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ICE-EM MATHEMATICS 5

THIRD EDITION

Colin Becker
Howard Cole
Andy Edwards
Garth Gaudry
Janine McIntosh
Jacqui Ramagge

INCLUDES INTERACTIVE TEXTBOOK POWERED BY CAMBRIDGE HOTMATHS

INTERNATIONAL CENTRE
OF EXCELLENCE FOR
EDUCATION IN
MATHEMATICS

AMSI AUSTRALIAN MATHEMATICAL SCIENCES INSTITUTE

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Preface

ICE–EM Mathematics Third Edition is a series of textbooks for students in years 5 to 10 throughout Australia who study the Australian Curriculum and its state variations.

The program and textbooks were developed in recognition of the importance of mathematics in modern society and the need to enhance the mathematical capabilities of Australian students. Students who use the series will have a strong foundation for work or further study.

Background

The International Centre of Excellence for Education in Mathematics (ICE-EM) was established in 2004 with the assistance of the Australian Government and is managed by the Australian Mathematical Sciences Institute (AMSI). The Centre originally published the series as part of a program to improve mathematics teaching and learning in Australia. In 2012, AMSI and Cambridge University Press collaborated to publish the Second Edition of the series to coincide with the introduction of the Australian Curriculum, and we now bring you the Third Edition.

Features

ICE–EM Mathematics Third Edition provides a progressive development from upper primary to middle secondary school. The writers of the series are some of Australia's most outstanding mathematics teachers and subject experts. The textbooks are clearly and carefully written, and contain background information, examples and worked problems.

The series places a strong emphasis on understanding basic ideas, along with mastering essential technical skills. Mental arithmetic and other mental processes are major focuses, as is the development of spatial intuition, logical reasoning and understanding of the concepts.

For the Third Edition, the series has been carefully edited to present the content in a more streamlined way without compromising quality. There is now one book per year level and the flow of topics from chapter to chapter and from each year level to the next has been improved.

For the Third Edition, *ICE-EM Mathematics* now comes with an Interactive Textbook: a cutting-edge digital resource where all textbook material can be answered online (with students' working-out), additional quizzes and features are included at no extra cost. See "The Interactive Textbook and Online Teaching Suite" on page xi for more information.

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Author biographies

Colin Becker

Colin Becker works as a Mathematics and ITLT specialist at an independent boys' school in Adelaide. Colin has written for professional publications, presented at conferences and schools, and is actively involved in mathematics education.

Howard Cole

Howard Cole was Senior Mathematics Master at Sydney Grammar School Edgecliff Preparatory for many years. He outlined the whole primary curriculum during that time, as well as writing and producing in-school workbooks for Years 5 and 6. Now retired from teaching, he still maintains a keen interest in mathematics and curriculum development.

Andy Edwards

Andy Edwards taught in secondary mathematics classrooms for 31 years in Victoria, Canada and Queensland. Since 2004, he has worked for the Queensland Curriculum and Assessment Authority writing materials for their assessment programs from Years 3 to 12 and as a test item developer for WA's OLNA program since 2013. He has written non-routine problems for the Australian Mathematics Trust since 1991.

Garth Gaudry

Garth Gaudry was Head of Mathematics at Flinders University before moving to the University of New South Wales (UNSW), where he became Head of School. He was the inaugural director of the Australian Mathematical Sciences Institute before becoming director of AMSI's International Centre of Excellence for Education in Mathematics. Previous positions include membership of the South Australian Mathematics Subject Committee and the Eltis Committee appointed by the NSW government to enquire into outcomes and profiles. He was a life member of the Australian Mathematical Society and Emeritus Professor of Mathematics, UNSW.

Janine McIntosh

Janine McIntosh works at The Australian Mathematical Sciences Institute, where she manages AMSI Schools. Janine leads a professional development and schools visit program for teachers across the country. Through clusters of schools supported by industry and government partners, Janine's aim is to encourage more Australians to enjoy and study mathematics. Janine has developed a suite of online and careers materials in her time at AMSI and was one of the writers for the Australian Curriculum: Mathematics F – 10. She is an experienced primary teacher, who has worked as a lecturer in mathematics education at the University of Melbourne and serves on the Maths Challenge and AMOC Committees of the Australian Mathematics Trust.

Jacqui Ramagge

Jacqui Ramagge is currently Head of the School of Mathematics and Statistics at the University in Sydney. After graduating in 1993 with a PhD in Mathematics from the University of Warwick (UK) she worked at the University of Newcastle (Australia) until 2007 and then at the University of Wollongong until 2015 when she moved to the University of Sydney. She has served on the Australian Research Council College of Experts, including as Chair of Australian Laureate Fellowships Selection Advisory Committee. She teaches mathematics at all levels from primary school to PhD courses and has won a teaching award. She contributed to the Vermont Mathematics Initiative (USA) and is a founding member of the Australian Mathematics Trust Primary Problems Committee. In 2013, she received a BH Neumann Award from the Australian Mathematics Trust for her significant contribution to the enrichment of mathematics learning in Australia.

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How to use this resource

The textbook

The Year 5 and Year 6 books are written in the style of a ‘conversation’. That conversation is meant to take a variety of forms: conversations between the teacher and students about the ideas and methods as they are developed; conversations among the students themselves about what they have done and learnt, and the different ways they have solved problems; and conversations with others at home. Each chapter addresses a specific Australian Curriculum content strand and set of sub-strands. The exercises within chapters take an integrated approach to the concept of proficiency strands, rather than separating them out. Students are encouraged to develop and apply Understanding, Fluency, Problem-solving and Reasoning skills in every exercise.

Question tags

The questions in each chapter are tagged. The tags are intended as a guide to teachers. They should be regarded as a way of encouraging student progress.

🟡 These give students practice using the basic ideas and methods of the section. They should give students confidence to go on successfully to the next level.

🔵 These build on the previous level and help students acquire a more complete grasp of the main ideas and techniques. Some questions require interpretation, using a reading ability appropriate to the age group.

🟢 For these questions, students may need to apply concepts from outside the section or chapter. Problem-solving skills and a higher reading ability are needed, and these questions should help develop those attributes.

Challenge exercises

The Challenge exercises, which can be downloaded via the Interactive Textbook, are a vital part of the *ICE-EM Mathematics* resource. These are intended for students with above-average mathematical and reading ability. However, the questions vary considerably in their level of difficulty. Students who have managed the harder questions in the exercises reasonably well should be encouraged to try them.

The Interactive Textbook and Online Teaching Suite

The Interactive Textbook is the online version of the textbook and is accessed using the 16-character code on the inside cover of this book. The Online Teaching Suite is the teacher version of the Interactive Textbook and contains all the support material for the series, including tests, curriculum documentation and more. For more information on the Interactive Textbook and Online Teaching Suite, see page xi.

The Interactive Textbook and Online Teaching Suite are delivered on the *Cambridge HOTmaths* platform, providing access to a world-class Learning Management System for testing, task management and reporting. They do not provide access to the *Cambridge HOTmaths* stand-alone resource that you or your school may have used previously. For more information on this resource, contact Cambridge University Press.

AMSI’s TIMES and SAM modules

The TIMES and SAM web resources were developed by the *ICE-EM Mathematics* author team at AMSI and are written around the structure of the Australian Curriculum. These resources have been mapped against your *ICE-EM Mathematics* book and are available to teachers and students via the AMSI icon on the dashboard of the Interactive Textbook and Online Teaching Suite.

The Interactive Textbook and Online Teaching Suite

Interactive Textbook

The Interactive Textbook is the online version of the print textbook and comes included with purchase of the print textbook. It is accessed by first activating the code on the inside cover. It is easy to navigate and is a valuable accompaniment to the print textbook.

Students can show their working

All textbook questions can be answered online within the Interactive Textbook. Students can show their working for each question using either the Draw tool for handwriting (if they are using a device with a touch-screen), the Type tool for using their keyboard in conjunction with the pop-up symbol palette, or by importing a file using the Import tool.

Once a student has completed an exercise they can save their work and submit it to the teacher, who can then view the student's working and give feedback to the student, as they see appropriate.

Auto-marked quizzes

The Interactive Textbook also contains material not included in the textbook, such as a short auto-marked quiz for each section. The quiz contains 10 questions which increase in difficulty from question 1 to 10 and cover all proficiency strands. There is also space for the student to do their working underneath each quiz question. The auto-marked quizzes are a great way for students to track their progress through the course.

Additional material for Year 5 and 6

For Years 5 and 6, the end-of-chapter Challenge activities as well as a set of Blackline Masters are now located in the Interactive Textbook. These can be found in the 'More resources' section, accessed via the dashboard, and can then easily be downloaded and printed.

Online Teaching Suite

The Online Teaching Suite is the teacher's version of the Interactive Textbook. Much more than a 'Teacher Edition', the Online Teaching Suite features the following:

- The ability to view students' working and give feedback – When a student has submitted their work online for an exercise, the teacher can view the student's work and can give feedback on each question.
- For Years 5 and 6, access to Chapter tests, Blackline Masters, Challenge exercises, curriculum support material, and more.
- For Years 7 to 10, access to Pre-tests, Chapter tests, Skillsheets, Homework sheets, curriculum support material, and more.
- A Learning Management System that combines task-management tools, a powerful test generator, and comprehensive student and whole-class reporting tools.

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CHAPTER 1 Preparation

Useful skills for this chapter:

- an understanding of place value of numbers to 1000
- the ability to 'pull apart' numbers into their place-value components.

KICK OFF

Download **BLM 1** 'Crazy tiles' from the Interactive Textbook. Ask students to fill in the missing numbers.

Show what you know

1 Read the following numbers aloud to your teacher.

a 178 **b** 304 **c** 1007 **d** 23 604

2 Write a 5-digit number and read it to your teacher.

3 Use base-10 blocks to make these numbers.

a 972 **b** 1349 **c** 3702

4 Copy these tiles, which have been cut from a number chart, and fill in the blank spaces with the numbers that belong there.

a

	67		
	77		
		88	

b

		283	
291			

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CHAPTER

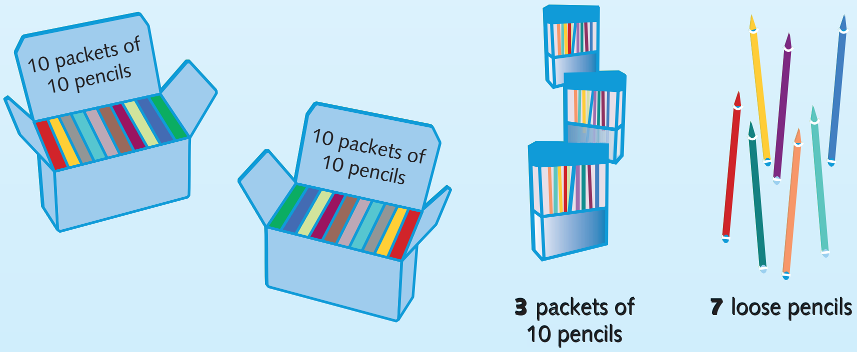
1

Number and Algebra

Whole numbers

We use numbers every day to describe people, places and things and to record amounts. For example:

- *how much* paper we need to cover a table to protect it from paint
- *how long* until school finishes
- *how many* pencils there are



200 + 30 + 7 = 237

- *how much* water there is.

This chapter looks at **whole numbers**, which are sometimes called the 'counting numbers'. The whole numbers are the numbers 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and so on. The list of whole numbers is infinite – it never ends.

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1A Place value

Numbers are written using the digits 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9.
The value of a digit changes according to where it is placed.

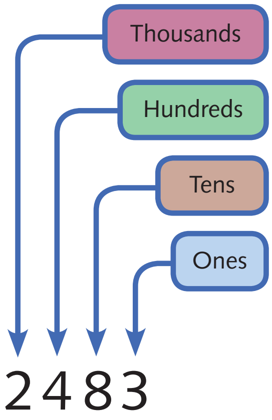
The digits 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 can be used to write:

- a 5-digit number, such as 24 871
- a 6-digit number, such as 390 513
- a 1-digit number, such as 3.

Each place in a number has a special value.

