Additional practice questions to further consolidate understanding at the end of each chapter.
- Reference to an online chapter review quiz to track results.
- Reference to Quizlet test to revise new terminology.

Problem solving through design thinking

- Each STEAM project investigates a real-world problem that students are encouraged to problem-solve using design thinking.

Full digital support

- Each STEAM project is supported by a wealth of digital resources, including student booklets (to scaffold students through the design-thinking process of each project), videos to support key concepts and skills, and implementation and assessment advice for teachers.

obook pro

Key features of Student obook pro

> Student <u>o</u>book pro is a completely digital product delivered via Oxford's online learning platform, **Oxford Digital**.

> It offers a complete digital version of the Student Book with interactive note-taking, highlighting and bookmarking functionality, allowing students to revisit points of learning.

> A complete ePDF of the Student Book is also available for download for offline use and read-aloud functionality.

Integrated digital resources

• Integrated hotspots allow students to access diagnostics tests, quizzes, interactive skill sheets, videos and inter-year links simply by clicking on the blue digital resource boxes throughout the pages of the book.

Complete digital version of the Student Book

• The digital version of the Student Book is true to the print version, making it easy to navigate and transition between print and digital.
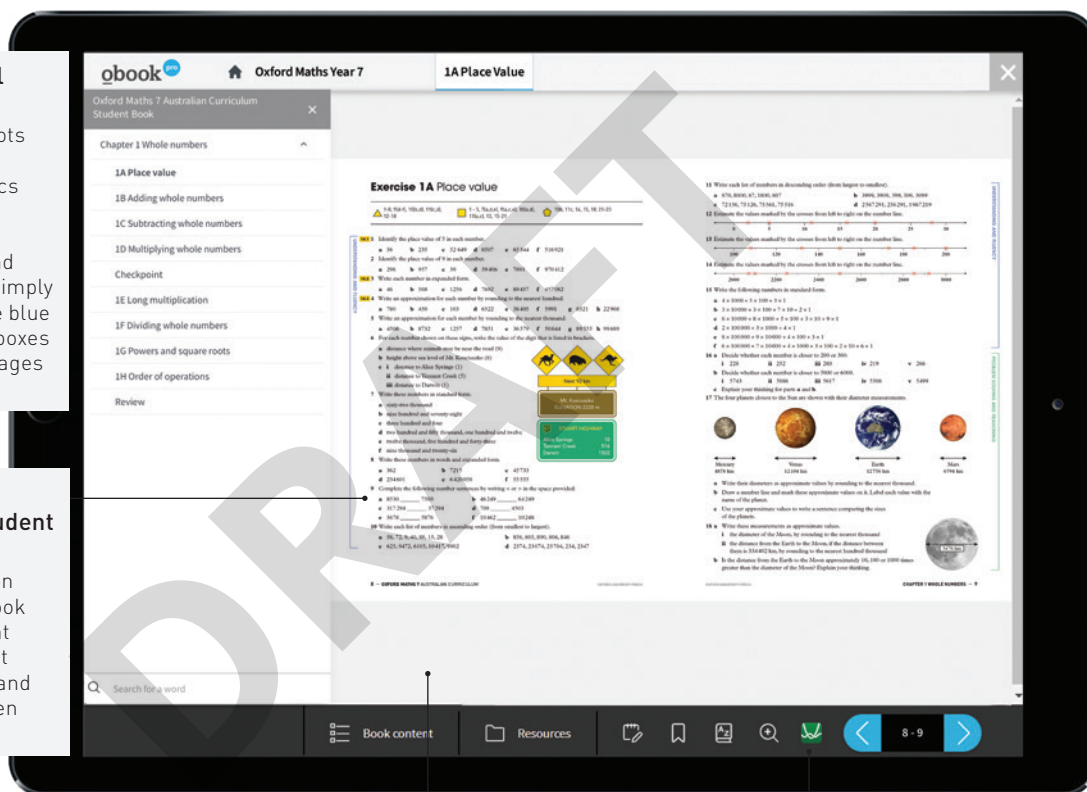
Toolbar features

• Notes can be added and saved to the text by simply selecting and highlighting.
• Bookmarks can be saved to any page.
• *Australian Concise Oxford Dictionary* can provide immediate definitions to any word within the text.

Desmos integration

• Our partership with Desmos allows students to access a suite of calculator tools as they read through the text, providing convenient graphical support as well as the opportunity to investigate plane geometry and Cartesian coordinates.

> Integrated *Australian Concise Oxford Dictionary* look-up feature

> Targeted instructional videos for every worked example question

> Groundwork resources to support assumed knowledge

> Interactive assessments to consolidate understanding

> Auto-marked practice exam question sets

> Integrated Quizlet sets, including real-time online quizzes with live leaderboards

> Access to online assessment results to track progress.

Benefits for students

Key features of Teacher obook pro

obook pro

> Teacher obook pro is a completely digital product delivered via Oxford's online learning platform, **Oxford Digital**.

> Each chapter and topic of the Student Book is accompanied by full teaching support, including assessment reporting, worked solutions, chapter tests, detailed teacher notes and lesson plans.

> Teachers can use their Teacher obook pro to share notes and easily assign resources or assessments to students, including due dates and email notifications.
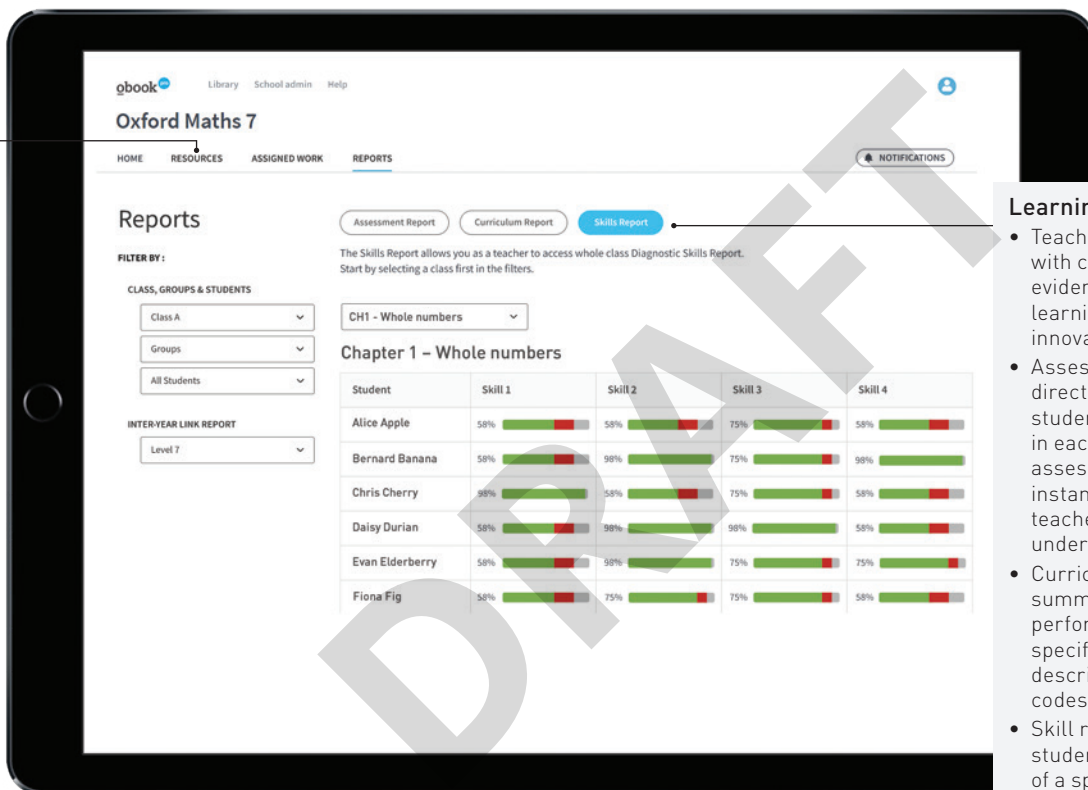
Learning pathway reports

- Teachers are provided with clear and tangible evidence of student learning progress through innovative reports.
- Assessment reports directly show how students are performing in each online interactive assessment, providing instant feedback for teachers about areas of understanding.
- Curriculum reports summarise student performance against specific curriculum content descriptors and curriculum codes.
- Skill reports indicate the students' understanding of a specific skill in mathematics.

Additional resources

- Each chapter of the Student Book is accompanied by additional interactive skillsheets, worksheets, investigations and topic quizzes to help students progress.

Benefits for teachers

> Diagnostic pre-tests and chapter tests that track students' progress against Study Design key knowledge, providing detailed learning pathway reports that differentiate each student's ability in each skill

> Assign reading and assessments to students either individually, or in groups – administration is taken care of!

> Ability to set-up classes, monitor student progress and graph results

> Worked solutions for every Student Book question

> Detailed teacher notes, teaching programs and lesson plans.
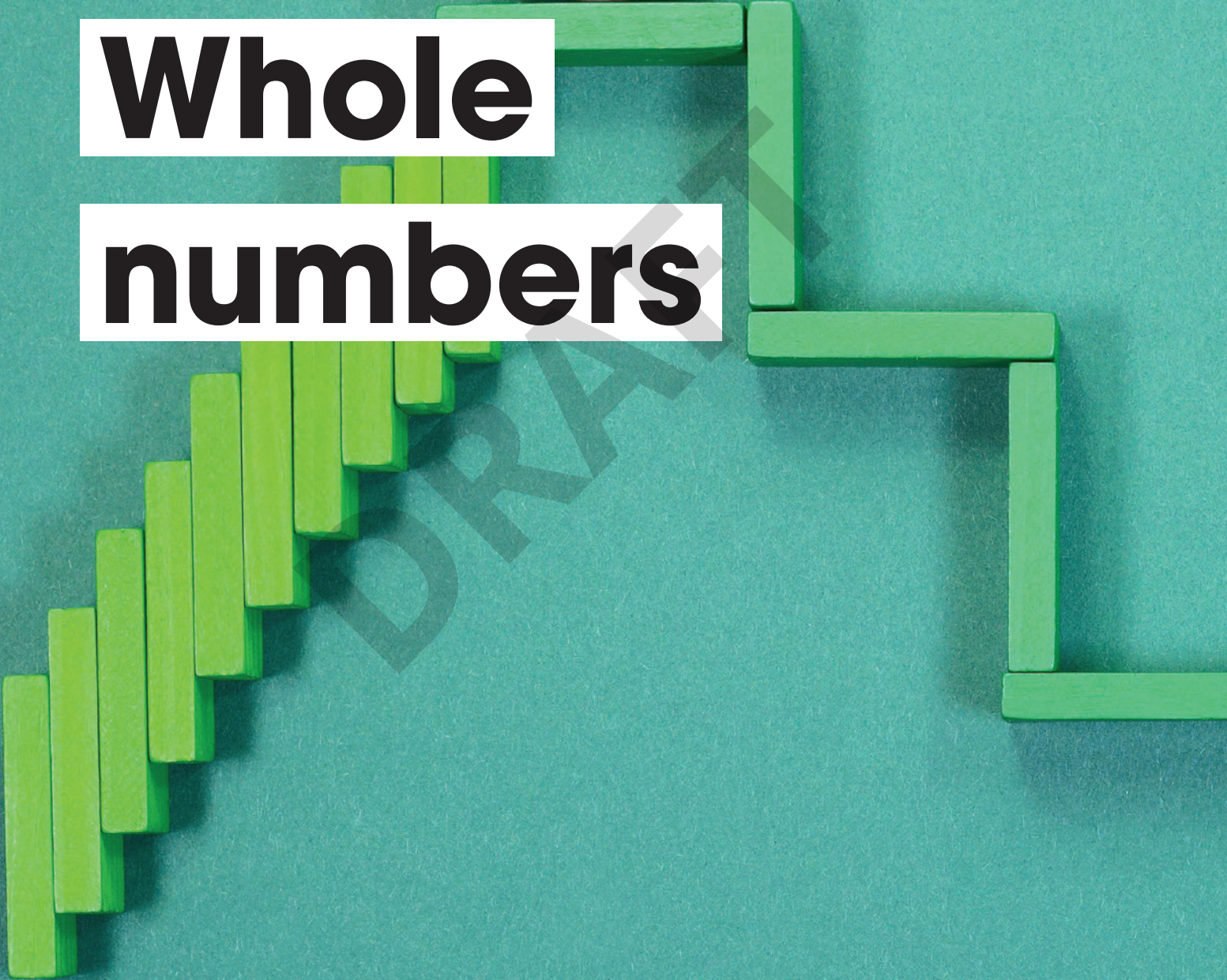
1

Whole numbers

Index

Prerequisite skills

Diagnostic pre-test
Take the diagnostic pre-test to assess your knowledge of the prerequisite skills listed below.

Interactive skillsheets
After completing the diagnostic pre-test, brush up on your knowledge of the prerequisite skills by using the interactive skillsheets.

✔ Counting in multiples

✔ Ordering and comparing large numbers

✔ Adding and subtracting two-digit numbers

✔ Times tables

✔ Number lines

Curriculum links

- Describe the relationship between perfect square numbers and square roots, and use squares of numbers and square roots of perfect square numbers to solve problems (AC9M7N01)
- Represent natural numbers in expanded notation using place value and powers of 10 (AC9M7N03)
- Use the 4 operations with positive rational numbers including fractions, decimals and percentages to solve problems using efficient calculation strategies (AC9M7N06)
- Compare, order and solve problems involving addition and subtraction of integers (AC9M7N07)

© ACARA

Materials

✔ Calculator

1A Place value

Learning intentions

By the end of this topic you will be able to…

✔ identify the place value of a digit in a number

✔ write numbers in expanded form

✔ round whole numbers.

Whole numbers

- The numeral representing a whole number is made up of one or more **digits**. There are 10 digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.
- The value of each digit depends on the place or position of the digit in the number.

Place value charts

- **Place value** charts can be used to determine the value of each digit in a number.

Millions	Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Ones
3	2	8	7	2	6	3

The place value of 3 is $3\,000\,000$

The place value of 2 is $200\,000$

The place value of 8 is $80\,000$

The place value of 7 is 7000

The place value of 2 is 200

The place value of 6 is 60

The place value of 3 is 3

3 2 8 7 2 6 3

Standard, expanded and worded form

- **Standard form** refers to the way we normally write numbers.
- **Expanded form** refers to writing a number by showing the value of each digit. The number is written as a sum of each digit multiplied by its corresponding place value.
- **Worded form** refers to the way we normally read numbers out loud.

Standard form	32 456
Expanded form	$3 \times 10\,000 + 2 \times 1000 + 4 \times 100 + 5 \times 10 + 6 \times 1$
Worded form	Thirty-two thousand, four hundred and fifty-six

Rounding

- **Rounding** a number involves replacing the number with an approximation that is simpler and easier to use in calculations. Rounding makes any calculations less accurate.
- When a number is rounded, the result is an approximation.
- 'Approximately equal' is shown using the symbol '≈'.
- When rounding to the nearest thousand, place a box around the digit in the thousands place.
    - → If the digit to the right is less than 5, round down.
    - → If the digit to the right is greater than or equal to 5, round up.

$$1\boxed{2}\,300 \approx 12\,000 \qquad 1\boxed{2}\,600 \approx 13\,000$$

- Rounding to a number's **leading digit** is to round a number based on its first two digits.

Leading digit

$$123\,456 = \boxed{1}23\,456 \approx 100\,000$$

Ordering numbers

- Numbers are in **ascending order** when they are arranged from smallest to largest.
- Numbers are in **descending order** when they are arranged from largest to smallest.
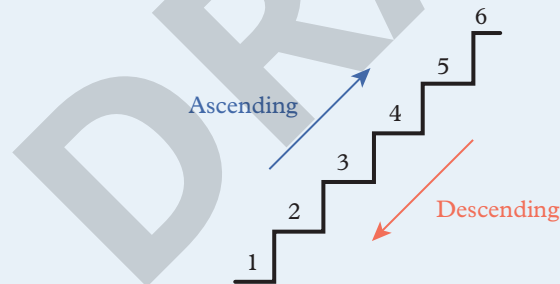
- 'Less than' is shown using the symbol '<'.
- 'Greater than' is shown using the symbol '>'.

Estimation

- To **estimate** is to find an approximate value of a calculation, usually involving rounding.
  For example, 1234 + 5678 ≈ 1000 + 6000, which is approximately equal to 7000. The actual result is 6912.
- Estimation is helpful to describe a quantity that is time consuming to count or measure in order to be exact.
  For example, estimating can be useful for determining the size of a large crowd or the area of a room.

Example 1A.1 Identifying the place value of a digit in a number

Identify the place value of the 5 in each number.

a 357   **b** 58 032

THINK

1 Show the numbers in a place value chart. Remember to include a zero in the appropriate columns.

2 Consider the place value of the 5.

WRITE

a

Ten thousands 10 000	Thousands 1000	Hundreds 100	Tens 10	Ones 1
		3	5	7

The 5 is in the tens column, so its place value is 50.

b

Ten thousands 10 000	Thousands 1000	Hundreds 100	Tens 10	Ones 1
5	8	0	3	2

The 5 is in the ten thousands column, so its place value is 50 000.

Example 1A.2 Writing numbers in expanded form

Write each number in expanded form.

a 369   **b** 28 104   **c** 5070

THINK

1 Show the numbers in a place value chart. Remember to include a zero in the appropriate columns.

2 Write each number in expanded form by showing the value of each digit.

WRITE

Ten thousands 10 000	Thousands 1000	Hundreds 100	Tens 10	Ones 1
		3	6	9
2	8	1	0	4
	5	0	7	0

a $369 = 3 \times 100 + 6 \times 10 + 9 \times 1$

b $28\,104 = 2 \times 10\,000 + 8 \times 1000 + 1 \times 100 + 4 \times 1$

c $5070 = 5 \times 1000 + 7 \times 10$

Example 1A.3 Rounding a number

Write an approximation for each number by rounding to the nearest hundred.

a 719 **b** 4482 **c** 990

THINK	WRITE
a 1 Put a box around the digit in the hundreds place.	**a** 7⃞19
2 Look to the right of the boxed digit. The next digit is less than 5, so do not change the boxed digit.	7⃞19
3 All digits to the left of the boxed digit stay the same. Replace all digits to the right of the boxed digit with a zero.	7⃞00 719 ≈ 700
b 1 Put a box around the digit in the hundreds place.	**b** 4⃞482
2 Look to the right of the boxed digit. The next digit is greater than 5, so add one to the digit in the box.	4⃞482
3 All digits to the left of the boxed digit stay the same. Replace all digits to the right of the boxed digit with a zero.	4⃞500 4482 ≈ 4500
c 1 Put a box around the digit in the hundreds place.	**c** 9⃞90
2 Look to the right of the boxed digit. The next digit is greater than 5, so add one to the digit in the box. The boxed digit changes from 9 to 10, so write zero in the boxed digit's place and add one to the place to the left.	9⃞90
3 All digits to the left of the boxed digit stay the same. Replace all digits to the right of the boxed digit with a zero.	1⃞000 990 ≈ 1000

Helpful hints

✔ The digit 0 (zero) is important. It shows that there is nothing in that place value position and it keeps all other digits in the correct places.

✔ Remember that the place of a digit in a numeral indicates the digit's value.
For example, the 4 in 3452 represents 400 **not** 4.

✔ Be careful when rounding to a specific place value. If you draw a square around the wrong place, your answer will not be correct. Use the place value chart to double check if you are unsure.

Ten thousands	Thousands	Hundreds	Tens	Ones
10 000	1000	100	10	1

Exercise 1A Place value

UNDERSTANDING AND FLUENCY

1A.1 **1** Identify the place value of 5 in each number.

    a 56   **b** 235   **c** 52 649   **d** 8507   **e** 65 344   **f** 516 921

2 Identify the place value of 9 in each number.

    a 298   **b** 957   **c** 39   **d** 59 406   **e** 7891   **f** 970 412

1A.2 **3** Write each number in expanded form.

    a 46   **b** 568   **c** 1256   **d** 7692   **e** 89 457   **f** 457 082

1A.3 **4** Write an approximation for each number by rounding to the nearest hundred.

    a 780   **b** 450   **c** 103   **d** 6522   **e** 38 405   **f** 5991   **g** 8521   **h** 22 968

5 Write an approximation for each number by rounding to the nearest thousand.

    a 4506   **b** 8732   **c** 1257   **d** 7851   **e** 36 579   **f** 50 644   **g** 89 555   **h** 99 689

6 For each number shown on these signs, write the value of the digit that is listed in brackets.

    a distance where animals may be near the road (9)

    b height above sea level of Mt. Kosciuszko (8)

    c **i** distance to Alice Springs (1)

       ii distance to Tennant Creek (5)

      iii distance to Darwin (1)
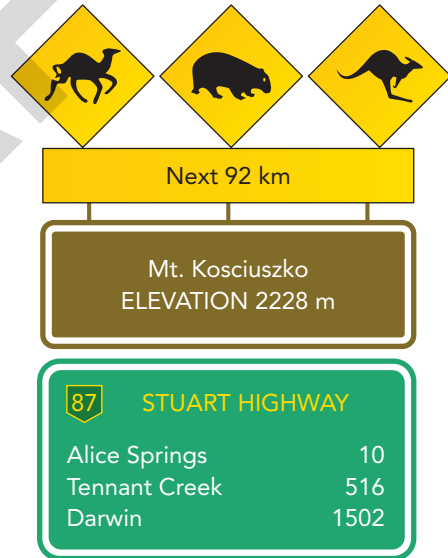
7 Write these numbers in standard form.

    a sixty-two thousand

    b nine hundred and seventy-eight

    c three hundred and four

    d two hundred and fifty thousand, one hundred and twelve

    e twelve thousand, five hundred and forty-three

    f nine thousand and twenty-six

Next 92 km

Mt. Kosciuszko
ELEVATION 2228 m

87   STUART HIGHWAY

Alice Springs	10
Tennant Creek	516
Darwin	1502

8 Write these numbers in worded and expanded form.

    a 362   **b** 7215   **c** 45 733

    d 234 601   **e** 6 420 058   **f** 55 555

9 Complete the following number sentences by writing < or > in the space provided.

    a 8530 _____ 7503   **b** 46 249 _____ 64 249

    c 317 294 _____ 37 294   **d** 709 _____ 4503

    e 5678 _____ 5876   **f** 10 462 _____ 10 248

10 Write each list of numbers in ascending order (from smallest to largest).

    a 58, 72, 9, 40, 88, 15, 28   **b** 856, 805, 890, 806, 846

    c 625, 9472, 6105, 10 417, 9902   **d** 2374, 23 074, 23 704, 234, 2347

11 Write each list of numbers in descending order (from largest to smallest).

    a 870, 8000, 87, 1800, 807   **b** 3999, 3909, 399, 309, 3099

    c 72 156, 75 126, 75 561, 75 516   **d** 2 567 291, 256 291, 1 967 219

12 Estimate the values marked by the crosses from left to right on the number line.
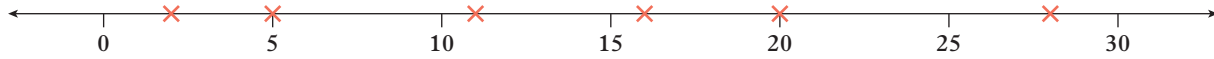
13 Estimate the values marked by the crosses from left to right on the number line.

14 Estimate the values marked by the crosses from left to right on the number line.
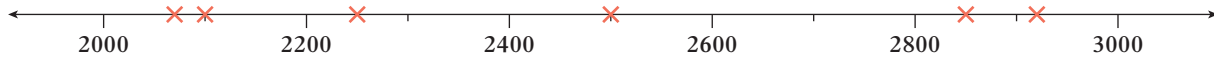
15 Write the following numbers in standard form.

    a $4 \times 1000 + 5 \times 100 + 3 \times 1$

    b $3 \times 10\,000 + 3 \times 100 + 7 \times 10 + 2 \times 1$

    c $6 \times 10\,000 + 8 \times 1000 + 5 \times 100 + 3 \times 10 + 9 \times 1$

    d $2 \times 100\,000 + 3 \times 1000 + 4 \times 1$

    e $8 \times 100\,000 + 9 \times 10\,000 + 4 \times 100 + 3 \times 1$

    f $6 \times 100\,000 + 7 \times 10\,000 + 4 \times 1000 + 3 \times 100 + 2 \times 10 + 6 \times 1$

16 a Decide whether each number is closer to 200 or 300.

    i 228   **ii** 252   **iii** 280   **iv** 219   **v** 266

    b Decide whether each number is closer to 5000 or 6000.

    i 5743   **ii** 5086   **iii** 5617   **iv** 5508   **v** 5499

    c Explain your thinking for parts **a** and **b**.

17 The four planets closest to the Sun are shown with their diameter measurements.

Mercury
4878 km

Venus
12 104 km

Earth
12 756 km

Mars
6794 km
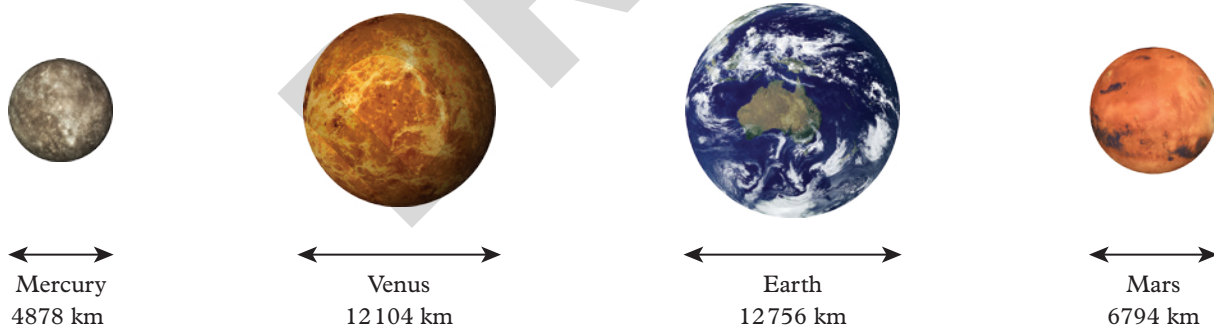
    a Write their diameters as approximate values by rounding to the nearest thousand.

    b Draw a number line and mark these approximate values on it. Label each value with the name of the planet.

    c Use your approximate values to write a sentence comparing the sizes of the planets.

18 a Write these measurements as approximate values.

    i the diameter of the Moon, by rounding to the nearest thousand

    ii the distance from the Earth to the Moon, if the distance between them is 334 402 km, by rounding to the nearest hundred thousand

    b Is the distance from the Earth to the Moon approximately 10, 100 or 1000 times greater than the diameter of the Moon? Explain your thinking.

3476 km

19 a How many different two-digit numbers can you make from 3 and 5 if you cannot repeat digits? List them in ascending order.

   b How many different two-digit numbers can you make from 3 and 5 if you can repeat digits? List them in descending order.

20 a How many different two-digit numbers can you make from 2, 4 and 7 if you cannot repeat digits? List them in descending order.

   b How many different two-digit numbers can you make from 2, 4 and 7 if you can repeat digits? List them in ascending order.

21 Consider the digits 1, 3, 6 and 9. Use these digits to write:

   a the largest four-digit number without repeating any digits

   b the smallest four-digit number if digits can be repeated

   c the largest even number without repeating any digits

   d all the four-digit numbers between 3620 and 6350 if no digits can be repeated

22 Consider the place value chart. The digit in the thousands column is currently missing.

Millions	Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Ones
1	2	3	★	0	2	9

   a When rounded to the nearest hundred thousand, what will the number be?

   b What digit, or digits, placed in the thousands column will give the number 1 230 000 when rounded to the nearest ten thousand?

   c If the digit in the thousands column is 9, and 760 000 is added to the number in the table, determine the number rounded to the nearest ten thousand.

   d If the digit in the thousands column is 9, and 760 000 is subtracted from the number in the table, determine the number rounded to the nearest ten thousand.

23 A multi-billionaire designed a special new lock for his safe. The lock, shown below, is reset to a different four numbers every 2 minutes. To crack the code, you must round each number so that the sum of the digits is closest to 20.

For example, 48922 would be rounded to 48900 as $4 + 8 + 9 = 21$, and rounding to the nearest hundred in this case gives the closest digit sum to 20.

Can you crack the code in the given time limit?

```
23569
98469
79499
85981
```

Check your Student obook pro for these digital resources and more:

Interactive skillsheet Place value

Interactive skillsheet Rounding integers

Investigation Roman numerals

Topic quiz 1A

1B Adding whole numbers

Learning intentions

By the end of this topic you will be able to…

✔ use mental strategies to add whole numbers

✔ use the addition algorithm for large numbers.

Addition properties

Addition (+)
Sum
Plus
More than
Increase
Total
Together

- The **associative law of addition** states that regardless of how the numbers are grouped, the answer does not change.
  For example, $(2 + 4) + 6 = 2 + (4 + 6)$.
- The **commutative law of addition** states that the order in which numbers are added does not change the answer.
  For example, $2 + 4 = 4 + 2$.

Mental addition strategies

- The **by-parts method** involves adding the digits in each place value separately.
  For example, $156 + 32 = 100 + (50 + 30) + (6 + 2)$
  $$= 188$$

$$156 + 32$$

1 hundred   8 tens   8 ones

$$188$$
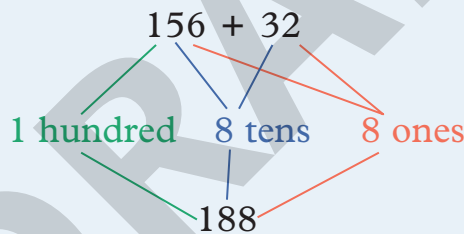
- The **jump method** involves breaking down one of the given numbers, then adding each part of the number in stages.
  For example, $156 + 32 = 156 + 30 + 2$
  $$= 188$$

+30   +2
156   186 188
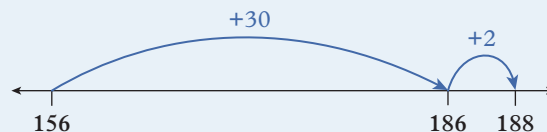
- The **compensation method** involves rounding one number to make the calculations easier.
  The amount required to round the number is then added or subtracted depending on if the number was rounded up or down.
  For example, $156 + 38 = 156 + 40 - 2$
  $$= 194$$

+40   −2
156   194 196
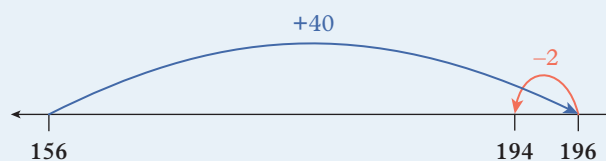
Addition algorithm

- In the addition algorithm, the numbers are written one under the other with the digits lined up according to their place value.
  - → Always start by adding the digits in the ones column first, followed by the tens column, then the hundreds column and so on.

$$\begin{array}{r} \overset{1}{2}29 \\ +\ 342 \\ \hline 571 \end{array}$$ ← answer

Ones column: 9 + 2 = 11, carry the 1
Tens column: 2 + 4 + (1) = 7
Hundreds column: 2 + 3 = 5

- Regrouping occurs when there is a result of 10 or more in one column.
  - → For example, 11 is the same as 1 ten and 1 one, so a result of 11 is the same as placing 1 in the tens column and 1 in the ones column. The 1 ten is represented by the orange 1 as it has been regrouped from the ones column.

Example 1B.1 Using mental strategies to add two numbers

Work out each sum using the mental strategy given in brackets.

a 78 + 21 (by-part method)

b 36 + 77 (jump method)

c 67 + 58 (compensation method)

THINK

a 1 Add the tens together.
  2 Add the ones together.
  3 Combine the two answers to get the final answer.

b 1 Choose a starting number, then break down the second number into tens and ones.
  2 Add the tens to the starting number followed by the ones.

c 1 Choose a starting number, then round the second number to the nearest 10.
  2 Add the rounded number to the starting number, then add or subtract the amount needed to round the second number.

WRITE

a

78 + 21

9 tens   9 ones

99

78 + 21 is 99.

b

+70   +7

36   106 113

36 + 77 is 113.

c

+60   −2

67   125 127
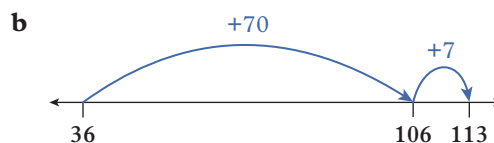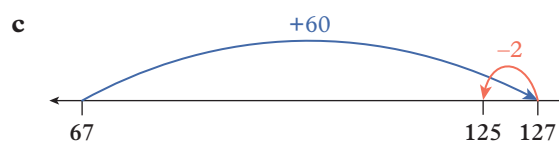
67 + 58 is 125.

Example 1B.2 Using the addition algorithm to add two numbers

Calculate 634 + 891 using the addition algorithm.

$$\begin{array}{r} 634 \\ + \underline{891} \\ \end{array}$$

THINK

1 Add the digits in the ones column: 4 + 1 = 5.

2 Add the digits in the tens column: 3 + 9 = 12.

    Write 2 in the tens column of the answer and write 1 above the hundreds column.

3 Add the digits in the hundreds column: 1 + 6 + 8 = 15.

WRITE

$$\begin{array}{r} \overset{1}{6}34 \\ + \underline{891} \\ 1525 \\ \end{array}$$

Example 1B.3 Using the addition algorithm to add three numbers

Use the addition algorithm to calculate 3108 + 547 + 1619.

THINK

1 Set out the addition problem by lining up digits according to place value.

2 Add the digit in the ones column: 8 + 7 + 9 = 24.

    Write 4 in the ones column of the answer and write 2 above the tens column.

3 Add the digits in the tens column: 2 + 0 + 4 + 1 = 7.

4 Add the digits in the hundreds column: 1 + 5 + 6 = 12.

    Write 2 in the hundreds column of the answer and write 1 above the thousands column.