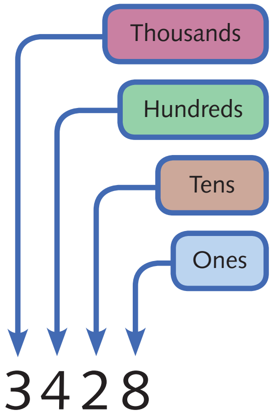
For example, in the number 2483:

- the 2 means 2 thousands
- the 4 means 4 hundreds
- the 8 means 8 tens
- the 3 means 3 ones.



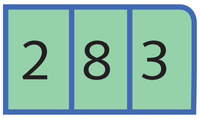
The value of a digit changes if it is in a different place.
If we take the example 2483 from above,
and change the digits to make 3428:

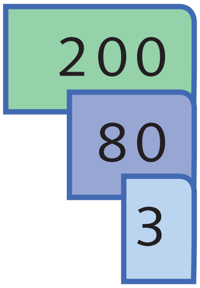
- the 3 means 3 thousands
- the 4 means 4 hundreds
- the 2 means 2 tens
- the 8 means 8 ones.



There are 283 people living in my street.
What does the 8 mean in this number?

We can ‘pull apart’ the number 283.
These place-value cards show the value of each place in 283.





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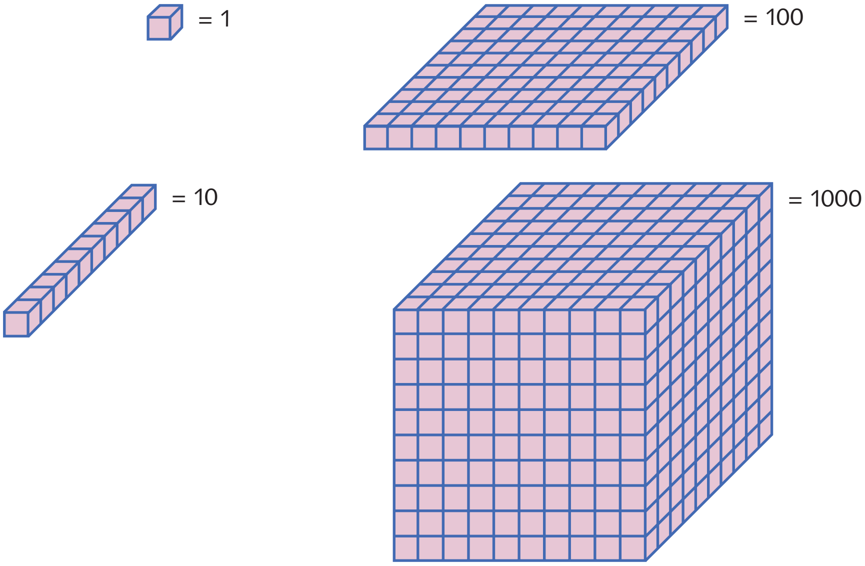
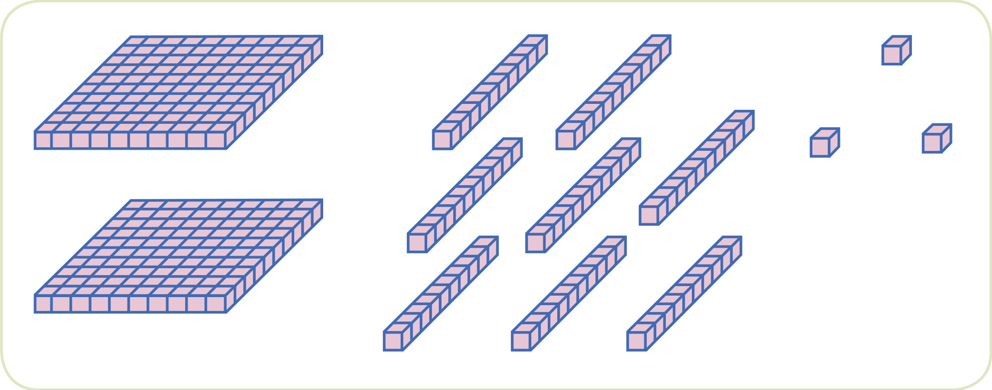
The 8 means 8 tens.

We can use base-10 blocks to help us understand place value.



This is the number 283 shown with base-10 blocks:



283 means 2 hundreds + 8 tens + 3 ones. The 8 in 283 means 8 tens.

Knowing what the places mean helps us to read numbers.

Once we get higher than one thousand it is as if we start again. We name numbers using whole numbers of thousands, tens of thousands and hundreds of thousands.

The biggest number we can write using the first 6 places is:

999 999

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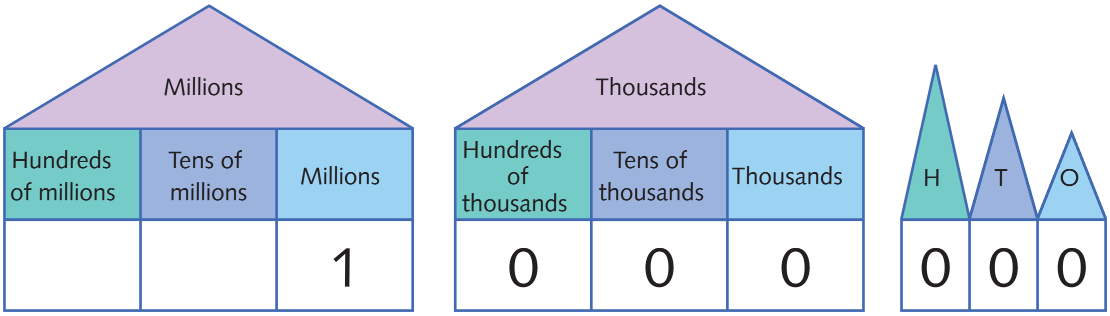
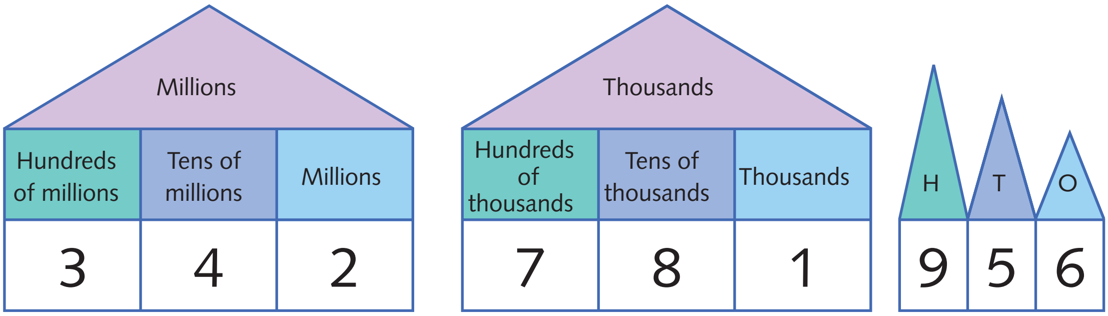
The next number is 1 million, which we write as:



Millions			Thousands					
Hundreds of millions	Tens of millions	Millions	Hundreds of thousands	Tens of thousands	Thousands	H	T	O
		1	0	0	0	0	0	0

1 million is 1000 thousands. 1 000 000 = 1000 lots of 1000.

The naming starts again for millions: we have whole numbers of millions, tens of millions and hundreds of millions.



Millions			Thousands					
Hundreds of millions	Tens of millions	Millions	Hundreds of thousands	Tens of thousands	Thousands	H	T	O
3	4	2	7	8	1	9	5	6

We read 342 781 956 as 'three hundred and forty-two million, seven hundred and eighty-one thousand, nine hundred and fifty-six'.

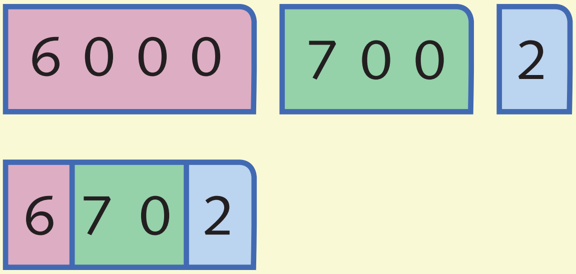
Example 1

Show 6702 using place-value cards and an abacus.

Solution

We use the place-value cards

to make



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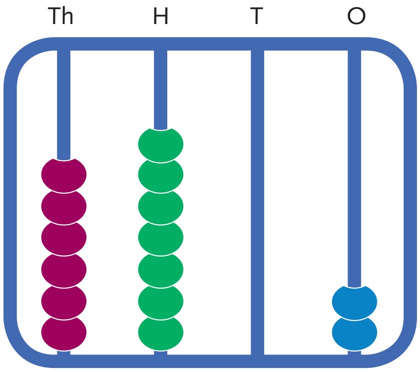
On an abacus, we show 6702 like this:



Example 2

Write the value of the 3 in each number.

a 43 000 **b** 2301 **c** 35 **d** 23

Solution

a In 43 000, the 3 is in the thousands place, so it stands for 3 thousands or 3000.
b In 2301, the 3 is in the hundreds place, so it stands for 3 hundreds or 300.
c In 35, the 3 is in the tens place, so it stands for 3 tens or 30.
d In 23, the 3 is in the ones place, so it stands for 3 ones or 3.

1A Whole class CONNECT, APPLY AND BUILD

1 Work in pairs. Person 1 reads parts **a**, **b**, **e** and **f** to Person 2.

Person 2 writes down each number as they hear it.

Then swap roles for **c**, **d**, **g** and **h**.

a 17 **b** 89 **c** 209 **d** 444
e 1209 **f** 18 348 **g** 56 902 **h** 98 053

2 Download **BLM 2** 'Place-value cards' from the Interactive Textbook and make a set.

Use your place-value cards to make these numbers.

a 128 **b** 3421 **c** 302 **d** 3056 **e** 7008

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3 **a** Use your place-value cards to make other numbers up to 9999.

b For each number you make with the place-value cards, show that number on an abacus. You can draw an abacus if you do not have one.

c For each number you make with the place-value cards, show that number using base-10 blocks.

4 **Who am I?**

Read each 'Who am I?' aloud to the class. Ask students to write each number in their books.

I am a number.

a I have 8 tens and 7 ones. Who am I?

b I have 9 hundreds, 4 tens and 9 ones. Who am I?

c I have 3 thousands, 8 hundreds and 5 ones. Who am I?

d I have 4 hundreds and 32 ones. Who am I?

e I have 12 tens and 7 ones. Who am I?

f I have 2 hundreds, 9 thousands, 5 ones and 7 tens. Who am I?

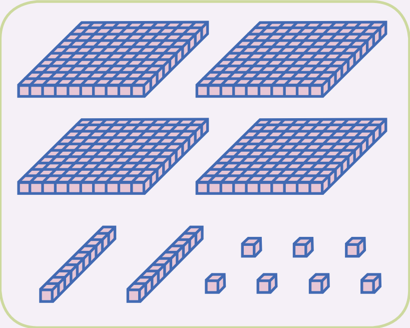
g I have 7 ten-thousands, 6 hundreds, 4 ones, 5 thousands and 3 tens. Who am I?

h I have 53 ones, two thousands and 8 hundreds. Who am I?

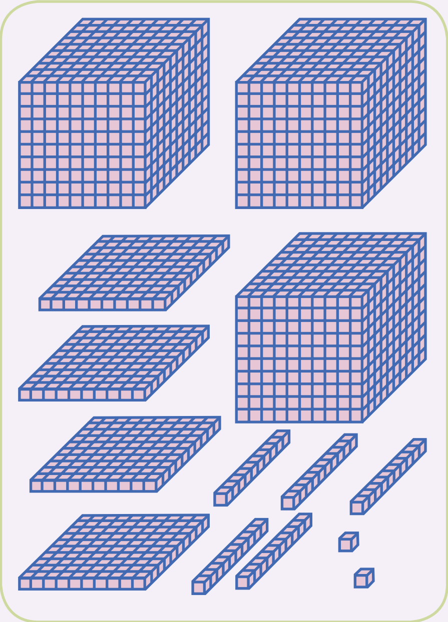
1A Individual

1 Write the numbers shown with these base-10 blocks.

a



b



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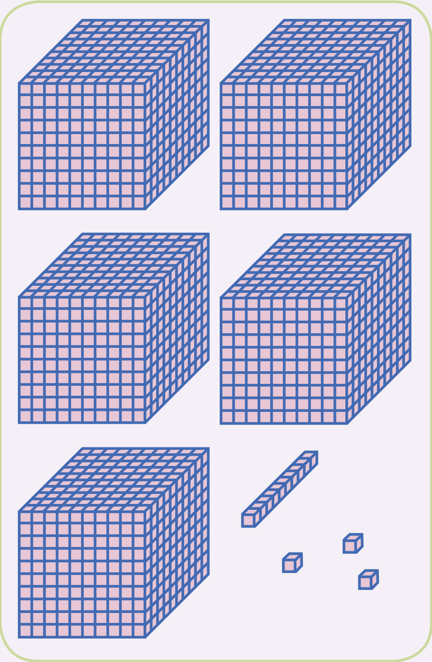
c



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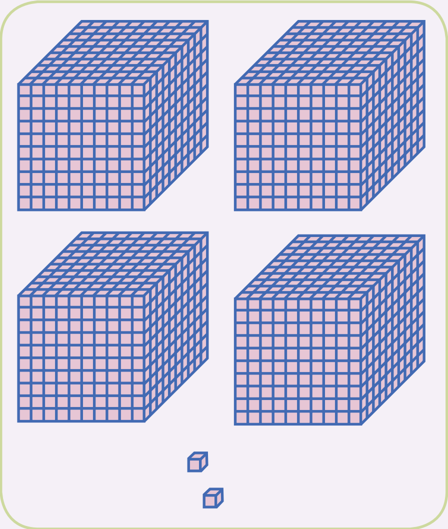
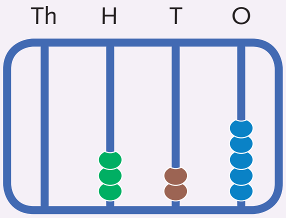


2 Write each number in words.

a 21 **b** 45 **c** 127 **d** 802 **e** 2309 **f** 9901

3 Write the number shown on each abacus.

a



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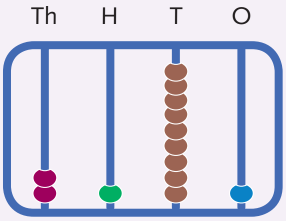

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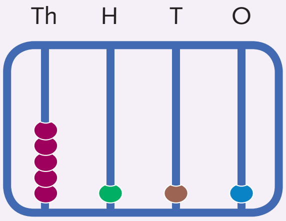

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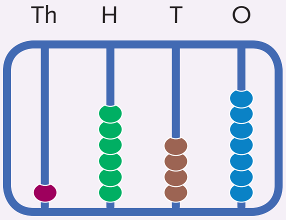

4 Copy and complete this place-value chart.

Number	**Place-value parts**				
	Tens of thousands	**Thousands**	**Hundreds**	**Tens**	**Ones**
12 345	1	2	3	4	5
34					
128					
8324					
13 042					

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5 Write each number in numerals.

a three hundred and forty-five

b twenty-six thousand and seventy-seven

6 Write the value of each highlighted digit.

a	234	**b**	407	**c**	2981	**d**	8921
e	10 827	**f**	28 673	**g**	99 999	**h**	432 811

7 Write these numbers.

a 63 hundreds, 4 tens and 7 ones

b 1 thousand, 47 tens and 3 ones

c 6 thousands, 5 hundreds and 21 ones

d 127 tens and 8 ones

8 Write these numbers.

a 72 hundreds, 9 ten-thousands and 6 ones and 1 ten

b 84 ones, 5 thousands, 1 hundred and 3 ten-thousands

c 86 thousands, 9 ones, 2 hundreds and 5 tens

1B Comparing numbers on the number line

Here are 7 blue smiley buttons and 9 yellow smiley buttons.

Which group is larger? We could count to find out. We could also try to match each blue smiley button to a yellow smiley button.

Counting is how we find out if one number is larger than another.

Whether we count or match smiley buttons, we can see that 9 is a larger number than 7.

We can also use the number line to compare numbers.

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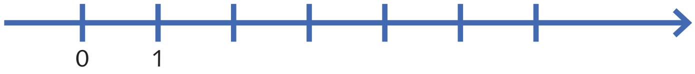
The number line

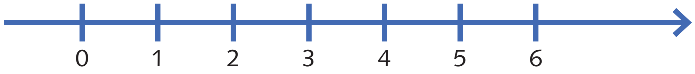
A number line helps us to make sense of numbers.

To make a number line, draw a line on paper and mark in ‘zero’. The arrow shows that the line continues in the same way forever.

Mark equally spaced points to the right side of the zero and label the first marker to the right of the zero as ‘1’.



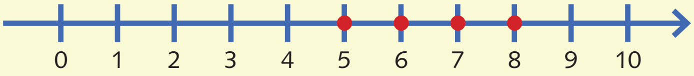
Label the next marker ‘2’, then keep going.



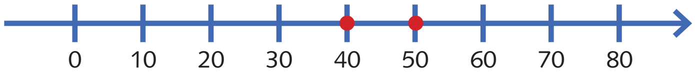
Example 3

Draw a number line from 0 to 10. Use large dots to mark the numbers from 5 to 8.

Solution



You can make number lines out of string or tape, or draw them on paper. They can be used to show any number, from the smallest right up to the largest number you can think of.



Numbers get larger as we go to the right on the number line. So 50 is larger than 40 because it lies further to the right.

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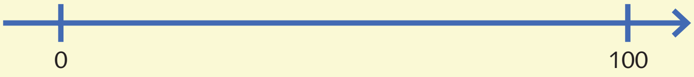
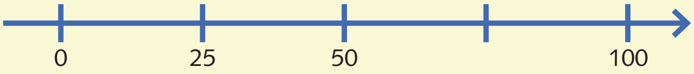
Example 4

Show where 25 would be on this number line.



Solution

50 is halfway between 0 and 100, so 25 is one-quarter of the distance.

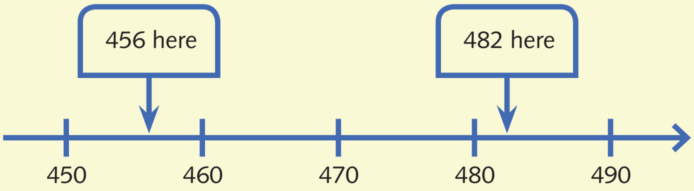


Example 5

Which number is larger: 456 or 482?

Solution a

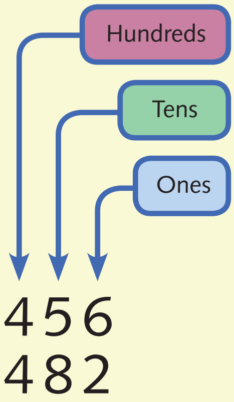
Place both numbers on a number line.
456 is between 450 and 460. 482 is between 480 and 490.
482 is larger because it is further to the right.



Solution b

Compare the digits from left to right. The hundreds digits (4) are the same in both numbers, so look at the next digit.

The tens digit in the first number is 5, which means 5 tens. The tens digit in the second number is 8, which means 8 tens. Since 8 tens is larger than 5 tens, 482 is larger than 456.



Now that you can compare numbers and understand place value, you can make and say larger or smaller numbers.

To find the number that is 400 more than 1387 we increase the hundreds digit by 4 and we get 1787.

To find the number that is 200 less than 1387 we decrease the hundreds digit by 2 and we get 1187.

Example 6

Write the number that is 1000 more than:

a 1273 **b** 451 **c** 23 **d** 23 784 **e** 909 231

Solution

a 2273 **b** 1451 **c** 1023 **d** 24 784 **e** 910 231

Example 7

Write the number that is 100 less than:

a 459 **b** 1451 **c** 198 **d** 1001

Solution

a 359 **b** 1351 **c** 98 **d** 901

1B Whole class CONNECT, APPLY AND BUILD

1 Stretch a piece of string between pegs and use it as a 0 – 100 number line. Write a number between 0 and 100 on a piece of paper and peg it to the string.

2 Use the same piece of string as a 0 – 1000 number line. Write a number between 0 and 1000 on a piece of paper and peg it to the string.

3 If you roll four 10-sided (0 – 9) dice to make a 4-digit number:

- **a** what is the largest possible number you can make?
- **b** what is the smallest possible 4-digit number you can make?

4 Work in a group of 3 to 6. One player removes the picture cards from a deck of cards and shuffles the deck. Each player draws 6 cards. Place your cards down in the order they are drawn, left to right, to make a 6-digit number. (An Ace is equal to 1.) Each player can rearrange their number once, by picking any card and moving it to the right of the row to become the last digit. The player with the largest number wins the round.

1B Individual

1 Draw a number line with 0 and 10 marked on it. Use a large dot to mark each number from 6 to 9.

2 Draw a number line with 0 and 10 marked on it. Use a large dot to mark the numbers 2, 3, 5 and 9.

3 Draw a number line with 0 and 20 marked on it. Use a large dot to mark each even number between 13 and 19.

4 Draw a number line with 0 and 20 marked on it. Use a large dot to mark each odd number between 10 and 20.

5 Draw a number line with 0 and 100 marked on it. Use a large dot to mark the numbers 10, 20, 30, 40, 50, 60, 70, 80 and 90 on it.

6 Draw a number line with 0 and 100 marked on it. Use a large dot to mark the numbers 40 and 80 on it.

7 Draw a number line with 0 and 100 marked on it. Use a large dot to mark the numbers 5 and 70 on it.

8 Draw a number line with 0 and 1000 marked on it. Use a large dot to mark the numbers 100 and 500 on it.

9 Draw a number line with 0 and 1000 marked on it. Use a large dot to mark the numbers 5 and 625 on it.

10 Write the number that is 100 more than:

a 400 **b** 682 **c** 981 **d** 1025 **e** 12 092

11 Write the number that is 100 less than:

a 400 **b** 682 **c** 981 **d** 1025 **e** 12 092

12 Write the number that is 1000 more than:

a 3000 **b** 439 **c** 2733 **d** 3033 **e** 19 999

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13 Write the number that is 1000 less than:

a 7000 **b** 2222 **c** 11 000 **d** 1043 **e** 21 837

14 Write the number that is 110 less than:

a 427 **b** 1035 **c** 700 **d** 2064 **e** 13 409

15 Write the number that is 1010 more than:

a 7266 **b** 14 808 **c** 19 680 **d** 2190 **e** 69 990

Homework

1. Draw a number line. Think of three adults and three children whose ages you know. Mark each person's age on your number line.
2. Look through newspapers or magazines. Find and cut out 10 numbers that have two or more digits, and order them from smallest to largest.
3. Write the largest number that you can make with the digits of your telephone number. Now write the smallest number.

1C Counting

Counting is used to find the answer to the question 'How many?' When we count, we mentally attach a number to an object.

It is good to be able to count forwards and backwards by one from any number.

Example 8

Write the first 10 whole numbers you would say when counting backwards from 103.

Solution

103, 102, 101, 100, 99, 98, 97, 96, 95, 94

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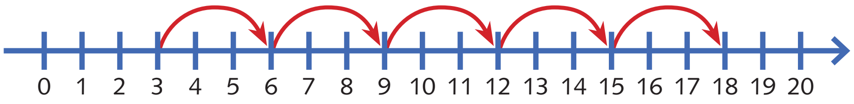
Sometimes it is easier to skip-count than to count each one individually.

There are 12 children waiting for the bus.

We can skip-count forwards and backwards by any number from any starting point. We can show skip-counting on a number line.

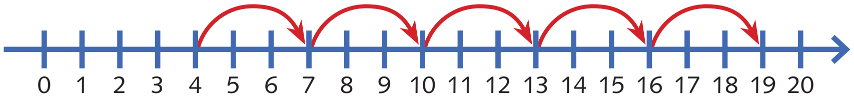
When we count forwards by three starting at 3, we say: 3, 6, 9, 12, 15, 18 …

This number line shows counting forwards by three, starting at 3.