5 Add the digits in the thousands column: 1 + 3 + 0 + 1 = 5.

WRITE

$$\begin{array}{r} \overset{1}{3}\overset{2}{1}08 \\ 547 \\ + \underline{1619} \\ 5274 \\ \end{array}$$

Helpful hints

✔ Don't forget that addition is commutative – reordering sums can make them a lot easier!
  For example, 12 + 123 455 = 123 455 + 12.

✔ Make sure that your place value columns are aligned so that you add together the correct digits.

✔ When you are adding multiple large numbers together, it can be helpful to estimate your answer using rounding to ensure you have the right answer. You can compare your two results and easily see if you have made a mistake.

Exercise 1B Adding whole numbers

UNDERSTANDING AND FLUENCY

1B.1 **1** Use the by-part method to work out each sum. Draw the corresponding diagram to support your answer.

    a $458 + 102$ **b** $75 + 23$ **c** $34 + 57$ **d** $49 + 810$

2 Use the jump method to work out each sum. Draw the corresponding diagram to support your answer.

    a $103 + 46$ **b** $112 + 13$ **c** $21 + 94$ **d** $66 + 22$

3 Use the compensation method to work out each sum. Draw the corresponding diagram to support your answer.

    a $48 + 56$ **b** $274 + 27$ **c** $26 + 58$ **d** $79 + 89$

4 Use any mental strategy to work out each sum.

    a $50 + 30$ **b** $120 + 60$ **c** $360 + 20$ **d** $25 + 13$

    e $16 + 61$ **f** $56 + 34$ **g** $65 + 35$ **h** $123 + 345$

5 Use any mental strategy to work out each sum.

    a $20 + 40 + 10$ **b** $500 + 100 + 300$ **c** $18 + 12 + 50$ **d** $73 + 7 + 20$

    e $52 + 11 + 27$ **f** $35 + 29 + 35$ **g** $115 + 205 + 80$ **h** $203 + 203 + 203$

1B.2 **6** Calculate each sum using the addition algorithm.

    a $\begin{array}{r} 243 \\ + 715 \\ \hline \end{array}$ **b** $\begin{array}{r} 538 \\ + 154 \\ \hline \end{array}$ **c** $\begin{array}{r} 758 \\ + 461 \\ \hline \end{array}$ **d** $\begin{array}{r} 697 \\ + 805 \\ \hline \end{array}$

7 Use the addition algorithm to calculate each of the following.

    a $641 + 478$ **b** $157 + 296$ **c** $2438 + 5160$ **d** $3762 + 1489$

    e $2175 + 485$ **f** $96 + 5743$ **g** $16\,407 + 782$ **h** $8009 + 35\,714$

1B.3 **8** Use the addition algorithm to calculate each of the following.

    a $385 + 461 + 723$ **b** $749 + 218 + 837$ **c** $927 + 56 + 614$

    d $869 + 21 + 70$ **e** $2764 + 8293 + 451$ **f** $7605 + 246 + 38$

9 Evaluate the following without using a calculator.

    a $23\,748 + 61\,392 + 53\,709$ **b** $82\,407 + 9385 + 411$

    c $34\,715 + 306\,937 + 8256$ **d** $947 + 600\,411 + 85\,103$

10 Evaluate the following without using a calculator.

    a $28 + 7640 + 459 + 7 + 834 + 2406$ **b** $92\,762 + 547 + 85 + 2942 + 6073$

11 Check your answers to questions **9** and **10** with a calculator.

12 You decide to train for a local cycling race. On the first weekend you cycle 32 km, on the second you cycle 45 km and on the third you cycle 59 km. To find the total distance covered over the three weekends, you can write the calculation in a number of ways.

    a Decide if the following statements are true or false.

        i $32 + 45 + 59 = (3 + 4 + 5) + (2 + 5 + 9)$

        ii $32 + 45 + 59 = 30 + 40 + 60 + 2 + 5 - 1$

        iii $32 + 45 + 59 = 59 + (30 + 40) + (2 + 5)$

    b List two other ways to write the calculation.

    c Calculate the total distance covered.

13 a Identify two two-digit numbers that add to 53.

b Identify two three-digit numbers that add to 386 and meet these conditions.

i both numbers are odd   **ii** both numbers are even

c Identify three whole numbers that add to 5207. Suggest another set of three numbers that add to the same total.

14 Riley is going to make enchiladas for his family for dinner. The recipe says that it will take 20 minutes preparation time and 55 minutes baking time.

a How long will it take for Riley to have dinner ready?

b Riley starts preparing the meal at 5:15 pm. What time will it be ready for the family to eat?

15 The Tour de France is an annual international cycling race that finishes in Paris, France. In 2011, Cadel Evans won the race, following the itinerary shown.

a Answer these questions without using a calculator.

i How far did the competitors ride in the first five days of the race?

ii How far did the competitors ride before their first rest day?

iii How far did the cyclists ride between leaving Gap and finishing in Paris?

iv What was the total distance covered in the Tour de France?

b Check your answers using a calculator.

c Research the latest Tour de France. What was the total distance covered?

Date in 2011	Start and finish	Distance
2 July	Passage du Gois → Mont des Alouettes	192 km
3 July	Les Essarts → Les Essarts (team time trial)	23 km
4 July	Olonne-sur-Mer → Redon	198 km
5 July	Lorient → Mûr-de-Bretagne	172 km
6 July	Carhaix → Cap Fréhel	165 km
7 July	Dinan → Lisieux	226 km
8 July	Le Mans → Châteauroux	218 km
9 July	Aigurande → Super-Besse Sancy	189 km
10 July	Issoire → Saint-Flour	208 km
11 July	Le Lioran Cantal	rest
12 July	Aurillac → Carmaux	158 km
13 July	Blaye-les-Mines → Lavaur	168 km
14 July	Cugnaux → Luz-Ardiden	211 km
15 July	Pau → Lourdes	152 km
16 July	Saint-Gaudens → Plateau de Beille	169 km
17 July	Limoux → Montpellier	192 km
18 July	Département de la Drôme	rest
19 July	Saint-Paul-Trois-Châteaux → Gap	163 km
20 July	Gap → Pinerolo	179 km
21 July	Pinerolo → Galibier Serre-Chevalier	200 km
22 July	Modane Valfréjus → Alpe-d'Huez	110 km
23 July	Grenoble → Grenoble (time trial)	42 km
24 July	Créteil → Paris Champs-Élysées	95 km

16 To enter the stadium for a soccer match, patrons used one of four gates. The number of people who passed through the turnstiles of each gate is shown.

a Estimate the number of people who attended the match by first rounding the numbers at each gate to the nearest thousand.

Gate	Number of people
A	8759
B	9042
C	10 365
D	11 008

b Calculate the exact number of people who attended the match.

c Which answer would a sports commentator be more likely to use when reporting on the match?

17 Consider adding the numbers from 1 to 10.

a Add the numbers in order: $1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 = ?$

b This calculation can also be completed by first pairing the numbers. Write the smallest number and the largest number together, then the second smallest and second largest together and so on.

$$1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10$$
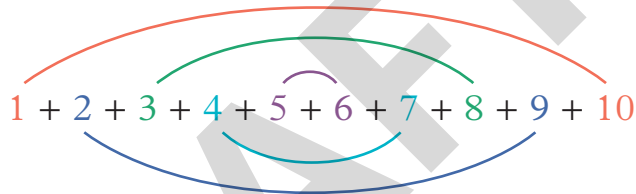
Complete this calculation for adding the numbers from 1 to 10.

$(1 + 10) + (2 + 9) + (3 + \_\_\_) + (4 + \_\_\_) + (5 + \_\_\_)$
$= \_\_\_ + \_\_\_ + \_\_\_ + \_\_\_ + \_\_\_$
$= \_\_\_$

c Which strategy did you find easier? Justify your answer.

18 Use the strategy of grouping numbers in suitable pairs to add the numbers from 1 to 20.

19 a Use the strategy of grouping numbers in suitable pairs to add these numbers.

   i from 1 to 9   **ii** from 1 to 19

b Explain what is different about using this strategy with an odd number of numbers.

c Use a suitable strategy to add these numbers.

   i from 2 to 8   **ii** from 3 to 17   **iii** from 5 to 25

20 a Identify two consecutive numbers that add to 53.

b Identify three consecutive numbers that add to 114.

c Identify four consecutive numbers that add to 190.

d What strategy did you use to find the sets of consecutive numbers?

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Worksheet
Adding numbers

Investigation
Abracadabra with magic squares

Topic quiz
1B

1C Subtracting whole numbers

Learning intentions

By the end of this topic you will be able to…

✔ use mental strategies to subtract whole numbers

✔ use the subtraction algorithm for large numbers.

Subtraction properties

Subtraction (−)
Difference
Take away
Less than
Fewer
Reduce
Minus

- Subtraction of two or more numbers is not associative. This means that two numbers cannot be grouped and subtracted before subtracting from the other number. Order is important.

  For example, $(8 − 5) − 2 = 1$ and $8 − (5 − 2) = 5$.

- Subtraction of two or more numbers is not commutative. This means that two or more numbers cannot be subtracted in any order and achieve the same result.

  For example, $7 − 4$ is not the same as $4 − 7$.

Mental subtraction methods

- The jump method and the compensation method can also be applied to subtraction.

  → Jump method for subtraction

  For example, $156 − 32 = 156 − 30 − 2$
  $\qquad\qquad\qquad\quad = 124$

  → Compensation method for subtraction

  For example, $156 − 38 = 156 − 40 + 2$
  $\qquad\qquad\qquad\quad = 118$
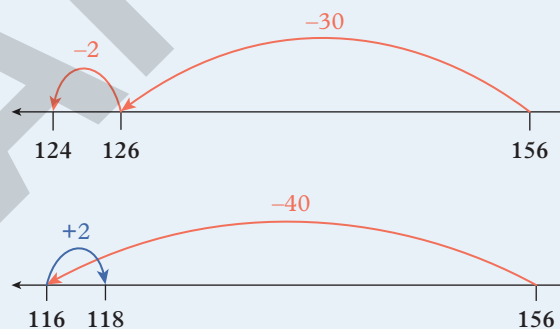
Subtraction algorithm

- In the subtraction algorithm, the number to be subtracted is written under the other number with the digits lined up according to their place value.

  → If the subtraction in a particular column cannot be done, take a value from the next column to the left. This is the opposite of the carrying process in the addition algorithm. For example, 1 ten is also 10 ones and can be moved into the ones column.

  → Always start by subtracting the digits in the ones column first, followed by the tens column, then the hundreds column and so on.

$$
\begin{array}{r}
{}^{1}\ {}^{11} \\
3\cancel{2}\cancel{1} \\
-\ 204 \\
\hline
117 \\
\end{array}
$$

Ones column: Take 10 from the tens column
$\qquad\qquad\quad 11 − 4 = 7$
Tens column: $1 − 0 = 1$
Hundreds column: $3 − 2 = 1$

← answer

Example 1C.1 Using mental strategies to subtract two numbers

Work out each difference using the mental strategy given in brackets.

a 81 − 56 (jump method)   **b** 78 − 49 (compensation method)

THINK

a **1** Choose a starting number, and then break down the second number into tens and ones.
   2 Subtract the tens from that number followed by the ones.
b **1** Choose a starting number, then round the second number to the nearest 10.
   2 Subtract the rounded number from the starting number, then add or subtract the amount needed to round the second number.

WRITE

a

81 − 56 is 25.

b
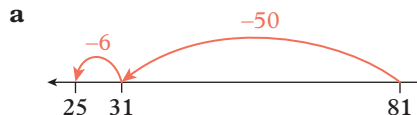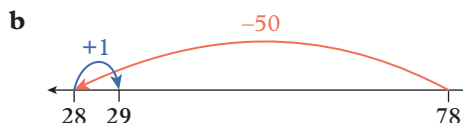
78 − 49 is 29.

Example 1C.2 Using the subtraction algorithm to subtract two numbers

Calculate 426 − 281 using the subtraction algorithm.

$$\begin{array}{r} 426 \\ -\ 281 \\ \hline \end{array}$$

THINK

1 Subtract the digits in the ones column: 6 − 1 = 5.

2 Subtract the digits in the tens column: 2 − 8.

Take 1 from the hundreds column by reducing the hundreds to 3 and increasing the tens as 12. Subtract the digits in the tens column: 12 − 8 = 4.

3 Subtract the digits in the hundreds column: 3 − 2 = 1.

WRITE

$$\begin{array}{r} {\scriptstyle 3\ 12} \\ 426 \\ -\ 281 \\ \hline 145 \end{array}$$

Example 1C.3 Using the subtraction algorithm to subtract numbers with different numbers of digits

Use the subtraction algorithm to calculate 788 − 27.

THINK

1 Set out the subtraction problem by lining up digits according to place value.

2 Subtract the digits in the ones column: 8 − 7 = 1.

3 Subtract the digits in the tens column: 8 − 2 = 6.

4 Subtract the digits in the hundreds column: 7 − 0 = 7. Recall that if there is no digit in a place then it has a value of zero.

WRITE

$$\begin{array}{r} 788 \\ -\ 27 \\ \hline 761 \end{array}$$

✔ Make sure that your place value columns are aligned so that you subtract the correct numbers. See example to the right.

$$\begin{array}{r} 654 \\ - \ 321 \\ \hline 333 \end{array}$$

✔ Subtraction is not commutative. Unlike with addition problems, you cannot change the order of the numbers around the sign and achieve the same result.

For example, $12 - 4$ is not the same as $4 - 12$.

✔ Read each question carefully. You may find some subtraction questions easy to calculate in your head. Don't find yourself performing lots of regrouping and end up with an answer as easy to find as 1!

For example, $101 - 99$ requires lots of work in the subtraction algorithm, but you might be able to see that the answer is 2 straight away!

ANS p503 **Exercise 1C** Subtracting whole numbers

▲ 1–6, 7(d, e, f), 9–12, 14, 17

■ 1–4, 6(a–d), 7–10, 11(a–c), 13–15, 18

⬠ 1(d), 2(d), 4(g, h), 6(g, h), 8, 11, 13, 15, 16, 18, 19

1C.1 **1** Use the jump method to work out each difference. Draw a corresponding diagram to support your answer.

   a $60 - 20$ **b** $78 - 26$ **c** $65 - 52$ **d** $184 - 96$

2 Use the compensation method to work out each difference. Draw a corresponding diagram to support your answer.

   a $85 - 19$ **b** $69 - 28$ **c** $129 - 67$ **d** $281 - 48$

3 Use any mental strategy to work out each difference.

   a $60 - 40$ **b** $300 - 200$ **c** $170 - 30$ **d** $250 - 40$

   e $710 - 20$ **f** $178 - 58$ **g** $270 - 35$ **h** $393 - 281$

4 Use any mental strategy to work out each problem.

   a $50 + 20 - 10$ **b** $700 + 100 - 300$ **c** $14 + 16 - 20$ **d** $98 + 12 - 1$

   e $570 + 25 - 80$ **f** $36 - 12 + 8$ **g** $63 - 41 + 20$ **h** $400 - 50 + 85$

1C.2 **5** Calculate each difference using the subtraction algorithm.

   a $\begin{array}{r} 58 \\ - \ 25 \\ \hline \end{array}$ **b** $\begin{array}{r} 87 \\ - \ 46 \\ \hline \end{array}$ **c** $\begin{array}{r} 624 \\ - \ 359 \\ \hline \end{array}$ **d** $\begin{array}{r} 406 \\ - \ 134 \\ \hline \end{array}$

6 Use the subtraction algorithm to calculate each of the following.

   a $56 - 14$ **b** $81 - 36$ **c** $456 - 234$ **d** $938 - 651$

   e $624 - 185$ **f** $3846 - 1724$ **g** $7508 - 5631$ **h** $8135 - 6479$

1C.3 **7** Use the subtraction algorithm to calculate each of the following.

   a $6327 - 215$ **b** $5962 - 647$ **c** $2475 - 728$

   d $7836 - 908$ **e** $4025 - 462$ **f** $5002 - 431$

8 Determine the following differences without using a calculator.

   a $36\,274 - 28\,093$ **b** $508\,246 - 137\,651$

   c $211\,537 - 36\,409$ **d** $81\,752 - 8362$

UNDERSTANDING AND FLUENCY

9 Evaluate without using a calculator.

    a $58\,945 - 45\,120 - 1205$ **b** $101\,101 - 45\,751 - 458 - 2378$

10 Check your answers to question **9** with a calculator.

11 For each calculation:

    i estimate the answer by first rounding each number to its leading digit

    ii use pen and paper to work out the exact answer

    iii use a calculator to check the result you obtained for part **ii**.

    a $61 + 48 - 77$ **b** $254 - 123 + 448$

    c $4708 - 369 + 532$ **d** $29\,071 + 8275 - 17\,466$

    e $77 - 25 + 89 - 60 + 41$ **f** $809 + 1252 - 754 - 36$

12 The longest river in the world is the Nile in Africa, with a length of 6650 km. The longest river in Australia is the Darling River, with a length of 2740 km. To find the difference in length between these two rivers, you can write the calculation in a number of ways.

    a Decide if the following statements are true or false.

      i $6650 - 2740 = 6000 - 2000 - 600 - 700 - 50 - 40$

      ii $6650 - 2740 = 6650 - 2000 - 700 - 40$

      iii $6650 - 2740 = 6650 - 3000 - 260$

      iv $6650 - 2740 = 6700 - 2700 - 60$

    b List two other ways to write the calculation.

    c Calculate the difference between the two river lengths.