When we count forwards by three starting at 4, we say: 4, 7, 10, 13, 16, 19 …

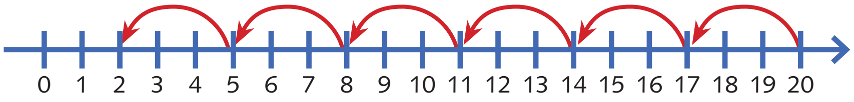
This number line shows counting forwards by three, starting at 4.



When we count backwards by three starting at 20, we say:

20, 17, 14, 11, 8, 5, 2 …

This number line shows counting backwards by three, starting at 20.



The ability to skip-count forwards and backwards from various starting points – and by different amounts – is an important skill.

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1C Whole class CONNECT, APPLY AND BUILD

These activities can be used as whole-class or small-group activities. Teachers can limit the time or the number of entries that students complete.

1 Buzz forwards

One student starts counting aloud by one. When they get to a number that is in the counting pattern, as listed below, they substitute the word ‘buzz’ for the number. Make the game trickier by randomly pointing to a different student each time a person says ‘buzz’.

a Count by three from 0.

b Count by seven from 0.

c Count by three from 14.

d Count by seven from 18.

2 Buzz backwards

One student starts counting backwards by one. When they get to a number that is in the counting pattern, as listed below, they substitute the word ‘buzz’ for the number. Make the game trickier by randomly pointing to a different student each time a person says ‘buzz’.

a Count by three from 100.

b Count by seven from 100.

c Count by ten from 1000.

d Count by seven from 18.

3 Make a list

You will need a clock. Write as many numbers in each counting sequence as you can in 2 minutes.

a Start at 0. Count forwards by three.

b Start at 4. Count forwards by five.

c Start at 100. Count backwards by six.

1C Individual

1 Write the first 10 numbers in each skip-counting sequence.

a Count forwards by one, starting at 11.

b Count forwards by one, starting at 98.

c Count backwards by one, starting at 56.

d Count backwards by one, starting at 1007.

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2 For each skip-counting sequence, write as many numbers as you can in 2 minutes.

- **a** Count forwards by four, starting at 9.
- **b** Count forwards by seven, starting at 70.
- **c** Count forwards by eleven, starting at 0.
- **d** Count backwards by five, starting at 500.
- **e** Count backwards by nine, starting at 1000.

3 Complete the next 4 numbers in the skip-counting sequences.

a 314 317 320 _____ _____ _____ _____

b 685 676 667 _____ _____ _____ _____

c 2480 2487 2494 _____ _____ _____ _____

d 3708 3697 3686 _____ _____ _____ _____

1D Review questions

1 Write these numbers.

a Two hundred and forty-seven

b Forty-three thousand and eighty-two

2 Write these numbers in words.

a 19 **b** 46 **c** 381 **d** 7254

3 Write the value of each highlighted digit.

a 189 **b** 237 **c** 4902

4 Copy and complete this place-value chart.

	Number	Place-value parts				
		Tens of thousands	Thousands	Hundreds	Tens	Ones
a	2306					
b	479					
c	89 210					
d	2007					

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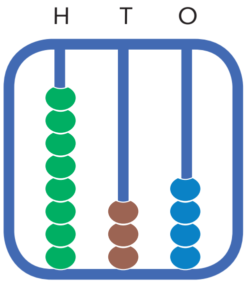
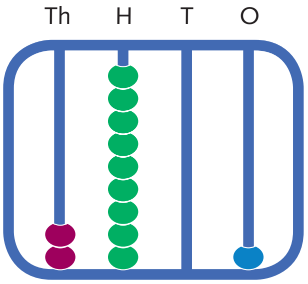
5 Write the number shown on each abacus.

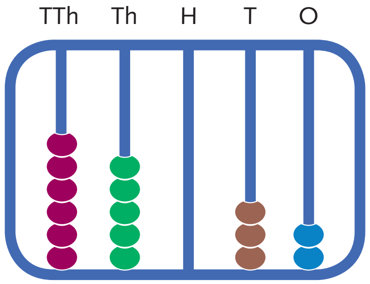
a



b



c



6 Draw a number line with 0 and 20 marked on it.
Use a large dot to mark each even number from 4 to 14.

7 Draw a number line with 0 and 100 marked on it.
Use a large dot to mark 80, 25 and 38.

8 **Who am I?**

a I have 3 tens and 8 ones. Who am I?

b I have 1 hundred, 2 tens and 6 ones. Who am I?

c I have 7 thousands, 2 hundreds and 8 ones. Who am I?

9 Write the number that is 100 more than:

a 200 **b** 713 **c** 976 **d** 1204 **e** 59 083

10 Write the number that is 100 less than:

a 200 **b** 713 **c** 976 **d** 1204 **e** 59 083

11 Write the number that is 1000 more than:

a 200 **b** 713 **c** 976 **d** 1204 **e** 59 083

12 Write the number that is 1000 less than:

a 10 000 **b** 4141 **c** 1023 **d** 10 045 **e** 61 111

13 Write as many numbers as you can in 2 minutes for each counting sequence.

a Count forwards by three, starting at 7.

b Count forwards by nine, starting at 4.

c Count backwards by five, starting at 804.

d Count backwards by seven, starting at 1000.

14 Complete the next four numbers in these counting sequences.

a 776 787 798 ____ ____ ____ ____

b 845 851 857 ____ ____ ____ ____

c 302 311 320 ____ ____ ____ ____

d 1214 1210 1206 ____ ____ ____ ____

e 13 685 13 679 13 673 ____ ____ ____ ____

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CHAPTER 2 Preparation

Useful skills for this chapter:

- an understanding of place value of numbers to 10 000
- knowing single-digit addition and subtraction facts.

KICK OFF

Download **BLM 3** 'Addition and subtraction grids (1)' from the Interactive Textbook and complete.

Show what you know

1 Calculate:

a 8 + 3 **b** 9 + 7 **c** 6 + 5 **d** 3 + 9

e 2 + 9 **f** 7 + 6 **g** 4 + 7 **h** 5 + 8

2 Work with a partner. Say the answers to parts **a–f** to your partner, then listen to your partner's answers to parts **g–l**. Correct each other, if needed.

a 17 + 6 **b** 34 + 9 **c** 28 + 4 **d** 21–7

e 14 – 8 **f** 23 – 5 **g** 22 + 8 **h** 13 + 9

i 36 + 5 **j** 15 – 6 **k** 31 – 4 **l** 22 – 8

3 **Who am I?**

I am a number.

a I am 6 more than 25.

b I am 9 less than 46.

c I am 7 more than 14.

d I am 7 less than 100.

e I am 9 more than 47.

f I am 4 less than 51.

g I am 5 more than 38.

h I am 6 less than 32.

i I am 12 more than 28.

j I am 12 less than 92.

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CHAPTER

2

Number and Algebra

Addition and subtraction

We use **addition** every day to work out the total number of things – for example:

- calculating how many people attended a concert in a week (we do this by adding the daily totals)
- estimating how much money we've already spent on shopping (to make sure we have enough money to pay for everything).

We use **subtraction** every day to record the **difference between** two amounts – for example:

- how many students are present at school (we do this by subtracting the number absent from the number of enrolled students)
- how much change we receive when we buy a train or bus ticket.

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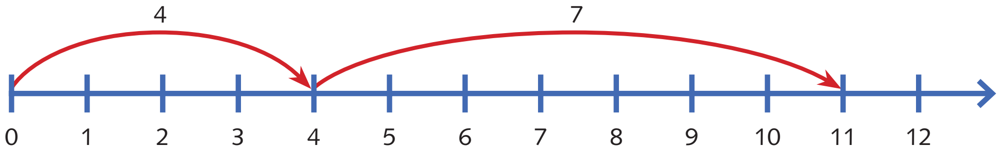
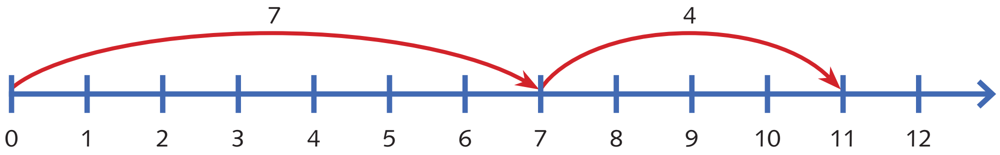
2A Mental strategies for addition

The **sum** of two numbers is the total of those numbers when they are added together.

You can find the sum of 4 and 7 by using a number line, beginning at 4 and making a jump of 7 to the right. We can see that 4 + 7 = 11.



The order in which we do addition does not matter; the answer will be the same whichever order we use. So we could begin at 7 and add 4 more to get the same result. The number line shows that 7 + 4 = 11.



When we add two or more numbers ‘in our head’, we can use what we know about place value to ‘pull apart’ the numbers and make them easier to add.

Make up to a 10

To add two numbers together, take a part of one number and add it to the other number to make up to a 10 or a multiple of 10.

Example 1

a Add 24 and 18.

b Find the sum of 37 and 45.

c Calculate the sum of 456 and 348.

Solution

a $24 + 18 = 22 + 2 + 18$ (24 is the same as 22 + 2.)

$= 22 + 20$

$= 42$

b $37 + 45 = 37 + 3 + 42$ (Take 3 from 45 and add it to 37 to make 40.)

$= 40 + 42$

$= 82$

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or

37 + 45 = 32 + 5 + 45 (Take 5 from 37 and add it to 45 to make 50.)
= 32 + 50
= 82

c 456 + 348 = 454 + 2 + 348 (Take 2 from 456 and add it to 348 to make 350.)
= 454 + 350
= 804

Add from the left

When we add from the left, we start with the largest parts first. Add the digits with the same place value, starting from the left.

Example 2

a Mike and Sally are 16 and 21. What is their combined age?
b Two old coins are 347 and 228 years old. What is their combined age?

Solution

a 16 + 21 = 10 + 20 + 6 + 1 (Add tens, then ones.)
= 30 + 7
= 37 years

or

16 + 21 = 21 + 10 + 6
= 31 + 6
= 37 years

b 347 + 228 = 300 + 200 + 40 + 20 + 7 + 8 (Add hundreds, then tens, then ones.)
= 500 + 60 + 15
= 575 years

Compensation

Add more than is needed, then subtract the extra you added on. Look at Example 3 on the next page.

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Example 3

a Add 43 and 29. **b** Add 438 and 347.

Solution

a
$$\begin{aligned} 43 + 29 &= 43 + 30 - 1 \\ &= 73 - 1 \\ &= 72 \end{aligned}$$

(Add 1 to 29 and immediately take it away.)

b
$$\begin{aligned} 438 + 347 &= 440 + 350 - 2 - 3 \\ &= 790 - 5 \\ &= 785 \end{aligned}$$

(Add 2 to 438, add 3 to 347, then subtract 2 and subtract 3.)

The best mental strategy is the one that makes things easy for you and saves you time. You should practise mental strategies and find out which strategies work best for you. A lot depends on the numbers you are working with.

2A Whole class CONNECT, APPLY AND BUILD

Teachers: read questions **1–3** to the class and ask them to write the answers.

1 Write the double of each number.

a 5 **b** 4 **c** 6 **d** 8 **e** 7 **f** 9

2 Double each number, then add 1.

a 5 **b** 4 **c** 6 **d** 8 **e** 7 **f** 9

3 Add 9 to each number by adding 10, then taking 1 away.

a 6 **b** 15 **c** 21 **d** 56 **e** 73 **f** 98

4  **Beachball**

Write the digits 0–9 on stickers and place them randomly on a large beachball. Pass the beachball around the classroom. Whoever catches the ball adds the digit nearest to their right thumb to:

a 12 **b** 14 **c** 28 **d** 39 **e** 77 **f** 98 **g** 128

5 Work in pairs. Person 1 reads parts **a–d** to Person 2. Person 2 writes the addition and then calculates the sum mentally before writing the answer. Then swap roles for parts **e–h**. Check each other's answers.

a 26 + 35 **b** 18 + 14 **c** 56 + 27 **d** 343 + 117

e 345 + 427 **f** 17 + 15 **g** 1452 + 1290 **h** 54 + 36

2A Individual

1 Mentally calculate these additions.

a 6 + 5 **b** 4 + 7 **c** 5 + 7 **d** 4 + 8

2 Mentally calculate these additions.

a 24 + 8 **b** 16 + 7 **c** 68 + 5 **d** 54 + 7

3 Which number makes a total of 20 when added to:

a 15? **b** 18? **c** 13? **d** 9? **e** 0? **f** 3?

4 Write three different 1-digit numbers that sum to:

a 6 **b** 18 **c** 24 **d** 15 **e** 12 **f** 17

5 Use the 'make up to a 10' strategy to mentally calculate the following additions.

a 27 + 33 **b** 21 + 99 **c** 46 + 54 **d** 28 + 102
e 124 + 17 **f** 132 + 12 **g** 555 + 28 **h** 491 + 47
i 387 + 68 **j** 48 + 193 **k** 25 + 878 **l** 39 + 666

6 Use the 'add from the left' strategy to mentally calculate each addition. Remember, the order of addition does not matter.

a 43 + 12 **b** 28 + 61 **c** 13 + 14 + 15 + 16
d 16 + 21 + 40 **e** 19 + 37 + 21 **f** 47 + 32 + 53 + 28
g 127 + 238 + 349 **h** 102 + 508 + 376 **i** 312 + 271 + 438

7 **a** There were 68 Holdens and 45 Fords in the car park. How many cars were there altogether?

b There were 272 boys and 296 girls on the roll of Palmer Street School. How many children were on the roll in total?

8 Use the 'compensation' strategy to mentally calculate these additions. The first one has been done for you.

a
$$\begin{aligned} 27 + 18 &= 27 + 20 - 2 \\ &= 47 - 2 \\ &= 45 \end{aligned}$$

b 18 + 27 **c** 29 + 48 **d** 42 + 36 **e** 104 + 59

9 Scientists have just discovered a new species of bird in the large sourplum trees of a remote part of Africa. One scientist counted the birds he saw in 10 different trees:

18 27 41 62 44 29 33 26 11 19

a Mentally calculate the number of birds the scientist saw.

b The scientist knows that a tree with an even number of birds has only male and female pairs. Trees with odd numbers have all males. How many male and female pairs are there?

10 With some 3-digit numbers, the third digit is the sum of the first two digits. For the number 213 we can add 1 and 2 to get 3, so the third digit is the sum of the first two digits.

Write as many 3-digit numbers as you can where the third digit is the sum of the first two digits.

11 **a** This is a 'magic square'. Each row, each column and each diagonal adds up to the same total.

9		
4		
5		3

Add the first column. It totals 18, so every row, column and diagonal equals 18. That means the missing number in the bottom row must be 10. The missing number in the diagonal is 6. Now work out the other numbers.

Copy these magic squares and write the missing numbers.

b

15		
	12	
11		9

c

13	6	11
		7

d

18		14
	12	
		6

12 Make four magic squares of your own. See if your partner can find the solution to each of your magic squares.

13 Place addition signs in this string of digits so that the sum of the numbers is 99.

9 8 7 6 5 4 3 2 1

2B The standard addition algorithm

An algorithm is a set of steps used to do calculations that may be too difficult to do mentally.

If we want to add 39 to 45 we can use the standard addition algorithm.

	Tens	Ones
	3	9
+	4	5

Set out the numbers one under the other according to their place value.

Start with the ones digits. Add the digits.

	Tens	Ones
	3	9
+	4_1	5
		4

We say, ‘9 ones plus 5 ones is 14 ones’.

14 ones is the same as 1 ten and 4 ones.

Write 4 in the ones column and carry 1 ten into the tens column.

	Tens	Ones
	3	9
+	4_1	5
	8	4

Now look at the tens column.

We say, ‘3 tens + 4 tens + 1 ten (carried from before) = 8 tens’.

Write the 8 in the tens column

$39 + 45 = 84$

The standard addition algorithm can be extended to add numbers of any size. All you need to do is add the columns from right to left, and carry whenever you get 10 or higher.

Example 4

Find the sum of 3786 and 5949.

Solution

$$\begin{array}{rcccc} & 3 & 7 & 8 & 6 \\ + & 5_1 & 9_1 & 4_1 & 9 \\ \hline & 9 & 7 & 3 & 5 \\ \hline \end{array}$$

Additions that involve more than two numbers can also be done this way.

Example 5

Find the sum of 2706, 978 and 88. (Remember to put the digits in the correct place-value columns.)

Solution

$$\begin{array}{ccccc}
 & 2 & 7 & 0 & 6 \\
 & & 9 & 7 & 8 \\
+ & & & 8 & 8 \\
 & {}_1 & {}_1 & {}_2 & \\
\hline
 & 3 & 7 & 7 & 2 \\
\hline
\end{array}$$

(Add the ones, carrying 2 tens into the tens column. Add the tens, including the carried tens from before. Add the hundreds, carrying where necessary. Then add the thousands.)

2B Whole class CONNECT, APPLY AND BUILD

1 Use place-value blocks to model each addition. Then record your working using the addition algorithm.

a 29 + 37 **b** 148 + 796 **c** 1072 + 3798

2B Individual

1 Use the standard addition algorithm to calculate these additions.

These have no carrying.

a 13 + 45 **b** 62 + 35 **c** 112 + 83 **d** 454 + 545

e 142 + 641 **f** 131 + 437 **g** 777 + 121 **h** 354 + 642

These involve adding a single digit to a number.

i 23 + 9 **j** 46 + 7 **k** 67 + 8 **l** 146 + 9

m 43 + 8 **n** 65 + 7 **o** 8 + 73 **p** 6 + 88

2 Use the standard addition algorithm to calculate these additions.

These involve carrying from the ones to the tens.

a 27 + 26 **b** 35 + 47 **c** 63 + 38

d 24 + 38 + 13 **e** 17 + 18 + 19 **f** 128 + 437

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These involve carrying from the ones to the tens, and from the tens to the hundreds.

g 87 + 66
h 95 + 36
i 72 + 88
j 87 + 89
k 23 + 25 + 27
l 43 + 86 + 29
m 241 + 178 + 346
n 981 + 74 + 48

3 **a** On Saturday, James and Toni hiked 32 kilometres. On Sunday, they hiked 26 kilometres. How many kilometres did they hike in total?

b Karli has 23 teddy bears. Her sister Kendra has 36 teddy bears. How many teddy bears do Karli and Kendra have in total?

4 Calculate:

a 316 + 466
b 634 + 289
c 397 + 259
d 766 + 464
e 3246 + 2055
f 6045 + 1836

5 Use the standard addition algorithm to work these out.

a 62 + 27 + 89
b 88 + 29 + 67
c 66 + 28 + 49 + 31
d 33 + 58 + 46 + 59
e 456 + 87 + 9
f 67 + 443 + 28
g 47 + 8 + 295
h 438 + 276 + 329
i 1409 + 2264 + 2176
j 3380 + 2577 + 2867
k 634 + 577 + 298
l 387 + 536 + 529
m 23 566 + 17 804
n 54 389 + 26 118
o 58 334 + 27 267
p 33 427 + 6055 + 237
q 298 + 44 + 1776
r 9354 + 12 848 + 176

6 **a** Peter has 74 marbles, Asaf has 66 marbles and Kia has 85 marbles. How many marbles do they have in total?

b In three days, Mr Lee drove 278 km, 188 km and 276 km. How many kilometres did he drive in total?

7 **a** What number is 3525 more than 6778?

b Add 2750 to the sum of 7755 and 5577.

c What number is 1432 more than the sum of 2413 and 3214?

d Add the sum of 5128 and 4736 to the sum of 7394 and 4328.

8 Jo spent $187 at the supermarket, $28 at the butcher and $9 at the bakery. What was the total amount she spent?

9 Lauren spilled chocolate milk on her worksheet and covered some of the numbers in the following additions. Write the missing number for each one.

a
$$\begin{array}{r} 1\ 2\ 7 \\ +\ \bigstar\ 3\ 2 \\ \hline 2\ 5\ 9 \\ \hline \end{array}$$

b
$$\begin{array}{r} 3\ 4\ \bigstar \\ +\ 1\ 5\ 6 \\ \hline 4\ 9\ 8 \\ \hline \end{array}$$

c
$$\begin{array}{r} \bigstar\ 9\ 1 \\ +\ 5\ 0\ 8 \\ \hline 9\ 9\ 9 \\ \hline \end{array}$$

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2C Mental strategies for subtraction

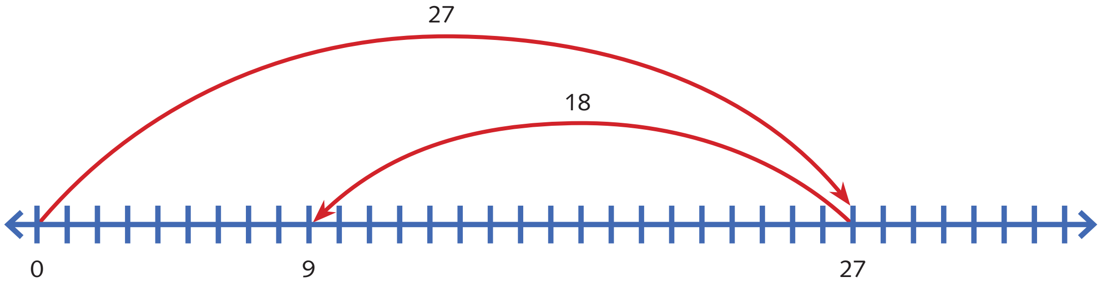
When we use subtraction, we are either 'taking away' one number from another, or 'building up' from one number to another.

You can think about subtraction as taking away or as adding on.

Either way, subtraction is the difference between two numbers.

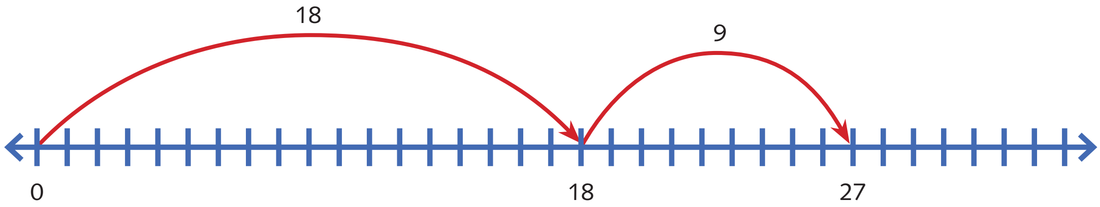
Taking away

For example, 27 – 18. When we take away using a number line we say, '27 take away 18 is …'.



Adding on

We can also use a number line to build up from one number to the next and we say, 'What do I add to 18 to get to 27?'



The mental strategies for subtraction use the idea that we can 'break numbers apart' to make calculations easier to manage. Sometimes the mental strategies we use are hard to write down. It is important to have conversations with your teacher and your classmates about the strategies you use when subtracting 'in your head'.

There are many mental strategies for subtraction. Here are some of them.

Subtract a bit at a time

Subtract two separate pieces instead of one.

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Example 6

a Subtract 17 from 43.

b Tony had 251 basketball cards.
He gave 174 cards to Ivan.
How many cards does he have left?

Solution

a $43 - 17 = 43 - 10 - 7$
$= 33 - 7$
$= 26$

b $251 - 174 = 251 - 100 - 70 - 4$
$= 151 - 70 - 4$
$= 81 - 4$
$= 77$

Tony has 77 cards left.

Build up to the larger number

Add on to the smaller number to build up to the larger number. Keep track of what you have added.

Example 7

Subtract 39 from 87.

Solution

To calculate $87 - 39$ we build up from 39:

$39 + 1 = 40$	(Add 1.)
$40 + 47 = 87$	(Add 47.)
$87 - 39 = 48$	(A total of 48 has been added.)

Add the same to both numbers

Adding the same number to both numbers does not change the difference between them.