13 a Identify two two-digit numbers that have a difference of 43.

    b Identify two numbers that have a difference of 168 and meet these conditions.

      i both numbers are odd

      ii both numbers are even

    c Identify two three-digit numbers that have a difference of 286 and meet these conditions.

      i one number must be more than twice the other

      ii one number must be triple the other

14 Josh is comparing the distance to travel by plane from Melbourne to Rome using two different routes. One journey stops at Hong Kong to refuel, while another stops at Singapore.

Flight sector	Distance by air
Melbourne–Hong Kong	7435 km
Melbourne–Singapore	6064 km
Hong Kong–Rome	9307 km
Singapore–Rome	10 048 km

   a Determine the total flight distance from Melbourne to Rome if the plane stops at Hong Kong on the way.

   b Determine the total flight distance from Melbourne to Rome if the plane stops at Singapore on the way.

   c Which flight distance is the shortest and by how much?

15 The 162-storey building named Burj Khalifa, located in Dubai, United Arab Emirates, was completed in 2010.

   a How does the height of this building compare with other structures? Find the difference in height between Burj Khalifa and each of the structures shown in this table.

Structures	Date completed	Height
Washington Monument (Washington DC, USA)	1884	169 m
Eiffel Tower (Paris, France)	1889	300 m
Empire State Building (New York, USA)	1931	381 m
Sydney Tower (Sydney, Australia)	1981	309 m
Petronas Towers (Kuala Lumpur, Malaysia)	1998	452 m
Taipei 101 (Taipei, Taiwan)	2003	509 m
Q1 (Gold Coast, Australia)	2005	323 m
Eureka Tower (Melbourne, Australia)	2006	297 m

828 m

   b Which two structures could have their heights added to give a result closest to the height of Burj Khalifa?

   c Which three structures could have their heights added to give a result closest to the height of Burj Khalifa?

16 The highest mountain in the world is Mount Everest, which has a height above sea level of 8848 m.

   a How does this compare to Mount Kosciuszko, the highest mountain in Australia, at 2228 m above sea level?

   b Compare the height of Mount Everest with the three mountains in our solar system listed below.

Mountain	Location	Height above surface
Mons Huygens	The Moon	4700 m
Maxwell Montes	Venus	11 000 m
Olympus Mons	Mars	21 171 m

   c Determine the difference in height between the mountains listed for Mars and the Moon.

   d Determine the difference in height between Mount Kosciuszko and Maxwell Montes.

17 There are 191 people travelling on a train. At the first station, 52 people leave the train and another 48 board the train. At the following station, 69 people get off the train and 75 get on. How many people are now on the train?

18 In May 2000, five planets in our solar system reached a point in their orbit around the Sun where they were roughly positioned in a straight line on the same side of the Sun (as viewed from the Sun). Earth was positioned on the opposite side of the Sun. The average distance from the Sun for each planet is shown on the right.

a Use this information to find the distance between these planets.

i Jupiter and Saturn

ii Mercury and Saturn

iii Venus and Mercury

b If the Sun has a diameter of about 1 392 000 km, what was the distance between Jupiter and Earth?

c In June 2010, Uranus, Jupiter and Mercury were roughly lined up on one side of the Sun while Venus, Mars and Saturn were lined up on the other side. At this time, what was the approximate distance between:

i Jupiter and Mercury?

ii Saturn and Venus?

iii Jupiter and Saturn?

d The film *War of the Worlds* is based on the idea that Martians travelled to Earth when the distance between Mars and Earth was the shortest. About what distance would the Martian spacecraft have travelled?

19 Consider the diagram below.

You are to place the numbers 1 to 10 in each of the boxes in the diagram. Each box may contain one number, which should be equal to the difference of the two boxes above. There is more than one solution to this problem.

a Explain why the number 10 must be placed in the top row.

b How many different solutions can you find? Symmetrical solutions are considered to be the same.
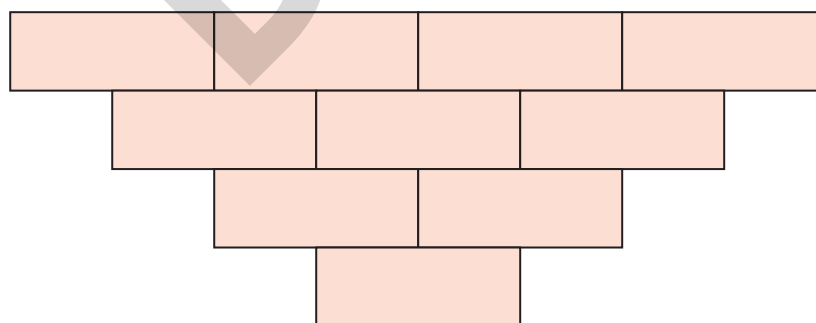
Earth
149 600 000 km
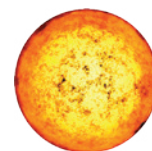
Sun

Mercury
57 909 000 km

Venus
108 200 000 km

Mars
227 940 000 km

Jupiter
778 400 000 km

Saturn
1 423 600 000 km

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Interactive skillsheet
Adding and subtracting whole numbers

Investigation
Discoveries across the globe

Topic quiz
1C

1D Multiplying whole numbers

Learning intentions

By the end of this topic you will be able to…

✔ use mental strategies to multiply whole numbers

✔ calculate the result of multiplying two numbers together

✔ multiply by powers of 10.

Multiplication properties

Multiplication (×)
Product
Times
Multiply
Groups of

- Multiplication is repeated addition which can be reduced to multiplication of factors resulting in a **product**.

$$3 + 3 = 2 \times 3 = 6$$

repeated addition   factors   product

- The **associative law of multiplication** states that regardless of how the numbers are grouped, the answer does not change.

For example, $(3 \times 5) \times 2 = 3 \times (5 \times 2)$.

- The **commutative law of multiplication** states that the order in which numbers are multiplied does not change the answer.

For example, $14 \times 2 = 2 \times 14$.

- The **distributive law** states that multiplication can be 'distributed' across a bracket. This means that large numbers can be broken down into a group of smaller numbers, which can then be multiplied separately.

$$5 \times 32 = 5 \times (30 + 2)$$
$$= 5 \times 30 + 5 \times 2$$
$$= 150 + 10$$
$$= 160$$

Short multiplication

- Short multiplication involves multiplying a large number by a one-digit number.

$$
\begin{array}{r}
\overset{+2}{3\,7} \\
\times \quad 4 \\
\hline
148
\end{array}
$$

1. Multiply 4 by 7 to get 28
2. Write the 8 in the ones column below
3. Add the 2 to the tens column above
4. Multiply 4 by 3 to get 12
5. Add the 2 tens to the 12 and get 14
6. Write 14 below

Multiplying by powers of 10

- Multiplying a number by 10 increases each digit's place value by 1 column. Move the whole number one place value space to the left and insert a zero into the ones column.

- Multiplying a number by 100 increases each digit's place value by 2 columns. Move the whole number two place value spaces to the left and insert two zeros into the tens and ones columns.

- Multiplying a number by 1000 increases each digit's place value by 3 columns. Move the whole number three place value spaces to the left and insert three zeros into the ones, tens and hundreds columns.

$$22 \times 1\underline{0} = 22\underline{0}$$
$$22 \times 1\underline{00} = 22\underline{00}$$
$$22 \times 1\underline{000} = 22\,\underline{000}$$

Example 1D.1 Using mental strategies to multiply numbers

Work out each product using the multiplication strategy given in brackets.

a 8×16 (the distributive law) **b** $4 \times 8 \times 5$ (associative law)

THINK

a 1 Break the second number into tens and ones: $16 = 10 + 6$.

2 Multiply each part of the second number by the first number: $8 \times 10 + 8 \times 6$.

3 Add the results together: $80 + 48 = 128$.

b 1 Use brackets to group pairs of numbers that are easy to multiply together.

2 Multiply the grouped numbers together: $8 \times 5 = 40$.

3 Multiply the result by the third number: $4 \times 40 = 160$.

WRITE

a $8 \times 16 = 8 \times (10 + 6)$

$= 8 \times 10 + 8 \times 6$
$= 80 + 48$
$= 128$

b $4 \times 8 \times 5 = 4 \times (8 \times 5)$

$= 4 \times 40$
$= 160$

Example 1D.2 Multiplying by a one-digit number

Use short multiplication to calculate 157×3.

THINK

1 Set out the multiplication problem by lining up digits according to their place value.

2 Multiply 3 by the 7 in the ones column. $3 \times 7 = 21$, put the 1 in the ones column below and put the 2 in the tens column above the 5.

3 Multiply 3 by the 5 in the tens column. $3 \times 5 = 15$, add the extra 2 to get 17. Put the 7 in the tens column below and put the 1 in the hundreds column above the 1.

4 Multiply 3 by the 1 in the hundreds column. $3 \times 1 = 3$, add the extra 1 to get 4. Put the 4 in the hundreds column below.

WRITE

$$\begin{array}{r} {\scriptstyle 1\ 2} \\ 1\,5\,7 \\ \times\quad 3 \\ \hline 471 \\ \hline \end{array}$$

Example 1D.3 Multiplying by 10, 100 or 1000

Calculate each product.

a 62×10 **b** 153×100 **c** 27×1000

THINK

a To multiply by 10, move 62 one place value space to the left and insert a zero into the empty space.

b To multiply by 100, move 153 two place value spaces to the left and insert two zeros into the empty spaces.

c To multiply by 1000, move 27 three place value spaces to the left and insert three zeros into the empty spaces.

WRITE

a 62_
$62 \times 10 = 620$

b 153_ _
$153 \times 100 = 15\,300$

c 27_ _ _
$27 \times 1000 = 27\,000$

Helpful hints

✔ Don't forget to keep the place value of the digits when using the distributive law.
For example,
$32 \times 3 = 30 \times 3 + 2 \times 3$
$32 \times 3 \neq 3 \times 2 + 2 \times 3$

✔ When you multiply by 10, you're not 'adding a zero.' Instead you're moving the digit one place to the left and then inserting a zero in the ones column. Think, 'insert a zero'.

ANS p504

Exercise 1D Multiplying whole numbers

▲ 1–5, 6–7(a–d), 8–10, 12, 13(a, b)   ■ 1–7, 9–11, 13, 14   ⬠ 2–4, 6, 7, 11–16

1 Use your times tables knowledge to answer each product.

a 7×4 **b** 9×2 **c** 12×11 **d** 6×7

1D.1 2 Use the distributive law to work out each product. Break up the larger number into tens and ones and multiply them separately with the smaller number.

a 15×3 **b** 14×8 **c** 5×19 **d** 7×16

3 Use the associative law to work out each product. Use brackets to group pairs of numbers that are easy to multiply together.

a $9 \times 3 \times 2$ **b** $2 \times 6 \times 7$ **c** $8 \times 4 \times 9$ **d** $3 \times 5 \times 11$

UNDERSTANDING AND FLUENCY

1D.2 **4** Use short multiplication to calculate each product.

a 74×8 **b** 93×2 **c** 45×3 **d** 26×7

e 192×5 **f** 804×9 **g** 532×6 **h** 281×4

1D.3 **5** Calculate each product.

a 5×10 **b** 32×10 **c** 639×10 **d** 48×100

e 7×100 **f** 103×100 **g** $51\,623 \times 10$ **h** 2784×1000

6 Calculate the product using any multiplication strategy.

a $4 \times 3 \times 10$ **b** $6 \times 7 \times 10$ **c** $2 \times 10 \times 9$ **d** $15 \times 4 \times 100$

e $8 \times 5 \times 1000$ **f** $41 \times 3 \times 1000$ **g** $356 \times 1000 \times 2$ **h** $125 \times 1000 \times 4$

7 Calculate each product. You can use the strategy of multiplying by 10 or 100 or 1000. Remember that 60 is the same as 10×6 or 6×10 (see the commutative law).

a 8×60 **b** 4×30 **c** 12×70 **d** 93×40

e 217×50 **f** 6345×20 **g** 52×800 **h** 428×300

8 Copy this table into your workbook.

First number × second number	Product	Number of zeros in the first number	Number of zeros in the second number	Number of zeros in the product
10×10				
100×10				
1000×10				
$10\,000 \times 10$				

a Write your answer to each multiplication in the product column.

b Complete each row by writing the number of zeros in the first number, the second number and the product.

c Can you see a pattern? Explain how this pattern provides a quick method of doing multiplications like this.

d Use this method to calculate each product.

  i 10×100 **ii** 100×100 **iii** 100×1000 **iv** 1000×1000

9 a To find 4000×100, the calculation can be written as $4 \times 1000 \times 100$ or $1000 \times 100 \times 4$.

  i Calculate 1000×100.

  ii Multiply this result by 4 to obtain your final answer.

b Use this strategy to calculate each of these products.

  i 300×10 **ii** 700×100 **iii** 6000×100 **iv** 2000×1000

  v 100×50 **vi** 1000×400 **vii** $10\,000 \times 8000$ **viii** 100×9000

10 a One way to calculate 300×20 is to calculate $3 \times 100 \times 2 \times 10$ or $3 \times 2 \times 100 \times 10$.

  i Calculate 3×2.

  ii Calculate 100×10.

  iii Multiply the results you found in parts **i** and **ii** and write your answer to 300×20.

b Use this strategy to calculate each product.

  i 400×20 **ii** 3000×30 **iii** 200×600 **iv** 9000×500

  v 70×800 **vi** 600×4000 **vii** $30\,000 \times 7000$ **viii** $800 \times 20\,000$

11 Calculate each product.

a $40 \times 10 \times 200$ **b** $60 \times 900 \times 3000$ **c** $700 \times 20 \times 400$ **d** $5000 \times 300 \times 80$

12 From a part-time job, James has saved $37 each week. To find the amount he has saved after 28 weeks, you can write the calculation in a number of ways.

a Decide if the following statements are true or false.

i $37 \times 28 = 37 \times (20 + 8)$

ii $37 \times 28 = (30 + 7) \times (20 + 8)$

iii $37 \times 28 = 28 \times 37$

iv $37 \times 28 = 37 \times 20 \times 37 \times 8$

v $37 \times 28 = 28 \times 30 + 28 \times 7$

b List two other ways to write the calculation.

c Perform the calculation to find the total amount that James has saved.

13 Rory enjoys rowing with her team on the lake. She knows that for each full stroke, they glide 5 metres and for each half stroke they glide 3 metres.

a If the team takes 230 full strokes, how far will they glide?

b If the team takes 358 half strokes, how far will they glide?

c If the lake is only 1000 metres long, how many full strokes does the team need to take to cross the lake 3 times? Justify your answer.

14 The train to Brisbane from Rosewood has 6 carriages. During peak hour, all 88 seats per carriage are full.

a How many seats are there on the train?

b If there are 166 passengers standing in each carriage during peak hour, how many passengers are standing in the entire train?

c How many people are there on the train during peak hour?

d If another carriage containing 166 standing passengers and 88 sitting passengers was added to the train, how many people would there be on the 7-carriage train?

15 A local electrician is ordering light bulbs for a new apartment complex. Each apartment needs 43 light bulbs.

a If there are 30 apartments in the complex, how many light bulbs does the electrician need to order?

b It takes approximately 4 minutes to install a light bulb. How long will it take the electrician to install all the light bulbs in the complex? Give your answer in minutes.

c Show that it takes the electrician one hour to install 15 light bulbs.

16 Multiplication can be represented visually in many different ways. One visual representation of 15×3 is:

$$15 \times 3 = 3 \begin{array}{|c|c|} \hline 10 & 5 \\ \hline 30 & 15 \\ \hline \end{array} = 45$$

Draw five different visual representations of 24×6 by splitting up the factors of 24 into columns and the factors of 6 in rows.

Check your Student obook pro for these digital resources and more:

Investigation
Multiplying magic

Worksheet
Multiplying by 10, 100 or 1000

Topic quiz
1D

Checkpoint

1A 1 Write each number in worded and expanded form.

    a 836   **b** 9654   **c** 629 000

1A 2 Write each number in standard form.

    a Four hundred and nineteen

    b Ninety-six thousand, two hundred

    c Three hundred and twenty-five thousand, six hundred and fifty-six

1A 3 Write an approximation for each number by rounding to the nearest thousand.

    a 9234   **b** 25 872   **c** 135 896

1B 4 Use any mental strategy to calculate each sum.

    a $70 + 40 + 4$ **b** $87 + 39 + 23$ **c** $118 + 232 + 250$

1B 5 Use the addition algorithm to calculate each of the following.

    a $654 + 387$ **b** $6826 + 8347$ **c** $34 763 + 365$

1B 6 The first AFLW game was held on Friday, 3 February 2017 at Princes Park. There was a crowd of 24 568 in attendance. The national television audience for the game was 896 000. What was the total number of people who saw the game?

1C 7 Use any mental strategy to calculate each difference.

    a $350 - 60$ **b** $586 - 46$ **c** $287 - 143$

1C 8 Use the subtraction algorithm to calculate each of the following.

    a $964 - 732$ **b** $4863 - 568$ **c** $8256 - 4737$

1C 9 The original books in the Harry Potter series have the following number of pages:

    The Philosopher's Stone – 223   The Order of the Phoenix – 766

    The Chamber of Secrets – 251   The Half-Blood Prince – 607

    The Prisoner of Azkaban – 317   The Deathly Hallows – 607

    The Goblet of Fire – 636

    a What is the total number of pages in the series?

    b What is the difference in pages between the longest and the shortest books?

1D 10 Use the distributive law to calculate each product.

    a 13×7 **b** 6×18 **c** 23×8

1D 11 Calculate the product using any multiplication strategy.

    a 536×9 **b** 437×40 **c** 675×700

1D 12 The list of ingredients for making 24 pancakes is below.

    Gayi is planning to make pancakes for all the Year 7 students at her school. To have enough ingredients for one pancake each, Gayi needs six times the ingredients.

> 3 cups milk
> 2 eggs
> 4 teaspoons vanilla extract
> 4 cups self-raising flour
> 1 cup sugar
> 50 g butter

    a How many Year 7 students are there at Gayi's school?

    b How much of each ingredient does Gayi need?

1E Long multiplication

Learning intentions

By the end of this topic you will be able to…

✔ use long multiplication to multiply a two-digit number by a two-digit number

✔ use long multiplication to multiply a three-digit number by a two-digit number.

Long multiplication

- In long multiplication, the digits are lined up according to place value.
- The process of long multiplication uses the distributive law to multiply the first number by the digits of the second number separately and then find their sum.

$$
\begin{array}{r}
\overset{2}{3}4 \\
\times\ 26 \\
\hline
204 \\
+\ 680 \\
\hline
884
\end{array}
$$

Write ⟶

Multiply by ones ⟶ 204   (34×6)

Multiply by tens ⟶ + 680   (34×20)
Don't forget the zero(s)

Add the results ⟶ 884

Example 1E.1 Using long multiplication to multiply a two-digit number by a two-digit number

Calculate the product using long multiplication.

$$
\begin{array}{r}
68 \\
\times\ 37 \\
\end{array}
$$

THINK

1 Set up the multiplication problem by lining up the digits according to their place value.

2 Multiply $7 \times 8 = 56$. Write the 6 in the ones column below and write the 5 in the tens column above the 6.

   Multiply $7 \times 6 = 42$. Add the extra 5 to get 47. Write the 7 in the tens column and the 4 in the hundreds column below.

3 Start a new line and multiply $3 \times 8 = 24$. Write the 4 in the tens column below and the 2 in the hundreds column next to the 6.

4 Write a zero in the ones column as the next step is to multiply by tens and there will be zero ones.

5 Multiply $3 \times 6 = 18$. Add the extra 2 to get 20 hundreds. Write the 0 in the hundreds column and the 2 in the thousands below.

6 Add the results of the products and write the answer.

WRITE

$$
\begin{array}{r}
\overset{2}{}\overset{5}{} \\
68 \\
\times\ \ 37 \\
\hline
476 \\
+\ 2040 \\
\hline
2516
\end{array}
$$

$68 \times 37 = 2516$

Example 1E.2 Using long multiplication to multiply a three-digit number by a two-digit number

Calculate the product using long multiplication.

$$\begin{array}{r} 5\,4\,3 \\ \times \quad 8\,6 \end{array}$$

THINK

1   Set out the multiplication problem by lining up the digits according to their place value.

2   Multiply by ones: $543 \times 6 = 3258$

3   Multiply by tens:
    $543 \times 80 = 43\,440$

4   Add the results of the products and write the answer underneath.

WRITE

$$\begin{array}{r} {\scriptstyle 3\ 2} \\ {\scriptstyle 2\ 1} \\ 5\,4\,3 \\ \times \quad 8\,6 \\ \hline 3\,2\,5\,8 \\ 4\,3\,4\,4\,0 \\ \hline 4\,6\,6\,9\,8 \end{array}$$

$543 \times 86 = 46\,698$

Helpful hints

✔ Take care to line up digits by place value when setting up long multiplication problems to avoid making errors when adding the products together.
✔ Don't forget to write down the zeros! When multiplying by a multiple of 10, don't forget to insert a zero in the ones column.
✔ When multiplying a three-digit number by a three-digit number, insert two zeros in the third line of your algorithm. In the first line you are multiplying by ones, in the second line you are multiplying by tens, and in the third line you are multiplying by hundreds.

$$\begin{array}{r} 1\,2 \\ \times \quad 3\,4 \\ \hline 4\,8 \\ 3\,6\,0 \\ \hline 4\,0\,8 \end{array}$$

Exercise 1E Long multiplication

ANS p505

△ 1–8, 9a(i, ii), 10–13

▢ 1, 2(e–h), 3, 4(c, d), 5(e–h), 6, 7(e–h), 8–10, 12, 14, 16

⬠ 2(g, h), 3, 5(e–h), 6, 7(e–h), 8, 9, 12, 13, 15–18

UNDERSTANDING AND FLUENCY

1E.1 1 Calculate each product using long multiplication.

a $\begin{array}{r} 94 \\ \times \ 27 \\ \hline \end{array}$ b $\begin{array}{r} 13 \\ \times \ 11 \\ \hline \end{array}$ c $\begin{array}{r} 25 \\ \times \ 18 \\ \hline \end{array}$ d $\begin{array}{r} 37 \\ \times \ 22 \\ \hline \end{array}$

2 Multiply the following pairs of numbers using long multiplication.

a 38×15 b 62×24 c 46×32 d 85×73

e 65×48 f 56×81 g 99×18 h 24×92

3 Check your answers to question **2** using a calculator.

1E.2 4 Calculate each product using long multiplication.

a $\begin{array}{r} 133 \\ \times \ 19 \\ \hline \end{array}$ b $\begin{array}{r} 205 \\ \times \ 34 \\ \hline \end{array}$ c $\begin{array}{r} 147 \\ \times \ 56 \\ \hline \end{array}$ d $\begin{array}{r} 281 \\ \times \ 64 \\ \hline \end{array}$

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5 Multiply the following pairs of numbers using long multiplication.

  a 415 × 23   b 283 × 54   c 123 × 37   d 231 × 56

  e 782 × 49   f 506 × 81   g 1059 × 18   h 2654 × 42

6 Check your answers to question 5 using a calculator.

7 Multiply the following pairs of numbers using long multiplication. Hint: Your third multiplication line should end with two zeros. This is because you are multiplying by hundreds.

  a 346 × 125   b 865 × 347   c 624 × 253   d 937 × 625

  e 538 × 124   f 361 × 253   g 497 × 516   h 702 × 281

8 Check your answers to question 7 using a calculator.

9 a Estimate these products by first rounding each number to the leading digit of each number, then multiplying.

  i 591 × 82   ii 2175 × 93   iii 7856 × 304   iv 63 019 × 5647

  b Check how close your estimations are to the exact result by performing the calculations.

10 An average adult human heart beats around 72 times in a minute.

  a How many times does it beat in one hour?

  b How many times does it beat in one day?

11 A school has 25 students in each of its 32 classes.

  a How many students are enrolled at this school?

  b On a particular day, three students are away from 15 of the classes and two students are away from 11 of the classes. How many students are at school on this day?

12 Over the school holidays, a team of eight teenagers deliver take-away menus to homes near a pizza restaurant. How many menus are delivered in a week if each teenager visits 46 homes each day?

13 Galápagos tortoises move extremely slowly, covering a distance of about 260 m in 1 hour.

  a What distance could a Galápagos tortoise travel in 4 hours?

  b Compare this result with the distance that a human could walk in 4 hours, assuming humans walk about 4500 m per hour.

  c The longest lifespan on record belongs to a male Galápagos tortoise kept in a British military fort for 154 years.

    Assume there are 365 days in a year. Calculate how long he lived in:

    i months   ii days   iii hours

    iv minutes   v seconds

14 a Assume there are 365 days in a year. Calculate how old you will be at your next birthday in:

    i months   ii days   iii hours

    iv minutes   v seconds

  b Estimate how many hours there are between now and your next birthday.

15 Earth travels a distance of about 2 575 200 km each day. Assuming there are 365 days in a year, estimate, by rounding to the leading digits in your calculations, the distance Earth travels in one complete orbit around the Sun.

16 In 2017, around 392 000 hectares of vegetation was cleared in Queensland. When 392 000 hectares of vegetation is cleared, it is estimated that 45 million animals, including koalas, birds and reptiles, die from loss of habitat.

    a If 392 000 hectares of vegetation is cleared every year from 2018–22, what is the total area of land that will be cleared over this time period?

    b Estimate how many animals will die if this occurs.

    c If 392 000 hectares of vegetation is cleared in 2020 and the area of vegetation cleared doubles each year, what is the total area of land that will be cleared from the start of 2020 to the end of 2022?

17 Fill in the stars using only the numbers 1, 2, 3, 4, 5 and 6 to solve the following problem. There may be more than one answer.

$$
\begin{array}{r}
\star\,\star\,\star \\
\times \quad \star\,\star \\
\hline
\star\,\star\,\star\,\star \\
+ \quad \star\,\star\,\star\,0 \\
\hline
= \quad \star\,\star\,\star\,\star
\end{array}
$$

18 Siân and Ajarné are building a model of a horse-riding arena they saw in a picture. In the picture, the arena is a flat and level rectangle that is 6 m long and 4 m wide with a fence around the perimeter.

    a Draw a picture of the arena and label the side lengths.

    b Determine the area of the picture of the arena. Recall that the area of a rectangle is the length multiplied by the width.

Siân and Ajarné decide to build their model arena on a piece of cardboard. They have a square piece of cardboard with a length of 25 cm.

    c What are the dimensions of the largest arena that can be built on the cardboard if they want the ratio of the length and width of the rectangle to be the same?

    d Determine the area of the model arena.

The girls decide to build the fence out of matchsticks. Each matchstick is 2 mm wide.

    e How many matchsticks will they need? Recall that there are 10 millimetres in 1 centimetre.

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Interactive skillsheet
Multiplying whole numbers

Topic quiz
1E

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1F Dividing whole numbers

Learning intentions

By the end of this topic you will be able to…

✔ calculate quotients using short division
✔ calculate quotients using long division.

Division

Division (÷)
Quotient
Divide
Shared
Distributed

- The **dividend** is the number that is divided by another number.
- The **divisor** is the number that divides the dividend.
- The **quotient** is the whole number result after the division has occurred.
- The **remainder** is the part of the dividend that is left over when the number is not a multiple of the divisor, and is always less than the divisor.

$$91 \div 6 = 15 \text{ remainder } 1$$

dividend divisor quotient remainder

- One number is said to be exactly divisible by another number when there is no remainder (the remainder is zero).
  For example, 91 is not exactly divisible by 6, but 36 is exactly divisible by 6.

Short division

- Always start by dividing the leading digit of the dividend by the divisor. This is different from addition, subtraction and multiplication, where the calculation starts with the ones digits.

quotient

$$1\ 4\ 5 \text{ remainder } 1$$
$$6\overline{)8\,{}^27\,{}^31}$$

divisor dividend remainder

Long division

- Long division is the same process as short divsion, however, all the steps are recorded. The same six steps listed are repeated until the answer is found.

Step 1: Divide
Step 2: Multiply
Step 3: Subtract
Step 5: Bring down
Step 6: Repeat or
remainder

```
    1              1 4            1 4 5 remainder 1
6)8 7 1        6)8 7 1        6)8 7 1
- 6↓           - 6↓           - 6↓
  2 7            2 7            2 7
               - 2 4↓         - 2 4↓
                 3 1            3 1
                              -  3 0
                                  1
```

Example 1F.1 Using short division

Use short division to calculate each quotient and remainder.

a $4\overline{)98}$ **b** $7\overline{)1459}$

THINK

a 1 How many 4s in 9? Write 2 above the 9 on the quotient line. Work out the remainder. $4 \times 2 = 8$, so remainder is $9 - 8 = 1$. Write the 1 next to the 8 to get 18.

  2 How many 4s in 18? Write 4 above the 8 on the quotient line. Work out the remainder. $4 \times 4 = 16$, so remainder is $18 - 16 = 2$.

b 1 How many 7s in 1? Write a zero above the 1. Underline 1 and 4.

  2 How many 7s in 14? Write 2 above the 4 on the quotient line.

  3 How many 7s in 5? Write a zero above the 5. Underline 5 and 9.

  4 How many 7s in 59? Write 8 above the 9 on the quotient line. Work out the remainder. $7 \times 8 = 56$, so remainder is $59 - 56 = 3$.

WRITE

a $\quad \overset{2\,4}{4\overline{)9^{1}8}}$ remainder 2

$98 \div 4 = 24$ remainder 2

b $\quad \overset{0208}{7\overline{)1459}}$ remainder 3

$1459 \div 7 = 208$ remainder 3

Example 1F.2 Using long division

Use long division to calculate $6492 \div 19$.

THINK

1 List multiples of 19.

2 Divide: How many 19s in 6? Write a zero above the 6. Underline 6 and 4.
How many 19s in 64? Write 3 above the 4 on the quotient line.
Multiply: $19 \times 3 = 57$
Subtract: Remainder is $64 - 57 = 7$
Bring down 9 and write it beside the remainder of 7.
Then, the next number to divide is 79.

3 Divide: How many 19s in 79? Write 4 above 9 on the quotient line.
Multiply: $19 \times 4 = 76$
Subtract: Remainder is $79 - 76 = 3$
Bring down 2 and write it beside the remainder of 3.
Then, the next number to divide is 32.

4 Divide: How many 19s in 32? Write 1 above 2 on the quotient line.
Multiply: $19 \times 1 = 19$
Subtract: Remainder is $32 - 19 = 13$

5 Check that the remainder is less than the divisor and write the answer.

WRITE

$$
\begin{array}{r}
0\,3 \\
19\overline{)6\,4\,9\,2} \\
-\,5\,7\,\downarrow \\
\hline
7\,9
\end{array}
$$

$$
\begin{array}{r}
0\,3\,4 \\
19\overline{)6\,4\,9\,2} \\
-\,5\,7\,\downarrow \\
\hline
7\,9 \\
-\,7\,6\,\downarrow \\
\hline
3\,2
\end{array}
$$

$$
\begin{array}{r}
0\,3\,4\,1 \text{ remainder } 13 \\
19\overline{)6\,4\,9\,2} \\
-\,5\,7\,\downarrow \\
\hline
7\,9 \\
-\,7\,6\,\downarrow \\
\hline
3\,2 \\
-\,1\,9 \\
\hline
1\,3
\end{array}
$$

$6492 \div 19 = 341$ remainder 13

✔ Remember that division starts from the left, dividing the largest place value digit first.

✔ Remainders and decimals are not the same thing! For example, remainder 2 is not the same as 0.2.

✔ Remember that 0341 = 341, as a zero in the first place value doesn't change the value of the number. However, 308 is not the same as 38. In this case, the zero shows that there are zero tens and keeps the 3 in the hundreds column and the 8 in the ones column.

✔ When dividing, the remainder is always less than the divisor.

✔ When using long division, it can be helpful to have the list of steps handy until you are confident in the skill.