Think of an adult and a child standing together. Suppose the difference in their heights is 25 centimetres. If they both stand together on a box, the difference between their heights is still the same.

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Example 8

$54 - 36$: find the result by adding the same amount to both numbers.

Solution

$$\begin{aligned} 54 - 36 &= 58 - 40 \\ &= 18 \end{aligned}$$

(Add 4 to both numbers.)

Adding 4 to both numbers does not change the difference between them. The difference between 58 and 40 is the same as the difference between 54 and 36.

Remember

We can think of subtraction in two ways:

- taking away one number from another
- adding on from one number to get to the other.

We can subtract using mental strategies – for example:

- taking away 2 pieces instead of 1.

  $$\begin{aligned} 27 - 13 &= 27 - 10 - 3 \\ &= 17 - 3 \\ &= 14 \end{aligned}$$

- building up to the larger number. $36 - 18$: add 2, then add 10, then add 6. 18 has been added: $36 - 18 = 18$.
- adding the same to both numbers.

  $$\begin{aligned} 83 - 16 &= 87 - 20 \\ &= 67 \end{aligned}$$

The difference between two numbers is the result when one number is subtracted from another.

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2C Whole class CONNECT, APPLY AND BUILD

1  **Beachball**

Write the digits 0–9 on stickers and place them randomly on a large beachball. Pass the beachball around the classroom. Whoever catches the ball subtracts the digit nearest to their right thumb from:

a 39 **b** 48 **c** 57 **d** 66
e 85 **f** 24 **g** 93 **h** 72

For questions **2**–**6**: The teacher reads each instruction aloud to the class and asks students to write the answer.

2 Mentally subtract 15 from each number by taking away 10, then taking away 5.

a 28 **b** 36 **c** 118 **d** 32 **e** 53 **f** 103

3 Mentally subtract 13 from each number by taking away 10, then taking away 3.

a 28 **b** 47 **c** 51 **d** 120 **e** 402 **f** 900

4 Mentally subtract 127 from each number by taking away 100, then taking away 20 and finally taking away 7.

a 498 **b** 769 **c** 820 **d** 650 **e** 222 **f** 1000

5 Mentally subtract 99 from each number by taking away 100, then adding 1.

a 103 **b** 217 **c** 530 **d** 647 **e** 888 **f** 1000

6 Add the number in brackets to both numbers, then complete the subtraction mentally.

a 37 – 28 (2) **b** 45 – 26 (4) **c** 148 – 99 (1)
d 56 – 27 (3) **e** 82 – 25 (5) **f** 134 – 88 (12)

2C Individual

1 Find the difference between these pairs of numbers by ‘building up’ to the larger number.

a 53 and 27 **b** 61 and 18 **c** 44 and 29 **d** 62 and 24

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2 Do these subtractions in your head by 'building up' to the larger number.

a 74 – 48　**b** 60 – 27　**c** 85 – 49

d 344 – 128　**e** 405 – 366　**f** 542 – 397

3 Use the 'add the same to both numbers' method to calculate these subtractions.

a 21 – 8　**b** 36 – 17　**c** 48 – 26

d 55 – 27　**e** 72 – 25　**f** 41 – 18

g 71 – 13　**h** 101 – 22　**i** 133 – 44

j 111 – 64　**k** 201 – 63　**l** 230 – 42

4 Mentally subtract 13 from each number by first subtracting 10, and then subtracting 3.

a 27　**b** 28　**c** 44　**d** 109　**e** 1007　**f** 2000

5 Mentally subtract 24 from each number by first subtracting 20, and then subtracting 4.

a 71　**b** 112　**c** 675　**d** 843　**e** 1022

6 Mentally subtract 36 from each number by first subtracting 30, and then subtracting 6.

a 57　**b** 82　**c** 91　**d** 106　**e** 621　**f** 1000

7 Use the 'add the same to both numbers' method to solve these subtractions mentally.

a 265 – 188　**b** 444 – 299　**c** 697 – 548　**d** 632 – 485

8 Download **BLM 4** 'Addition and subtraction grids (2)' from the Interactive Textbook and complete.

9 **a** There were 72 children in Year 5. If 43 of the children were girls, how many boys were there?

b A factory employs 375 men and 288 women. How many more men than women are employed in the factory?

c Sumitra has 803 stamps. Her friend Eni has 645 stamps. How many more stamps does Sumitra have than Eni?

d The nursery has 675 petunia plants and 397 dahlia plants. How many more petunia plants than dahlia plants are there?

e Mardi's shopping came to a total of $143.35. She gave the cashier two $100 notes. How much change should Mardi receive?

f There are 463 children in Mount Leafy School. 78 of the children are in Year 5. If all of Year 5 went on an excursion, how many children would be left at school?

10 Choose your own strategy to calculate these subtractions mentally.

a 462 – 371　**b** 627 – 411　**c** 1064 – 82

d 4621 – 799　**e** 3264 – 2837　**f** 10 000 – 6421

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11 Use mental strategies to solve these problems. Insert addition or subtraction signs to make each statement true.

a 8 ☐ 4 ☐ 6 ☐ 7 = 13

b 27 ☐ 13 ☐ 8 ☐ 3 = 3

c 49 ☐ 121 ☐ 642 ☐ 777 = 35

d 264 ☐ 391 ☐ 227 ☐ 443 = 871

Homework

1 **a** Zara's car has the registration number 987456. Use these digits to make six different 2-digit numbers. Use the numbers to calculate five additions and five subtractions.

b Use the digits of your telephone number to make six different 2-digit numbers. Use the numbers to calculate five additions and five subtractions if you can.

2 **a** Add together all of the numbers from 1 to 5.

b Add together all of the numbers from 1 to 9.

c Add together all of the numbers from 1 to 13.

d Add together all of the numbers from 1 to 19.

e Can you think of an easy way to keep adding like this?

3 An alpha-numeric code replaces letters of the alphabet with numbers.

a Write a code that replaces each letter of the alphabet with a number, starting with A = 1 and finishing with Z = 26.

Use the code to write these names and places and do the additions.

For example, if Archie Jackson adds his first name to his last name this is what happens:

A + R + C + H + I + E = 1 + 18 + 3 + 9 + 5 = 36 and
J + A + C + K + S + O + N = 10 + 1 + 3 + 11 + 19 + 15 + 14 = 73
so A + R + C + H + I + E + J + A + C + K + S + O + N = 36 + 73 = 110.

b Add your first name to your last name.

c Add a friend's first name to their last name.

d Add your street name to the month you were born in.

e Add the name of your favourite television show to the name of your favourite football team.

f Add the name of the prime minister to the name of the premier or chief minister of your state or territory.

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2D Subtraction algorithms

Sometimes you need to use a subtraction algorithm rather than mental strategies. Here is a standard subtraction algorithm.

Calculate 68 – 45.

	Tens	Ones
	6	8
–	4	5

Set out the numbers one under the other, and line them up in place-value columns. Write the number to be subtracted from the other number.

	Tens	Ones
	6	8
–	4	5
		3

Start with the ones digits. Subtract the bottom digit from the top digit.

We say, ‘8 ones take away 5 ones is 3 ones’.

Write 3 in the ones column.

	Tens	Ones
	6	8
–	4	5
	2	3

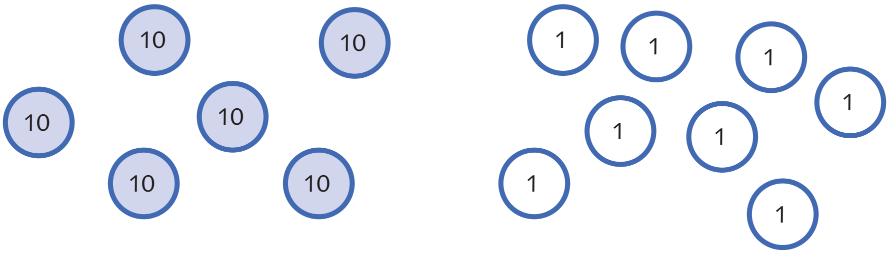
Now work with the tens digits. Subtract the bottom digit from the top digit.

We say, ‘6 tens take away 4 tens is 2 tens’.

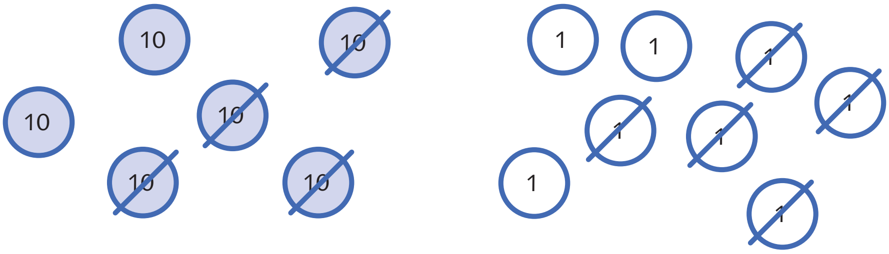
Write 2 in the tens column. 68 – 45 = 23

We can also draw a picture to show 68 – 45.

68 is 6 tens and 8 ones.



We can show taking away 45 by crossing off 4 tens and 5 ones.



We are left with 2 tens and 3 ones, which is the same as 23.

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However, not all subtractions are as simple as this example. Sometimes the numbers are not as easy to deal with. There are two different algorithms you can use, so choose the algorithm you feel most comfortable with.

Trading or decomposition

Find the difference between 63 and 47. This method is based on trading 1 ten for 10 ones and 1 hundred for 10 tens, and so on.

	Tens	Ones
	6	3
–	4	7

To calculate 63 – 47, set out the numbers one under the other according to their place value.

Start with the ones digits. There are not enough ones. We need to trade.

	Tens	Ones
	$^{5}\cancel{6}$	$^{1}3$
–	4	7

Trade 10 ones for 1 ten in the top number.

Cross out the 6 and write a 5 to show there are 5 tens left.

Write a 1 in the top number near the 3 to show that there are now 13 ones.

	Tens	Ones
	$^{5}\cancel{6}$	$^{1}3$
–	4	7
		6

Now we can subtract the ones digits.

We say, ‘13 ones take away 7 ones is 6 ones’.

Write 6 in the ones column.

	Tens	Ones
	$^{5}\cancel{6}$	$^{1}3$
–	4	7
	1	6

Now look at the tens column.

We say, ‘5 tens take away 4 tens is 1 ten’.

Write 1 in the tens column.

63 – 47 = 16

The picture on the next page shows how the trading algorithm for 63 – 47 works.

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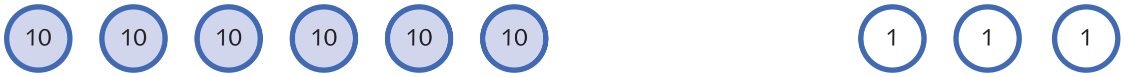
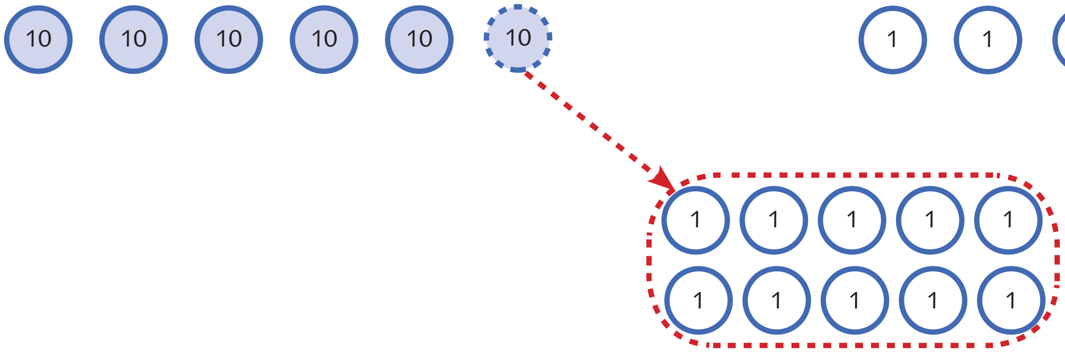
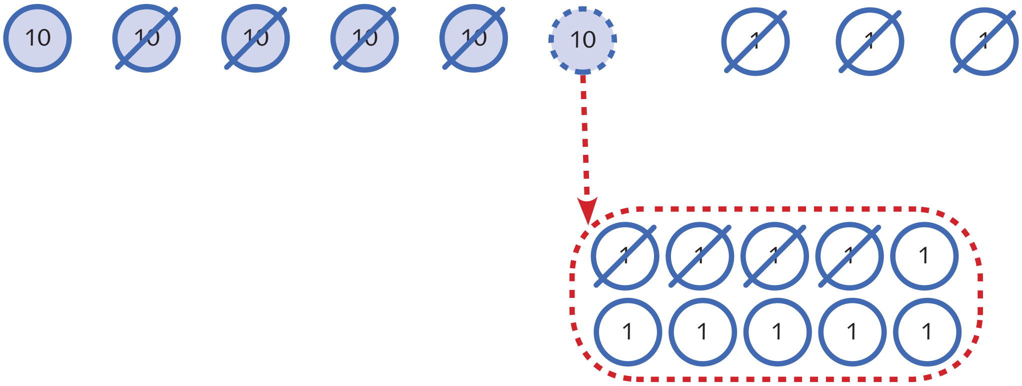
63 is 6 tens and 3 ones.