Step 1: Divide
Step 2: Multiply
Step 3: Subtract
Step 5: Bring down
Step 6: Repeat or remainder

ANS p505

Exercise 1F Dividing whole numbers

▲ 1–4, 5(a–d), 6(a, b), 7–10, 12–14, 16(a, b)

■ 1–4, 5(a, c, e, g), 6, 7, 9–11, 15, 16(a, b), 18

⬠ 3(g, h), 4(c, d), 5(e–h), 6, 7, 10, 11, 13, 16–20

1 For each division, identify:

    i the dividend   **ii** the divisor

    iii the quotient   **iv** the remainder

  a $9 \div 2 = 4$ remainder 1   **b** $17 \div 7 = 2$ remainder 3   **c** $30 \div 5 = 6$

1F.1 **2** Use short division to calculate each quotient and remainder.

  a $2\overline{)13}$ **b** $5\overline{)23}$ **c** $3\overline{)17}$ **d** $10\overline{)25}$

  e $8\overline{)38}$ **f** $4\overline{)26}$ **g** $9\overline{)66}$ **h** $6\overline{)48}$

3 Use short division to calculate each quotient and remainder.

  a $538 \div 4$ **b** $756 \div 6$ **c** $172 \div 3$ **d** $1229 \div 5$

  e $877 \div 5$ **f** $489 \div 7$ **g** $668 \div 8$ **h** $1234 \div 4$

4 Another way to write a division calculation is as a fraction.

For example, $57 \div 3$ is the same as $\frac{57}{3}$. The horizontal line between the two numbers replaces the division sign. Perform each division using short division.

  a $\frac{63}{9}$ **b** $\frac{1470}{6}$ **c** $\frac{658}{7}$ **d** $\frac{1251}{3}$

1F.2 **5** Use long division to calculate each quotient and remainder.

  a $542 \div 21$ **b** $739 \div 18$ **c** $884 \div 26$ **d** $798 \div 12$

  e $465 \div 22$ **f** $881 \div 41$ **g** $7462 \div 35$ **h** $1234 \div 56$

6 Use long division to calculate each quotient and remainder.

  a $1658 \div 43$ **b** $4509 \div 45$ **c** $15\,789 \div 13$ **d** $12\,023 \div 80$

7 Evaluate each of the following.

  a $\frac{272}{17}$ **b** $\frac{3350}{25}$ **c** $\frac{47\,136}{32}$ **d** $\frac{36\,088}{52}$

8 Copy this table.

First number ÷ second number	First number / second number	Quotient	Number of zeros in the first number	Number of zeros in the second number	Number of zeros in the quotient
10 ÷ 10	$\dfrac{10}{10}$				
100 ÷ 10	$\dfrac{100}{10}$				
1000 ÷ 10	$\dfrac{1000}{10}$				
10 000 ÷ 10	$\dfrac{10\,000}{10}$				
100 ÷ 100	$\dfrac{100}{100}$				
1000 ÷ 100	$\dfrac{1000}{100}$				
10 000 ÷ 100	$\dfrac{10\,000}{100}$				

a Write your answer to each division in the 'Quotient' column.

b Complete each row of the table by writing the number of zeros in the first number, the second number and the quotient.

c Can you see a pattern? Explain how this pattern provides a shortcut for dividing by multiples of 10.

d Use this method to work out the following quotients.

    i 10 000 ÷ 10   **ii** 100 000 ÷ 100   **iii** 1000 ÷ 1000   **iv** 10 000 ÷ 1000

9 a To work out 5000 ÷ 100, the calculation can be written as $\dfrac{5000}{100}$.

    i Calculate 1000 ÷ 100.

    ii Multiply this result by 5 to obtain your final answer.

b Use this strategy to evaluate the quotient of each of the following.

    i 200 ÷ 10   **ii** 600 ÷ 100   **iii** 9000 ÷ 100   **iv** 4000 ÷ 1000

    v 800 ÷ 10   **vi** 3000 ÷ 100   **vii** 50 000 ÷ 1000   **viii** 6000 ÷ 10

10 a One way to evaluate 600 ÷ 20 is to write the calculation as $\dfrac{600}{20}$.

    i Calculate 6 ÷ 2.

    ii Calculate 100 ÷ 10.

    iii Multiply the results obtained in parts **i** and **ii** and write your answer to 600 ÷ 20.

b Use this strategy to perform each division.

    i $\dfrac{900}{30}$ **ii** $\dfrac{8000}{20}$ **iii** $\dfrac{1200}{60}$

    iv $\dfrac{25\,000}{500}$ **v** 6000 ÷ 300   **vi** 80 000 ÷ 4000

    vii 70 000 ÷ 700   **viii** 1600 ÷ 80   **ix** 2500 ÷ 50

11 a Estimate the quotient of each of the following by first rounding each number to the first digit of each number before dividing. (Hint: use your strategy from question **10**.)

    i 627 ÷ 33   **ii** 5940 ÷ 18   **iii** 3852 ÷ 214   **iv** 83 490 ÷ 3795

b Use a calculator to check how close your estimations are to the exact result.

12 Georgia is helping to arrange a birthday party for her younger brother. She has 165 sweets to share among 15 party bags. To work out the number of sweets in each party bag, you can describe the calculation in a number of ways.

   a Which of the following number sentences correctly describes the information above?

   A Divide 165 by15.

   B How many times does 165 go into 15?

   C Evaluate 166 ÷ 15.

   D Find the quotient when 15 is divided by 165.

   E Find the product of 165 and 15.

   b List one other way to write the calculation.

   c Determine the number of sweets in each party bag.

13 Chris can type (on his computer) at a rate of 68 words each minute.

   a How long would it take him to type a message of 272 words?

   b Explain how you could check the answer to this division problem using multiplication.

14 Charlotte swam 1500 m in a 50 m swimming pool. How many laps of the pool did she complete?

15 The ancestor of the common wombat and the southern hairy-nosed wombat is the giant wombat (diprotodons), a marsupial that disappeared from Australia around 40000 years ago. On average, giant wombats were 3 m in length and 180 cm in height, with a mass of 2000 kg. The mass of an average common wombat is 37 kg. The photo shows a hairy-nosed wombat and its mass.

21 kg

   a How many common wombats, when their weights are added together, would be approximatively equivalent to one giant wombat?

   b How many hairy-nosed wombats, when their weights are added together, would be approximatively equivalent to one giant wombat?

16 Isobel and Connor are helping to make food parcels for a charity organisation. There are 1350 bags of rice to be shared among 84 food parcels.

   a How many bags of rice will be in each food parcel?

   b How many bags of rice will be left over?

   c Determine the number of food parcels that could be made up with an equal share of the bags of rice so that no bags are left over. There are many solutions to this question.

17 Earth orbits the Sun in about 365 days, while the planet Jupiter completes an orbit around the Sun in about 4333 Earth days. Earth has a diameter of approximately 12756 km.

Diameter
142984 km

   a Estimate the number of times that Earth would complete a full orbit around the Sun for each one of Jupiter's orbits. First round each number to its leading digit.

   b If Earth was drawn to the same scale as Jupiter is shown in the photo, approximately how many Earths would fit across the equator of Jupiter?
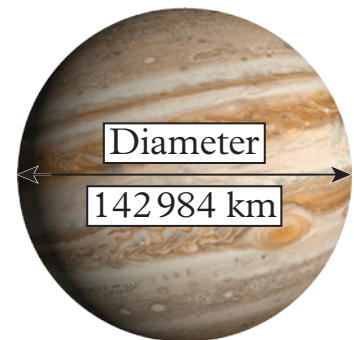
18 An apartment building has twelve apartments that are numbered from 110 to 121. The manager has twelve key cards for the apartments numbered from 1 to 12.

The manager has forgotten which key card is for which apartment but knows that each apartment number is divisible by the number of its key card.

Determine which key cards pair with each apartment.

19 Below are the numbers 1 to 9. Using only the operations +, −, × and ÷, find at least one way to make 100 using all the digits.

$$1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8 \quad 9$$

$$+ \quad - \quad × \quad ÷$$

$$= 100$$

20 The following is a long division problem showing all the working out steps and the result. There is no remainder. When this book was printed, the numbers were replaced with letters! Fortunately, each letter represents the same number throughout the problem. Construct the original problem.

$$
\begin{array}{r}
\text{I A E D H E} \\
\text{A B}\overline{)\text{C D F G G C}} \\
-\underline{\text{A B}} \\
\text{B F} \\
-\underline{\text{G C}} \\
\text{A A G} \\
-\underline{\text{A I B}} \\
\text{J G} \\
-\underline{\text{J I}} \\
\text{G C} \\
-\underline{\text{G C}} \\
\text{I}
\end{array}
$$

1G Exponents and square roots

Learning intentions

By the end of this topic you will be able to…

✔ convert numbers between exponent and expanded form

✔ evaluate numbers in exponent form

✔ evaluate the square root of a number.

Exponent notation

- An **exponent** or **index** of a number indicates how many times a number is multiplied by itself. The number that is being multiplied is called the **base**. A number is in **exponent form** when it is written as a base with an exponent.

$$\text{base} \rightarrow 2^3 = 2 \times 2 \times 2 = 8 \leftarrow \text{exponent/index}$$

exponent form   expanded form   basic numeral

→ In the example above, the number in exponent form is read as '2 to the power of 3'. Similarly, 3^4 is read as '3 to the power of 4'.

Perfect square numbers
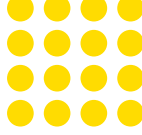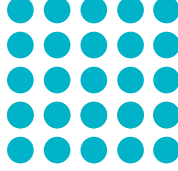
- **Perfect square** numbers are numbers that can be represented in a square pattern. They can also be expressed as the product of two equal whole numbers.
  For example, $3 \times 3 = 9$, so 9 is a perfect square number.
- To **square** a number is to multiply it by itself or 'raise it to the power of 2'.
  For example, squaring 3, or raising 3 to the power of 2, can be written numerically as:
  $3^2 = 3 \times 3 = 9$.

Square roots

- To find the **square root** of a number, find the number that when squared (raised to the power of 2) results in the original number.
  For example, $\sqrt{9} = 3$ because when 3 is multiplied by itself the result is 9.
- The function of a square root of a number is denoted by the radical symbol $\sqrt{}$.

$1^2 = 1 \times 1 = 1$	●	$\sqrt{1} = 1$
$2^2 = 2 \times 2 = 4$	●● ●●	$\sqrt{4} = 2$
$3^2 = 3 \times 3 = 9$	●●● ●●● ●●●	$\sqrt{9} = 3$
$4^2 = 4 \times 4 = 16$	●●●● ●●●● ●●●● ●●●●	$\sqrt{16} = 4$
$5^2 = 5 \times 5 = 25$	●●●●● ●●●●● ●●●●● ●●●●● ●●●●●	$\sqrt{25} = 5$

Example 1G.1 Converting numbers to exponent form

Write each repeated multiplication in exponent form.

a $8 \times 8 \times 8 \times 8 \times 8 \times 8$

b $3 \times 3 \times 4 \times 4 \times 4 \times 4 \times 4$

THINK

a Identify the base and the exponent. The base is the number that is repeatedly multiplied, 8. The exponent represents the number of times the base appears in expanded form, 6.

b Identify the base and the exponent. Notice that there are two different bases. Write the first base, 3, with its exponent, 2, multiplied by the second base, 4, with its exponent, 5.

WRITE

a $8 \times 8 \times 8 \times 8 \times 8 \times 8$

$= 8^6$

b $3 \times 3 \times 4 \times 4 \times 4 \times 4 \times 4$

$= 3^2 \times 4^5$

Example 1G.2 Calculating the value of a number in exponent form

Write each of the following in expanded form and calculate their values.

a 4^3

b $2^4 \times 3^2$

THINK

a 1 Identify the base and the exponent. The base is 4 and the exponent is 3, so 4 is multiplied by itself 3 times.

2 Perform the multiplication.

b 1 Identify the base and the exponent. In this case, there are two bases, so each base needs to be expanded separately.

2 Perform the multiplication.

WRITE

a $4^3 = 4 \times 4 \times 4$

$= 16 \times 4$

$= 64$

b $2^4 \times 3^2 = 2 \times 2 \times 2 \times 2 \times 3 \times 3$

$= 4 \times 4 \times 9$

$= 16 \times 9$

$= 144$

Example 1G.3 Calculating the square root

Calculate the value of each of the following square roots.

a $\sqrt{16}$

b $\sqrt{144}$

THINK

Use the times tables or square numbers to determine which number multiplied by itself is equal to the number under the square root symbol.

WRITE

a $4 \times 4 = 16$

So, $\sqrt{16} = 4$

b $12 \times 12 = 144$

So, $\sqrt{144} = 12$

✔ Don't confuse exponents and multiplication!

For example, $2^3 = 2 \times 2 \times 2$
$2^3 \neq 2 \times 3$

✔ Write your exponents carefully – they should be smaller than the base and sit on the right shoulder of the base. Your 4^2 should look different to your 42!

$4^2 \neq 42$

ANS p506 **Exercise 1G** Exponents and square roots

1–3, 4–7(a, c, e, g), 8, 9(1st, 2nd columns), 10, 11(a, b), 12, 13, 15, 17

1–3, 4–7(b, d, f, h), 8, 9(1st, 3rd columns), 10–14, 16, 18, 19, 21

1(e, f), 3(e, f), 4–7(f, g, h), 8(c, d), 9(d, f, h, l), 10, 11(c, d), 14, 17, 20, 22–24

1G.1 **1** Write each repeated multiplication in exponent form.

a $5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5$

b $4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 4$

c $11 \times 11 \times 11$

d $20 \times 20 \times 20 \times 20 \times 20$

e $9 \times 9 \times 9 \times 9 \times 9 \times 9 \times 9 \times 9$

f $300 \times 300 \times 300 \times 300$

2 How would you read each answer obtained in question **1**? Write each answer using words.

3 Write each repeated multiplication in exponent form.

a $7 \times 7 \times 7 \times 9 \times 9 \times 9 \times 9$

b $4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 2 \times 2 \times 2$

c $3 \times 3 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5$

d $8 \times 8 \times 8 \times 8 \times 13 \times 13$

e $2 \times 2 \times 2 \times 2 \times 6 \times 6 \times 7 \times 7$

f $19 \times 19 \times 23 \times 23 \times 23 \times 23 \times 31$

1G.2 **4** Write each of the following in expanded form and calculate their values.

a 3^2 **b** 2^5 **c** 7^3 **d** 5^2 **e** 9^4 **f** 4^3 **g** 1^5 **h** 6^3

5 Calculate the value of each of the following.

a 2^4 **b** 3^4 **c** 7^2 **d** 5^3 **e** 11^3 **f** 12^2 **g** 10^3 **h** 16^2

6 Write each product in expanded form and calculate their values.

a $2^3 \times 4^2$ **b** $3^4 \times 5^2$ **c** $8^2 \times 10^3$ **d** $3^5 \times 1^4$

e $2^6 \times 7^2$ **f** $10^2 \times 3^3$ **g** $9^4 \times 11^2$ **h** $6^2 \times 3^2$

1G.3 **7** Calculate the value of each of the following square roots.

a $\sqrt{9}$ **b** $\sqrt{36}$ **c** $\sqrt{64}$ **d** $\sqrt{1}$

e $\sqrt{49}$ **f** $\sqrt{121}$ **g** $\sqrt{144}$ **h** $\sqrt{400}$

8 Without using a calculator, complete each statement.

a $11^2 = 121$ so $\sqrt{121} = \underline{\hspace{1cm}}$

b $35^2 = 1225$ so $\sqrt{1225} = \underline{\hspace{1cm}}$

c $61^2 = 3721$ so $\sqrt{\underline{\hspace{0.8cm}}} = 61$

d $298^2 = 88\,804$ so $\sqrt{\underline{\hspace{0.8cm}}} = 298$

9 Evaluate each of the following by first working out the value of any numbers written in exponent form.

a $3^4 + 2^3$ **b** $10^2 + 5^2$ **c** $8^2 - 2^6$ **d** $4^3 - 1^9$

e $10^2 \div 5^2$ **f** $6^4 \div 3^3$ **g** $4^2 + 2^4 + 3^3$ **h** $9^2 + 2^2 - 1^5$

i $10^2 \times 3^2 \times 2^2$ **j** $4 \times 2^3 \times 5$ **k** $7^2 \times 8 \times 9^2$ **l** $9^3 \times 6^2 \times 8^1$

UNDERSTANDING AND FLUENCY

10 Which number is bigger: 3^5 or 5^3?

11 Arrange the numbers in each list from smallest to largest. You may like to use a calculator to help you.

    a 3^2, 4^5, 2^3, 5^4 **b** 7^6, 6^7, 1^{50}, 50^3 **c** 3^{10}, 9^4, 6^5, 10^3 **d** 8^3, 3^8, 4^6, 12^2

12 State if each of the following is true or false.

    a $12 < \sqrt{121} < 13$ **b** $8 < \sqrt{16} < 10$ **c** $7 < \sqrt{64} < 9$ **d** $11 < \sqrt{144} < 13$

13 The square root of a non-perfect square number is not a whole number. We can, however, find two consecutive whole numbers that the square root is between. For example, what is $\sqrt{10}$? Recall that $3^2 = 9$ and $4^2 = 16$. Since 10 is between the perfect squares 9 and 16, $\sqrt{10}$ is between 3 and 4. This is useful for estimating square roots.

    State if each of the following is true or false.

    a $2 < \sqrt{7} < 3$ **b** $5 < \sqrt{26} < 6$ **c** $7 < \sqrt{30} < 8$ **d** $9 < \sqrt{80} < 10$

14 Write the closest whole numbers that each square root lies between.

    a $\_\_ < \sqrt{15} < \_\_$ **b** $\_\_ < \sqrt{33} < \_\_$ **c** $\_\_ < \sqrt{40} < \_\_$

    d $\_\_ < \sqrt{99} < \_\_$ **e** $\_\_ < \sqrt{120} < \_\_$ **f** $\_\_ < \sqrt{214} < \_\_$

15 a Complete this table.