We do not have enough ones, so we trade 1 ten for 10 ones.



We can show taking away 47 by crossing off 4 tens and 7 ones.



We are left with 1 ten and 6 ones, which is the same as 16.

Equal addition

This method is based on the mental strategy of adding the same to both numbers. It is sometimes called the 'borrow and pay back' method. When the same amount is added to both numbers, the difference between them is the same.

	Tens	Ones
	6	3
–	4	7

To calculate 63 – 47, set out the numbers one under the other according to their place value.

Start with the ones digits. There are not enough ones.

	Tens	Ones
	6	$^{1}3$
–	4_{1}	7

We add 10 to both numbers. There is a special way to do this.

Because 10 ones is the same as 1 ten, we add 10 ones to the top number and 1 ten to the bottom number.

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	Tens	Ones
	6	$^{1}3$
−	4_1	7
		6

Write 1 in the ones column of the top number, so the 3 becomes 13.

Write 1 in the bottom number near the 4. (This is added to the 4 later.)

We say, '13 ones take away 7 ones is 6 ones'.

Write 6 in the ones column.

	Tens	Ones
	6	$^{1}3$
−	4_1	7
	1	6

Now look at the tens column.

We say, '6 tens take away 5 tens (remember the 1 carried from before) is 1 ten'.

Write 1 in the tens column.

63 – 47 = 16

Example 9

Calculate the difference between:

a 84 and 28 **b** 296 and 18 **c** 584 and 228

Solution

Trading

a 84 – 28

$$\begin{array}{rrr} & {}^{7}\cancel{8} & {}^{1}4 \\ - & 2 & 8 \\ \hline & 5 & 6 \end{array}$$

b 296 – 18

$$\begin{array}{rrrr} & 2 & {}^{8}\cancel{9} & {}^{1}6 \\ - & & 1 & 8 \\ \hline & 2 & 7 & 8 \end{array}$$

c 504 – 228

$$\begin{array}{rrrr} & {}^{4}\cancel{5} & {}^{9}\cancel{0} & {}^{1}4 \\ - & 2 & 2 & 8 \\ \hline & 2 & 7 & 6 \end{array}$$

Equal addition

a 84 – 28

$$\begin{array}{rrr} & 8 & {}^{1}4 \\ - & 2_1 & 8 \\ \hline & 5 & 6 \end{array}$$

b 296 – 18

$$\begin{array}{rrrr} & 2 & 9 & {}^{1}6 \\ - & & 1_1 & 8 \\ \hline & 2 & 7 & 8 \end{array}$$

c 504 – 228

$$\begin{array}{rrrr} & 5 & {}^{1}0 & {}^{1}4 \\ - & 2_1 & 2_1 & 8 \\ \hline & 2 & 7 & 6 \end{array}$$

Remember

There are two commonly used subtraction algorithms. Use the one you feel more comfortable with.

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2D Whole class CONNECT, APPLY AND BUILD

1 Use place-value blocks to model each subtraction. Then record your working using a subtraction algorithm.

a 273 – 198 **b** 1641 – 753 **c** 5314 – 1999 **d** 6218 – 5974

2D Individual

Use one of the subtraction algorithms to complete these exercises.

1 Calculate these subtractions.

a 43 – 21 **b** 78 – 65 **c** 134 – 103 **d** 267 – 56

e 498 – 171 **f** 642 – 523 **g** 1076 – 34 **h** 5972 – 3051

2 Calculate these subtractions.

a 38 – 19 **b** 43 – 18 **c** 118 – 81 **d** 125 – 64

e 87 – 68 **f** 868 – 459 **g** 248 – 139 **h** 389 – 297

3 On Monday, Sofia's bean plant was 86 centimetres tall. On Tuesday, it was 92 centimetres tall. How much did Sofia's bean plant grow?

4 Calculate these subtractions.

a 805 – 439 **b** 703 – 426 **c** 921 – 278 **d** 623 – 348

5 The school bus seats 64 passengers. There are 29 people on the bus. How many empty seats are there?

6 Ace Cinema seats 865 people. There are 679 people in the cinema. How many empty seats are there?

7 Calculate these subtractions.

a 8320 – 2583 **b** 3916 – 1257 **c** 5432 – 2738 **d** 5287 – 2398

8 There are 1423 children in Henley School. If 846 children are boys, how many girls are there?

9 Trevor's dad bought a car for $6375. He sold it a year later for $4990. How much money did Trevor's dad lose?

10 Jim needs $6325 to buy a new home-theatre system. He has already saved $4897. How much more does he need to save?

11 **a** Take 32 847 from 56 003.

b Find the difference between 62 497 and 43 014.

c How much more than 42 917 is 64 164?

2E Review questions

1 What do you need to add to each number to make a total of 50?

a 17 **b** 23 **c** 32 **d** 45 **e** 29 **f** 7

2 Mentally calculate these additions.

a 7 + 8 **b** 7 + 28 **c** 12 + 9 **d** 14 + 18

e 36 + 8 **f** 13 + 47 **g** 88 + 7 **h** 88 + 17

i Minh has 57 videos and 28 DVDs in her movie collection. How many movies does she have in total?

3 Use the addition algorithm to calculate these.

a 57 + 8 **b** 126 + 9 **c** 47 + 28 **d** 136 + 29

e 403 + 214 **f** 88 + 88 **g** 746 + 621 **h** 3196 + 729

i Leanne sold 67 T-shirts at the market. Andrew sold 188 T-shirts. How many T-shirts did they sell in total?

j Write the number that is 3489 more than 2184.

k Write the number that is 32 904 more than 3821.

4 Calculate these additions.

a 52 + 20 + 22 **b** 22 + 20 + 57 **c** 55 + 22 + 40 + 31

d 33 + 52 + 45 + 50 **e** 455 + 27 + 10 + 27 **f** 1400 + 57 + 443

5 Find the difference between:

a 27 and 43 **b** 102 and 34 **c** 111 and 49

6 Complete these subtractions.

a 72 – 29 **b** 50 – 27 **c** 95 – 29

d 322 – 129 **e** 505 – 355 **f** 255 – 199

7 Write the number that is:

a 239 less than 3857 **b** 483 less than 57 239

8 It's Jedda's first year at high school. Jedda's parents spent \$2839 on a computer, \$64 on a schoolbag, \$567 on school uniforms and \$394 on books for her.

a How much did they spend in total?

b Jedda's parents had \$4000 in their 'getting Jedda ready for high school' bank account. How much money was left over?

9 Lachlan spilled strawberry milk on his worksheet and covered some of the numbers in the following additions. Write the missing number for each one.

a
$$\begin{array}{cccc} & 4 & \star & 5 \\ - & 2 & 3 & 4 \\ \hline & 2 & 3 & 1 \\ \hline \end{array}$$

b
$$\begin{array}{cccc} & 2 & 4 & 7 \\ + & 1 & \star & 6 \\ \hline & 1 & 1 & 1 \\ \hline \end{array}$$

c
$$\begin{array}{cccc} & 9 & 8 & \star \\ + & 3 & 7 & 2 \\ \hline & 6 & 1 & 0 \\ \hline \end{array}$$

CHAPTER 3 Preparation

Useful skills for this chapter:

- understanding the multiplication of single-digit numbers
- understanding the connection between repeated addition and multiplication.

KICK OFF

Dirk's Backyard Building Company has supplied 12 square concrete tiles for Pam's backyard. Pam wants Dirk to arrange the tiles to make a rectangle.

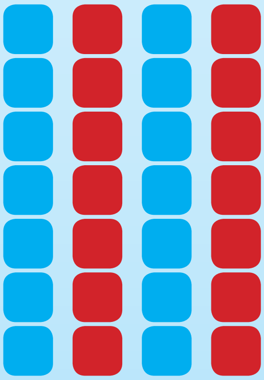
How many different ways can Dirk arrange the tiles? Cut 12 squares from paper and arrange them in different ways to make rectangles.

Draw all the possibilities.

Discuss your drawing with a friend, then compare your drawing with your classmates' drawings.

Show what you know

Skip-counting and repeated addition



1 Luke has 4 towers. Each tower has 7 blocks.

  a Write an addition statement about Luke's towers.

  b Write a multiplication statement about Luke's towers.

2 Look at the picture of Luke's blocks in question **1**. Draw a similar picture to show 3 times 6.

3 Write the pattern for skip-counting by three from 0 to 42.

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CHAPTER

3

Number and Algebra

Multiplication

We can **multiply** two numbers together to work out a total.

You can think of multiplication as the total of 'lots of' a number.

For example, Isaac has a collection of toy cars, but he's not sure how many he has.

Rather than count them all, he assembles them into lots of five cars.

When he does this, he finds he has four lots, each of five cars.

This is written as 4 × 5 = 20, or four times five is twenty. So Isaac has a total of 20 toy cars. He can check this by counting them one by one if he wants to.

Multiplying is a fast and easy way of counting large sets of things.

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3A Arrays

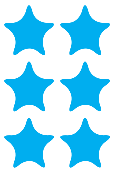
When we count by two, we say:

2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26 …

The twos counting pattern can be shown in pictures called **arrays**, like this:

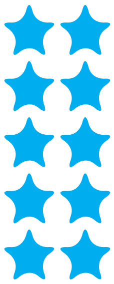
1 lot of 2
$1 \times 2 = 2$

2 lots of 2
$2 \times 2 = 4$



3 lots of 2
$3 \times 2 = 6$

4 lots of 2
$4 \times 2 = 8$



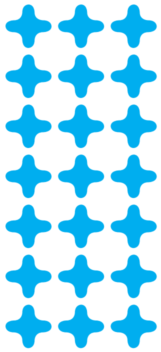
5 lots of 2
$5 \times 2 = 10$

We use the multiplication symbol × as a short way of saying 'lots of'.

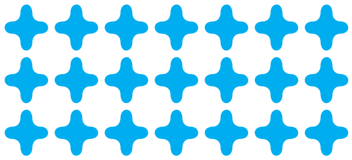
The answer to the multiplication is the number of objects in the array.

Arrays can be drawn so that they stand up or lie down.

Here are the two arrays for the multiplication $7 \times 3 = 21$.



Standing up: 7 lots of 3



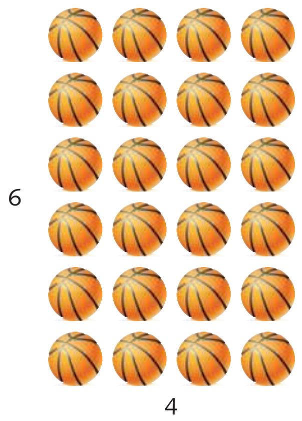
Lying down: 3 lots of 7

The number is the same in both. It does not matter in which order we do the multiplication – we always get the same answer.

$7 \times 3 = 3 \times 7 = 21$

When we multiply two numbers, the answer we get is called the **product** of the two numbers.