Exponent form	Expanded form	Basic numeral	Number of zeros in the basic numeral
10^1	10	10	1
10^2	10×10	100	
10^3			
10^4			
10^5			

    b Can you see a pattern? This pattern provides a quick method for finding the value of numbers in exponent form with a base of 10. Describe this method.

    c Use this method to evaluate the following.

        i 10^8 **ii** 10^6 **iii** 10^{15} **iv** 10^{10}

    d Use the pattern in the table to help you deduce the value of 10^0.

    e Write each number in exponent form using a base of 10 and the appropriate exponent.

        i 100   **ii** 10 000   **iii** 1   **iv** 10 000 000

16 Create a list of the first 20 square numbers.

17 The square of a two-digit number can be found using an area diagram. For example, to find 43^2 write $43 = 40 + 3$. Draw a square with side length 43 and break into the four sections as shown. The area of the square is equal to $43^2 = (40 + 3)^2$. It is also equal to the sum of the areas of the orange and green squares and two copies of the blue rectangle. This means that $43^2 = 3^2 + 40^2 + 2 \times 3 \times 40 = 9 + 1600 + 240 = 1849$.

    a Using this method find:

        i 27^2 **ii** 52^2 **iii** 99^2

    b Can you see a pattern? Explain how this pattern provides a method for finding the squares of two-digit numbers.
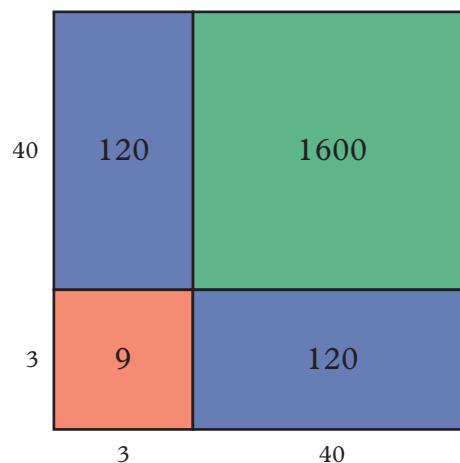
18 A colony of bacteria grows very quickly and triples its size each day.

Number of days	Size of colony (in millions)		Number of bacteria (in millions)
	Expanded form	**Exponent form**	
1	3	3^1	3
2	3×3	3^2	9
3	$3 \times 3 \times 3$		
4			
5			

a Complete the table above.

b What is the size of the colony after:

  i 6 days?

  ii 1 week?

  iii 2 weeks?

c How long does it take for the bacteria colony to be:

  i 27 times larger than day 1?

  ii 243 times larger than day 1?

  iii 6561 times larger than day 1?

19 Dianna sends a text message to four of her friends. Each friend forwards it to another four people, who each then send it to another four people.

a How many text messages in total have been sent?

b Explain how indices can be used to solve this problem.

20 Over the summer school holidays, Taylor is offered a part-time job for which he will earn $100 per week. The job is available for 4 weeks. Taylor decides to discuss a different payment plan with his prospective boss. 'How about paying me only $5 in the first week and then in each of the other weeks paying me five times as much as the week before.' The boss thinks this new plan might save her money. Which payment plan do you think the boss should go with? Use calculations to justify your answer.

21 Arrange the numbers 1 to 16 in pairs so that each pair adds up to a perfect square.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

22 Interesting patterns emerge when we investigate square numbers. Consider the difference between two consecutive square numbers. Recall that consecutive means one following directly after another.

a The square numbers are 1, 4, 9, 16, 25…. Find difference between the first 10 pairs of consecutive square numbers, starting with 1 and 4. Record your results in a table.

b What do all these differences have in common?

c Consecutive numbers in a sequence can be written as n and $n + 1$ where n is a whole number. Write a number sentence showing the difference between two consecutive square numbers using n and $n + 1$.

d Using algebra, we can simplify the number sentence to $2 \times n + 1$. Explain how $2 \times n + 1$ relates to part **b**.

23 An evil genius has discovered a new toxic serum that, when consumed, decreases a person's weight by taking the square root of their current weight, every hour on the hour.
The evil genius tests the serum on four brave volunteers.

  a At the time they consume the serum, Person A weighs 99 kg, Person B weighs 142 kg, Person C weighs 56 kg, and Person D weighs 82 kg. Without using a calculator, approximate the weight of each person after the first hour has past.

  b Without using a calculator, approximate the weight of each person after the second hour has past. Remember, the serum will decrease each person's weight by the square root of their new weight, not their original weight.

  c Without using a calculator, approximate the weight of each person after the third hour has past.

  d Estimate how much each person will weigh after 10 hours?

  e Will the weight of each person ever reach 0 kg?

  f Determine a mathematical serum formula that could hypothetically decease a person's weight to 0 kg after 13 hours.

24 Consider the following triangles. On the edges are square roots and basic numerals. Match the square roots to their result. Your finished puzzle should look like a diamond.
You may like to draw the triangles and cut them out so that you can move them around easily. For an extra hard challenge, do not use a cut-out version of the triangle to help you.
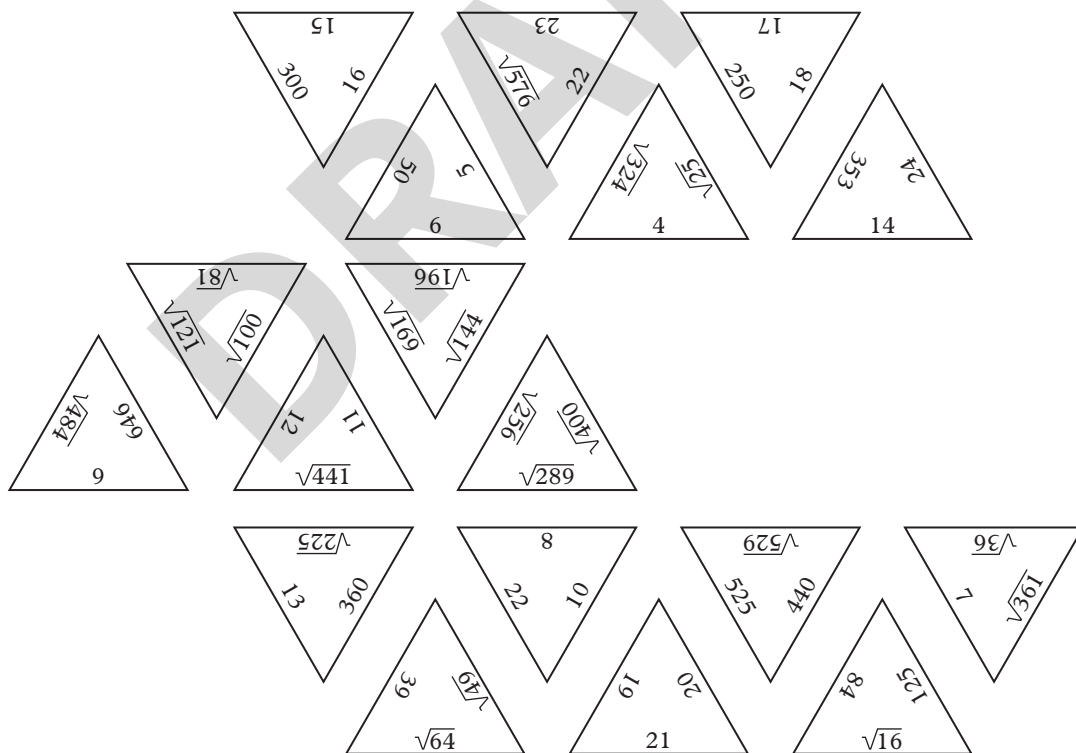
1H Order of operations

Learning intentions

By the end of this topic you will be able to…

✔ order operations in calculations involving two or more operations
✔ use the BIDMAS acronym to solve problems involving order of operations.

Order of operations

- Operations at the same ranking are performed in order from left to right.
- Where there is more than one set of brackets in the problem, perform the operations inside the innermost brackets first.

  BIDMAS can be used to help remember the order of operations.

B	Brackets	Operations inside brackets are always performed first. For example, $5 \times (10 - 2) = 5 \times 8 = 40$.
I	Indices (or exponents)	Next, evaluate indices and square roots. For example, $3^3 - 4 = 27 - 4 = 23$.
D	Division	Then working from **left to right,** perform any multiplication or division before adding or subtracting. For example, $5 \times 3 - 4 + 8 \div 4 = 15 - 4 + 2 = 13$.
M	Multiplication	
A	Addition	Finally, working from **left to right,** perform any addition and subtraction. For example, $15 - 4 + 2 = 13$.
S	Subtraction	

Example 1H.1 Order of operations

Without using a calculator, evaluate each of the following.

a $3 + 8 \div 2 - \sqrt{4}$ **b** $7 \times 2^3 - 9 \times 5$

THINK

a 1 Exponents and square roots are worked out before $\times$, $\div$, $+$ and $-$. Calculate $\sqrt{4} = 2$.
   2 Division is performed before addition. Calculate $8 \div 2 = 4$.
   3 Working from left to right, perform the addition then the subtraction.

b 1 Exponents and square roots are worked out before $\times$, $\div$, $+$ and $-$. Calculate $2^3 = 8$.
   2 Multiplication is performed before subtraction so, working from left to right, first calculate $7 \times 8 = 56$.
   3 Perform the next multiplication. Calculate $9 \times 5 = 45$.
   4 Perform the subtraction.

WRITE

a $3 + 8 \div 2 - \sqrt{4}$
   $= 3 + 8 \div 2 - 2$
   $= 3 + 4 - 2$
   $= 5$

b $7 \times 2^3 - 9 \times 5$
   $= 7 \times 8 - 9 \times 5$
   $= 56 - 9 \times 5$
   $= 56 - 45$
   $= 11$

Example 1H.2 Order of operations with brackets

Without using a calculator, evaluate each of the following.

a $16 \div (10 - 2) + 3 \times 7$

b $8 + [12 \div (9 - 5)]^2 - 1$

THINK	WRITE
a **1** Perform any operations inside brackets first. Calculate $10 - 2 = 8$.	**a** $16 \div (10 - 2) + 3 \times 7$
2 Perform division and multiplication before addition. Working from left to right, first calculate $16 \div 8 = 2$.	$= 16 \div 8 + 3 \times 7$
3 Perform multiplication before addition. Calculate $3 \times 7 = 21$.	$= 2 + 3 \times 7$
4 Perform the addition.	$= 2 + 21$
	$= 23$
b **1** There are two sets of brackets. Perform the operation in the innermost set of brackets first. Calculate $9 - 5 = 4$.	**b** $8 + [12 \div (9 - 5)]^2 - 1$
2 Perform the operation in the remaining set of brackets. Calculate $12 \div 4 = 3$.	$= 8 + [12 \div 4]^2 - 1$
3 Apply exponents before addition and subtraction. Calculate $3^2 = 9$.	$= 8 + 3^2 - 1$
4 Working from left to right, perform the addition then the subtraction.	$= 8 + 9 - 1$
	$= 17 - 1$
	$= 16$

Helpful hints

✔ Remember to use BIDMAS and not to just work from left to right.

✔ Remember to always complete any operations in brackets first!

✔ Calculators don't always get the order of operations correct. If you are using a basic calculator, you will need to type in the calculation in a way that follows the BIDMAS rules.

✔ When a division is immediately followed by a multiplication, as in $12 \div 4 \times 3$, use brackets to clarify whether you mean $(12 \div 4) \times 3 = 9$ or $12 \div (4 \times 3) = 1$.

BIDMAS

Addition (+)	Subtraction (−)	Multiplication (×)	Division (÷)
Sum	Difference	Product	Quotient
Plus	Take away	Times	Divide
More than	Less than	Multiply	Shared
Increase	Fewer	Groups of	Distributed
Total	Reduce		
Together	Minus		

ANS p508 **Exercise 1H** Order of operations

△ 1–3(1ˢᵗ, 2ⁿᵈ columns), 4, 5(1ˢᵗ column), 6(a–c), 7–10, 14

▢ 1, 2–3(3ʳᵈ column), 4, 5(2ⁿᵈ column), 6(a, c, e), 7, 9, 11, 12, 14–16

⬠ 1(i–l), 2–3(3ʳᵈ column), 4, 5–6(d, e, f), 7, 9, 12, 13, 16–18

1H.1 **1** Without using a calculator, evaluate each of the following.

a $6 + 15 \div 3$

b $9 - 4 \times 2$

c $7 + 3 \times 6 - 4$

d $12 \div 4 + 7 \times 8$

e $4 \times 4 + 6 \div 2$

f $2 + 9 \times 4 \div 6$

g $10 \times 5 \div 5 + 2$

h $12 \div 3 + 4 - 8$

i $7 + (25 \div 5) \times 3 + 2$

j $16 - (8 \div 4) \times 2 + 5$

k $6 \times 4 - 10 \times 2$

l $9 \times 3 - 6 \times 3 \div 2$

2 Following the correct order of operations, complete the calculations below.

a $10 \times 6 - 5 \times 9$

b $8^2 - 5 \times 3 + 11$

c $21 - 3^2 \times 2 + 1$

d $4 \times 3^3 - 6^2 \times 2 + 1$

e $\sqrt{9} + 9 \times 8 - 2^3$

f $34 - 3^3 + 2 \times 4^2$

g $\sqrt{144} \div 12 + 2^2 - 5$

h $22 - 2 \times 11 + 4^2 \div \sqrt{16}$

i $7 - 3^2 + \sqrt{4} \times 3^3$

j $(84 \div 7) \times 2^2 - 5 + \sqrt{36}$

k $4 \times \sqrt{49} + 6^2 - \sqrt{81}$

l $5 \times \sqrt{100} - (\sqrt{9} \div 3) \times 7^2$

1H.2 **3** Without using a calculator, evaluate each of the following. Remember to start with the innermost bracket.

a $28 \div (12 - 5) + 2 \times 6$

b $(9 + 3) \div (15 - 13)$

c $4^3 - 10 \times (3 + 1)$

d $\sqrt{64} \div 4 + (2 \times 3) + 7$

e $\sqrt{100} \times 5 - 2 \times (2 + 3)$

f $3 \times [8 + (2 \times 9 - 4)] + 20$

g $[2 \times (3 + 4 - 5) + 4] \div 4$

h $3 - 22 \div (4 + 7) + 2^3$

i $8 \div [2 \times (4 - 3) + 2] + \sqrt{16}$

j $2^3 + (5 - 3) \times 9 - \sqrt{4}$

k $4^3 - [7 - 5 \times (3 + 8)] + 3$

l $(5^2 - 5) \times (3^2 + 3) \times (4^2 - 4)$

4 a Evaluate each of the following pairs of expressions.

i $(25 \div 5) \times 5$ and $25 \div (5 \times 5)$

ii $(30 \div 2) \times (2 + 1)$ and $30 \div [2 \times (2 + 1)]$

iii $[(22 + 10) \div 4] \times (7 - 5)$ and $(22 + 10) \div [4 \times (7 - 5)]$

b Sam provided the following working to evaluate the expression $81 \div 9 \times 3$.

$81 \div 9 \times 3 = 81 \div 3 \times 9 = 27 \times 9 = 243$.

i Explain what Sam did incorrectly.

ii Rewrite the original expression twice with brackets in different locations, as in part **a**.

iii Evaluate both of your expressions.

5 For each calculation:

i find an estimate of the answer by first rounding each number to its leading digit

ii use a calculator to work out the exact answer.

a $69 \times (28 + 11) - 51 \times 2$

b $(67 + 31) \div (12 - 5)$

c $815 \times (61 - 49) + 17 \times 3$

d $19 \times (9 - 4) + 3 \times (52 + 27)$

e $\sqrt{100} \times 7 + 2 \times (3^2 + 42)$

f $[13 \times (7 - 5) + 28] \times 2$

6 For each of the following:

i write the problem using numbers and symbols. Use brackets where necessary

ii work out the result.

a 10 divided by 2, then subtracted from the product of 11 and 4

b The quotient of 12 and 4, all multiplied by 2 to the power of 3

c 9 to the power of 2 take away 3 to the power of 3, all doubled

d 9 subtracted from 17 then multiplied by square root 4, all shared between 2

e The product of square root 16 and 6, then divided by 2 to the power of 3

f 3 less than the difference of 14 and 7

7 The average of a set of scores is calculated as follows:

$$\text{average} = (\text{total sum of the scores}) \div (\text{number of scores})$$

For example, the average of 9, 10 and 14 is found by working out $(9 + 10 + 14) \div 3$.

a Use the correct order of operations to find the average of 9, 10 and 14.

b Find the average of each set of numbers.

i 15, 18 and 24

ii 3, 5, 6, 8, 9 and 11

iii 278 and 356

iv 7, 7, 11 and 15

v 50, 51, 52, 52 and 60

vi 50, 20, 30, 40, 60, 50 and 30

8   Shaz makes scooters and skateboards. She has made eight scooters and eight skateboards but needs to order wheels first. If each scooter has two wheels and each skateboard has four wheels, how many wheels does Shaz need to order?

9   Ines is in charge of transporting four Year 7 classes to a local farm on a school excursion. She decides that they will hire coaches. Each class consists of 21 students and 2 teachers. One coach can carry 48 people including the driver.

   a   If each coach is driven by one of the teachers, how many coaches does Ines need to hire?

   b   How many spare seats will there be?

   c   The cost of hiring the coaches is shared evenly across all the students and teachers. If it costs $598 to hire one coach for a day, how much would each person need to pay?

10 Kyle goes down to the store to buy ingredients for his cake. He buys 3 cartons of 12 eggs, but 4 eggs from each carton break on the way home. He returns to the store and buys another carton of 12 eggs. How many eggs in total does Kyle have that are not broken?

11 Jun is purchasing all the tennis balls for her club for the season. Each tennis student at the club needs 8 balls for them to use during practice. At the busiest time of the day there are 4 classes running. There is a class with 2 students, a class with 3 students, a class with 1 student, and a class with 5 students. How many tennis balls should Jun purchase?

12 Sam is organising food for a movie night. He buys enough party pies for each attendee to have 4 pies. He buys 96 pies, but then finds out that 2 people cannot come to the movie night. How many people will attend the movie night?

13 In Australian Rules football, each team scores goals and behinds. Each goal has a value of six points and each behind has a value of one point. During a match, the scoreboard usually shows the number of goals, behinds and points both teams have scored. This photo, taken by a football fan, does not show the number of points.

   a   Write statements to show the total points scored by each team. Use the numbers and operations needed to calculate the total:

      i   points scored by the Sharks

      ii points scored by the visitors

   b   Calculate the number of points each team scored.

   c   At this stage of the match, which team is winning and by how much?

14 You and a group of friends go to the cinema. At the cinema kiosk, you order eight medium soft drinks, four jumbo containers of popcorn and seven ice creams.

   a Write a mathematical calculation to show how to work out the total cost of the food and drink.

   b Calculate the total cost.

$ 6

$ 10

$ 5

15 Jordan completed a worksheet on the order of operations. Identify the errors in Jordan's working.

   a $5 \times 7 - 2 \times (3 - 1)^2 - 1 = 35 - 2 \times 2^2 - 1$
   $$= 35 - 4^2 - 1$$
   $$= 35 - 16 - 1$$
   $$= 15$$

   b $(3 + 4)^2 - 2^2 \times (5 - 2) = 3 + 4^2 - 2^2 \times 3$
   $$= 3 + 16 - 4 \times 3$$
   $$= 15 \times 3$$
   $$= 45$$

16 In the late 1780s, students in a class were asked to add the whole numbers from 1 to 100. A student named Johann Carl Friedrich Gauss (who later became a famous mathematician) correctly answered the question in less than one minute by using the strategy of adding pairs of numbers. Try this calculation yourself. Can you find the answer in less than one minute?

17 Shubhra tells Roneet to roll three dice and regardless of which three numbers are rolled, he will be able to make all the numbers from 1 to 20 using only BIDMAS, including squares and square roots.

   a Roneet rolls the three dice and the numbers that come up are: 3, 4 and 5. Use each of 3, 4 and 5 once only and BIDMAS to make the numbers from 1 to 20.

   b Roll three dice and repeat part a with the numbers you roll.

   c Is Shubhra telling the truth? Are there any sets of three numbers that cannot be used to make all the numbers from 1 to 20?

18 Simplify the following problems.

   a $\dfrac{45}{8(9 - 8) - 3} + \dfrac{2(4)^2 - 5\sqrt{4}}{100 \div 50}$

   b $\dfrac{(6 - 5)^2 + (7 - 4)^2}{\sqrt{25} - \sqrt{9}}$

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Interactive skillsheet Order of operations

Investigation Four 4s

Topic quiz 1H

Chapter summary

Writing numbers

Standard form	32 456
Expanded form	$3 \times 10\,000 + 2 \times 1000 + 4 \times 100 + 5 \times 10 + 6 \times 1$
Worded form	Thirty-two thousand, four hundred and fifty-six

Mental addition and subtraction

- By-parts method

$$156 + 32$$

1 hundred   8 tens   8 ones

188

- Jump method

+30   +2

156   186 188

- Compensation method

+2   −40

116 118   156

Rounding

$1\boxed{2}\,600 \approx 13\,000$

9
8
7
⑥   Round up
5

$1\boxed{2}\,300 \approx 12\,000$

4
③   Round down
2
1
0

Ordering

6
5
4
3
2
1

Ascending   Descending

- Less than <
- Greater than >

Addition algorithm

$$
\begin{array}{r}
1 \\
229 \\
+\ 342 \\
\hline
571
\end{array}
$$

Subtraction algorithm

$$
\begin{array}{r}
1\ 11 \\
3\cancel{2}\cancel{1} \\
-\ 204 \\
\hline
117
\end{array}
$$

Division

quotient

1 4 5   remainder 1

6)8²7³1

divisor dividend   remainder

Multiplying by powers of 10

- $22 \times 1\underline{0} = 220$
- $22 \times 1\underline{00} = 2200$
- $22 \times 1\underline{000} = 22\underline{000}$

Multiplication algorithm

1. Write
2. Multiply by ones
3. Multiply by tens
4. Don't forget the zero(s)
5. Add the results

$$
\begin{array}{r}
2 \\
3\ 4 \\
\times\quad 2\ 6 \\
\hline
2\ 0\ 4 \quad (34 \times 6) \\
+\ 6\ 8\ 0 \quad (34 \times 20) \\
\hline
8\ 8\ 4
\end{array}
$$

Long division

14**5** remainder 1

$$
6\overline{)871}
$$

− 6↓
27
− 24↓
31
− 30
1

1. List the multiples
2. Divide leading digit
3. Multiply
4. Subtract
5. Bring down
6. Repeat or remainder

Order of operations

B	**Brackets**	Operations inside brackets are always performed first. For example, $5 \times (10 - 2) = 5 \times 8 = 40$
I	**Indices (or exponents)**	Next, evaluate indices and square roots. For example, $3^3 - 4 = 27 - 4 = 23$
D	**Division**	Then, working from **left to right,** perform any multiplication or division before adding or subtracting. For example, $5 \times 3 - 4 + 8 \div 4 = 15 - 4 + 2 = 13$
M	**Multiplication**	
A	**Addition**	Finally, working from **left to right,** perform any addition and subtraction. For example, $15 - 4 + 2 = 13$
S	**Subtraction**	

Exponents and squares

$2^2 = 2 \times 2 = 4$
$\sqrt{4} = 2$

$3^2 = 3 \times 3 = 9$
$\sqrt{9} = 3$

$4^2 = 4 \times 4 = 16$
$\sqrt{16} = 4$

Chapter review

Multiple-choice

1A **1** Which list of numbers is written in ascending order?

    A 1053, 531, 510, 501

    B 345, 354, 3045, 3405

    C 2461, 2614, 2641, 2611

    D 85, 83, 81, 82, 87, 89

    E 245, 254, 524, 452, 542

1A **2** Which number is an approximation of 78 945 rounded to the nearest ten thousand?

    A 70 000   **B** 78 900   **C** 78 000   **D** 79 000   **E** 80 000

1B **3** What is 14 985 + 486 + 1987 + 9135?

    A 14 373   **B** 25 483   **C** 26 593   **D** 174 805   **E** 26 566

1C **4** Which calculation gives an answer of 42?

    A 96 − 42   **B** 1569 − 584   **C** 7859 − 7813

    D 9026 − 8984   **E** 2048 − 1997

1D **5** Using the distributive law, 6×45 becomes:

    A $6 \times 40 + 6 \times 50$ **B** $6 \times 40 + 6 \times 5$ **C** $45 \times 6 + 4 \times 5$

    D $45 \times 6 + 40 \times 6$ **E** $45 \times 4 + 45 \times 5$

1E **6** Which product has the greatest value?

    A 48×49 **B** 13×78 **C** 26×54 **D** 89×21 **E** 59×30

1F **7** Which division does *not* have a remainder of 4?

    A $79 \div 5$ **B** $36 \div 8$ **C** $43 \div 10$ **D** $22 \div 6$ **E** $99 \div 5$

1G **8** What is $5 \times 5 \times 5 \times 8 \times 8$ in exponent form?

    A $3^5 \times 2^8$ **B** $5^3 + 8^2$ **C** 40^5 **D** $5^3 \times 8^2$ **E** $5^3 - 8^2$

1H **9** What is $5 + 4 \times 9 - 3$?

    A 15   **B** 38   **C** 54   **D** 78   **E** 21

1H **10** $70 - (2 \times 3)^2 + 4$ is equal to:

    A 38   **B** 62   **C** 49   **D** 64   **E** 34

Short answer

1A **1** Write each number in expanded form.

    a 467   **b** 7856   **c** 9030   **d** 15 452

1A **2** Write each list of numbers in ascending order.

    a 5347, 547, 53 047, 57   **b** 87 605, 87 506, 87 056

1A **3** Write an approximation of each number by rounding to the nearest hundred.

    a 392   **b** 9488   **c** 554   **d** 12 945

1B **4** Evaluate each sum.

    a 75 + 49   **b** 83 + 32   **c** 561 + 224   **d** 85 + 33

1B **5** Evaluate each of the following.

    a 467 + 56 + 7801 + 943   **b** 383 604 + 2557 + 16 092

1B **6** Find two three-digit whole numbers that add to 478 if:

    a both numbers are odd   **b** both numbers are even.

1C **7** Evaluate each of the following differences.

    a $9564 - 5381$ **b** $371\,625 - 38\,047$

    c $17\,659 - 9816$ **d** $101\,011 - 59\,678$

1C **8** Evaluate each of the the following.

    a $4895 - 1625 - 325$ **b** $978 - 486 - 239$

1D **9** Use a mental strategy to evaluate each of the following.

    a 38×11 **b** 41×21 **c** $5 \times 8 \times 7$

    d 72×14 **e** $2 \times 48 \times 4$ **f** $91 \times 5 \times 2$

1D **10** Calculate each product.

    a 68×7 **b** 91×6 **c** 546×3

    d 741×9 **e** 2458×8 **f** $17\,853 \times 4$

1E **11** Use a strategy to evaluate each of the following.

    a 389×100 **b** 412×6000 **c** 3400×200

    d $500 \times 300 \times 40$ **e** $25 \times 48 \times 4$ **f** $931 \times 50 \times 3$

1E **12** Determine the value of each of the following.

    a 542×37 **b** 456×78 **c** 6135×29

    d 9856×11 **e** $25 \times 96 \times 2$ **f** $122 \times 43 \times 5$

1F **13** Evaluate each of the following.

    a $850 \div 6$ **b** $\dfrac{68\,445}{4}$

    c $\dfrac{7521}{3}$ **d** $567\,204 \div 7$

1F **14** Evaluate each of the following.

    a $45\,987 \div 11$ **b** $18\,423 \div 16$

    c $\dfrac{5648}{23}$ **d** $\dfrac{78\,525}{45}$

1F **15** Use a strategy to evaluate each of the following.

    a $7000 \div 10$ **b** $80\,000 \div 2000$

    c $15\,000 \div 30$ **d** $210\,000 \div 700$

1G **16** Write each in expanded form and calculate its value.

    a 2^6 **b** $5^3 \times 3^2$ **c** $2^3 \times 7^2$ **d** $6^2 \times 4^3$

1G **17** Write $10\,000$ in exponent form with a base of 10.

1G **18** Write each of these in exponent form and evaluate.

    a seven squared   **b** the square of six

    c the square of 19   **d** 8 squared

1G **19** Calculate the value of each of these square roots.

    a $\sqrt{25}$ **b** $\sqrt{81} + 4^2$

    c $\sqrt{64} - \sqrt{16}$ **d** $\sqrt{100} + \sqrt{9} - \sqrt{49} - \sqrt{36}$

1H **20** Use the correct order of operations to perform each of the following calculations.

    a $7^2 - 6 \times 4 + 3$ **b** $8 \times (19 - 13) + 2 \times \sqrt{36}$

    c $4 + 3 \times (5 - 2)^2$ **d** $16 - 2 \times (3 + 4) + 9$

1H **21** Evaluate each of the following.

    a $6 \times [12 - (8 - \sqrt{4})]$ **b** $100 - [5 \times (3 - 2)]^2$

    c $[6^3 \div (3^2 - \sqrt{9})] \div 9$ **d** $(3 \times 3)^2 - (2 \times 4)^2 + \sqrt{49}$

Analysis

1 Saina gives her dad the following question:

$20 + 10 \div 5 \times 6$

'Got it!', says Dad. 'The answer is 36.'

'Uh-uh, Dad, you're wrong', says Saina.

   a What did Saina's dad do wrong?   **b** Add a pair of brackets to make the order of operations clear.

   c What is the correct answer?

2 Jordan wrote a list of the type and quantity of food he needed for his birthday party. He carefully noted the price per item during his shopping trip.

   a Calculate how much Jordan spent on each item.

   b How much did he spend in total?

   c If he paid with two $50 notes, how much change did he get?

   d What is the cheapest item on the list?

   e Which item did he spend the least money on? Is this different from the answer to part **d**? Explain why or why not.

   f Each bag of Allen's mixed lollies has 40 lollies. How many lollies in total does Jordan have?

   g Jordan wants lolly bags for himself and his friends with at least 10 lollies in each bag. What is the maximum number of friends he can invite?

   h Jordan adds Freddo frogs to the lolly bags. How many Freddo frogs does each friend get? How many Freddo frogs are left over?

Item	Quantity	Price per item
Party Pie 24 pack	4	$4
Allen's mixed lollies	3	$3
Chips 100 g	4	$2
M&Ms 250 g	2	$4
Freddo frogs 20 pack	2	$5
Cocktail sausages 2 kg pack	1	$6
Frozen pizza	1	$10
Mudcake	3	$4

   i Jordan and his friends need to be divided into equal groups for games. Using your answer from part **g**, what size could the groups be if there must be at least three people in each?

3 Tom and Kate are elite supercar drivers. They are competing in the next Melbourne 400 championships. Four races are held over four days and each race is 100 km long.

   a If there are 19 laps in each race, approximate the distance of each lap in kilometres.

   b If Tom has completed 246 km, which day of the event is it?

   c There are 16 turns in the track. Over the four days, how many turns will each driver make?

   d Lap times are usually around 2 minutes each. On Day 1 of the race, Kate's incredibly consistent lap time was 1 minute and 56 seconds, and Tom's consistent lap time was 2 minute and 6 seconds. Determine each driver's total time for one day's race. Give your answer in minutes and seconds.

   e On the second day of the race day, Kate's lap time was a little faster at 1 minute 49 seconds but she took an extra long pit stop time of 3 minutes. Was Kate's total time shorter on Day 1 or Day 2? State the difference between the two times.

   f For each car, pit stop teams can change between hard tyres and soft tyres. Hard tyres are not as fast as soft tyres, but they last longer on the track. Soft tyres provide the driver with more grip on the road so that they can go faster, but they don't last long before the driver must change the tyres. During a pit stop, the tyre must be changed from soft to hard, or from hard to soft.
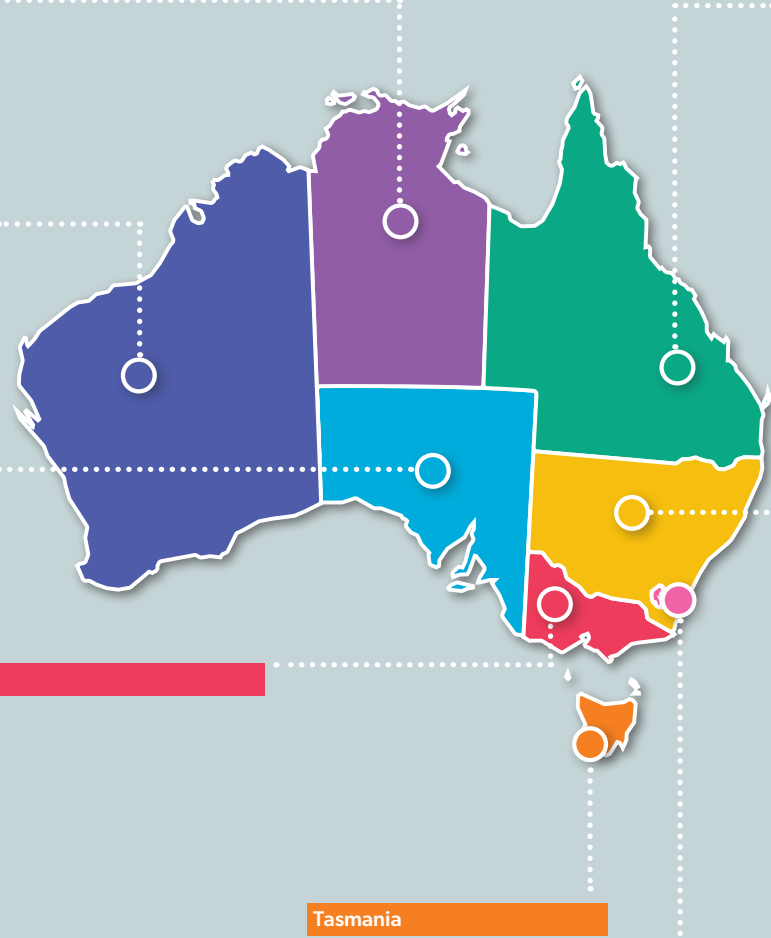
On day three, Tom completes his first two laps on hard tyres at his previous consistent time of 2 minutes and 6 seconds. His pit stop team then changes his tyres in 17 seconds, and on the soft tyres his lap time drops by 12 seconds for 8 laps. After these 8 laps, Tom needs to change his tyres again, and on the new set of hard tyres he completes 5 laps at a consistent lap time of 2 minutes and 1 second, with the pit stop taking 15 seconds.

With 4 laps to go, Tom can change his tyres again. Another pit stop will take 15 seconds, and he will complete each lap on the new soft tyres in 1 minute and 55 seconds. Should Tom pit stop again and, if so, how much quicker will he complete the race?

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