Look at the grouping of 24 basketballs at the top of the next page.



The product of 6 and 4 is 24.

There are 6 lots of 4 in 24.

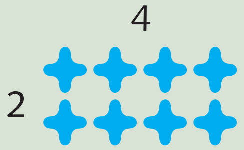
We also have 4 lots of 6 in 24.

$6 \times 4 = 24$ is the same as $4 \times 6 = 24$.

Think about the shape of the arrays that we have been looking at. What kinds of shapes are always used. Discuss why this is the case.

Remember

We can use an array to make a picture of multiplication.



$2 \times 4 = 8$

It does not matter in which order we do the multiplication – for example:

$3 \times 4 = 4 \times 3$

$7 \times 6 = 6 \times 7$

When we multiply two numbers, the answer we get is called the product of the two numbers.

12 is the product of 3 and 4.

42 is the product of 7 and 6.

3A Whole class CONNECT, APPLY AND BUILD

1 Download **BLM 5** ‘Arrays’ from the Interactive Textbook and complete.

2 **a** Draw the array for the product $3 \times 3 = 9$.
b What do you notice about the shape of the array?
c Why do you think 9 is called a ‘perfect square’?

3 The number 36 is also a perfect square.
a What shape do you think the array for $6 \times 6 = 36$ will be?
b Draw the array for $6 \times 6 = 36$.

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4 Draw arrays for:

a 2 × 2 = 4 **b** 4 × 4 = 16 **c** 5 × 5 = 25 **d** 7 × 7 = 49

5 **a** List the first seven perfect squares.

b What do you think the next five perfect squares will be? List them.

3A Individual

1 **a** Draw 6 rows of 2 apples.

Write the total number of apples under your drawing.

Complete the statements: 6 × 2 = ___ 2 × ___ = ___

b Draw 3 rows of 4 oranges.

Write the total number of oranges under your drawing.

Complete the statements: 3 × 4 = ___ 4 × ___ = ___

c Draw 10 rows of 10 bananas.

Write the total number of bananas under your drawing.

Complete the statement: 10 × 10 = ___

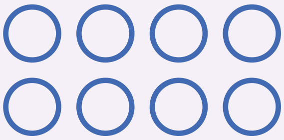
d Draw 4 rows of 12 watermelons.

Write the total number of watermelons under your drawing.

Complete the statements: 4 × 12 = ___ 12 × ___ = ___

2 Copy and complete the statements for each array.

a



2 rows of ___ circles

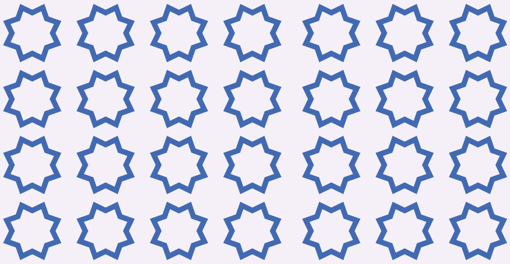
2 × ___ = 8 4 × ___ = ___

b

___ row of 5 hexagons

___ × 5 = 5 1 × ___ = ___

c



___ rows of ___ stars

___ × ___ = ___

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3 Draw a rectangular array for each product.

a 2 × 3 = 6 **b** 3 × 5 = 15 **c** 8 × 4 = 32

d 9 × 3 = 27 **e** 1 × 13 = 13 **f** 6 × 6 = 36

4 Draw all the possible rectangular arrays that give 24 as the product. Write the multiplication statement for each array.

5 Draw a picture of a car yard with 3 rows of 6 cars.

How many cars are there in total? 3 × 6 = ___

6 The floor tiles in Cara's bathroom are in rows of 8.

There are 11 rows of tiles. Draw Cara's bathroom tiles.

How many tiles are there in total? 8 × 11 = ___

7 Ian's kitchen has 48 tiles in 4 rows. How many tiles are in each row?

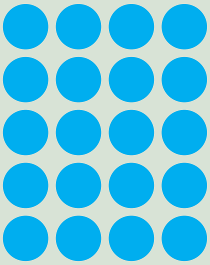
Homework

1 **a** Draw 3 rows of 5 basketballs. **b** Draw 4 rows of 11 trees.

c Draw 6 rows of 3 stars. **d** Draw 5 rows of 6 blocks.

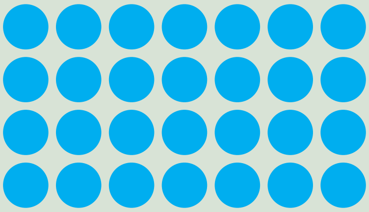
2 Write a product for each array.

a



___ × ___ = ___

b



___ × ___ = ___

c

___ × ___ = ___

3 Draw a rectangular array for each product.

a 4 × 2 = 8 **b** 3 × 3 = 9 **c** 2 × 8 = 16

d 4 × 4 = 16 **e** 16 × 1 = 16 **f** 11 × 1 = 11

Show what you know

Download **BLM 6** 'Multiplication tables' from the Interactive Textbook, complete and keep. It will help you find out which table's facts you know and which facts you need to work on.

You should know your multiplication tables as well as you know your birth date and how to spell your name. This is because when you use multiplication tables, you need to remember them quickly.

3B The multiplication table

This section is designed to help you learn your tables if you do not know them 'off by heart'. You may know some of these ideas already. It is a good idea to be very quick at remembering your tables as they are used in other areas of mathematics such as division, fractions and measurement.

You can think about multiplication as a **repeated addition**. For example:

4 is the same as $1 \times 4 = 4$

$4 + 4 = 8$ is the same as $2 \times 4 = 8$

$4 + 4 + 4 = 12$ is the same as $3 \times 4 = 12$

$4 + 4 + 4 + 4 = 16$ is the same as $4 \times 4 = 16$

$4 + 4 + 4 + 4 + 4 = 20$ is the same as $5 \times 4 = 20$

$4 + 4 + 4 + 4 + 4 + 4 = 24$ is the same as $6 \times 4 = 24$.

When we multiply a number by any other number, we get a **multiple** of the number.

So 4, 8, 12, 16, 20 and 24 are multiples of 4.

You can get more multiples of 4 by adding 4 at a time. For example:

$4 + 4 + 4 + 4 + 4 + 4 + 4 = 7 \times 4 = 28$
$4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 = 8 \times 4 = 32$, and so on.

If you know how to count by five, you would fill in part of the multiplication table like this.

×	0	1	2	3	4	5
0	0	0	0	0	0	0
1	0	1	2	3	4	5
2	0	2	4	6	8	10
3	0	3	6	9	12	15
4	0	4	8	12	16	20
5	0	5	10	15	20	25

Multiplication tables are really just lists of multiples of a number. In the next whole-class activity, we look at some tips for learning multiplication facts.

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3B Whole class CONNECT, APPLY AND BUILD

1 You will need to download a fresh copy of **BLM 6** 'Multiplication tables' from the Interactive Textbook.

We will look at some tips and tricks for learning multiplication tables. This activity can be completed with the whole class using an overhead projector or electronic whiteboard. These activities could be completed over a number of days, checking for consolidation of the earlier parts as you go.

a **Perfect squares**

When we multiply a number by itself, we get a **perfect square**.
Perfect squares are also known as square numbers.

So the first 12 perfect squares are:

$1 \times 1 = 1$	$2 \times 2 = 4$	$3 \times 3 = 9$	$4 \times 4 = 16$
$5 \times 5 = 25$	$6 \times 6 = 36$	$7 \times 7 = 49$	$8 \times 8 = 64$
$9 \times 9 = 81$	$10 \times 10 = 100$	$11 \times 11 = 121$	$12 \times 12 = 144$

You need to memorise these.

Can you find the perfect squares on the multiplication table?

Colour them in. Your chart should look like this.

×	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10	11	12
2	0	2	4	6	8	10	12	14	16	18	20	22	24
3	0	3	6	9	12	15	18	21	24	27	30	33	36
4	0	4	8	12	16	20	24	28	32	36	42	44	48
5	0	5	10	15	20	25	30	35	40	45	50	55	60
6	0	6	12	18	24	30	36	42	48	54	60	66	72
7	0	7	14	21	28	35	42	49	56	63	70	77	84
8	0	8	16	24	32	40	48	56	64	72	80	88	96
9	0	9	18	27	36	45	54	63	72	81	90	99	108
10	0	10	20	30	40	50	60	70	80	90	100	110	120
11	0	11	22	33	44	55	66	77	88	99	110	121	132
12	0	12	24	36	48	60	72	84	96	108	120	132	144

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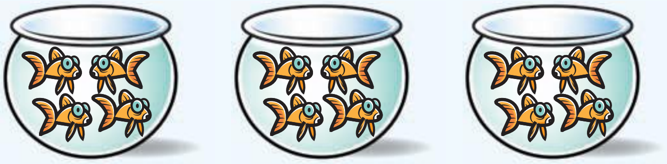
b Backwards or forwards multiplying

3 tanks of 4 fish …



is the same number of fish as 4 tanks of 3 fish.

The order in which we write the product of two numbers does not matter. It will always give the same answer. For example, 3 × 4 = 4 × 3 = 12.

On the multiplication table, every product above the diagonal of perfect squares can also be found below it. Colour in the repeated facts.

Now your multiplication chart should look like this.

×	0	1	2	3	4	5	6	7	8	9	10	11	12
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10	11	12
2	0	2	4	6	8	10	12	14	16	18	20	22	24
3	0	3	6	9	12	15	18	21	24	27	30	33	36
4	0	4	8	12	16	20	24	28	32	36	42	44	48
5	0	5	10	15	20	25	30	35	40	45	50	55	60
6	0	6	12	18	24	30	36	42	48	54	60	66	72
7	0	7	14	21	28	35	42	49	56	63	70	77	84
8	0	8	16	24	32	40	48	56	64	72	80	88	96
9	0	9	18	27	36	45	54	63	72	81	90	99	108
10	0	10	20	30	40	50	60	70	80	90	100	110	120
11	0	11	22	33	44	55	66	77	88	99	110	121	132
12	0	12	24	36	48	60	72	84	96	108	120	132	144

Good news! You now only have to remember less than half of the multiplication table. All we need to learn now are the multiplications that give the numbers in the white boxes.

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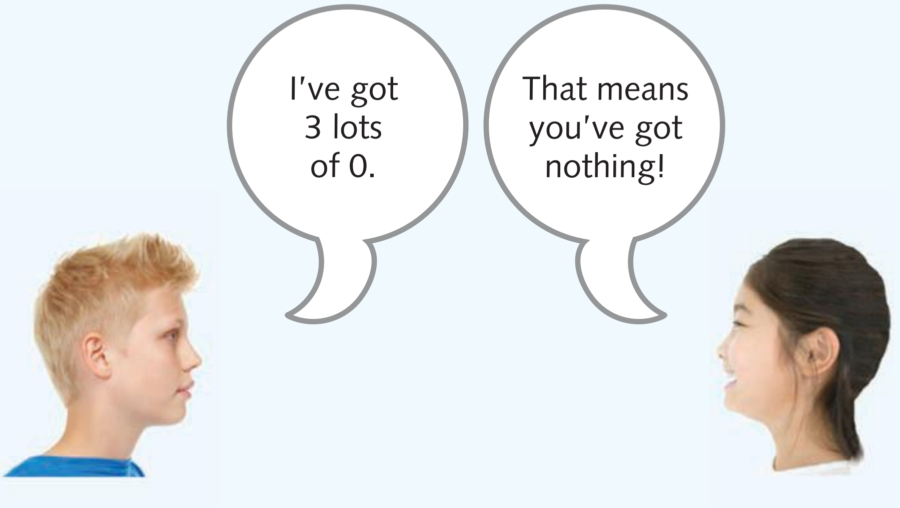
c **Multiplying by zero**

3 × 0 means 3 *lots of* zero. Think of 3 fish tanks with 0 fish in each tank.

We have no fish. 3 × 0 = 0

When a number is multiplied by zero, the answer is always zero.



Find the zeroes on your multiplication table. Colour them in.

×	0	1	2	3	4	5	6	7	8	9	10	11	12
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10	11	12
2	0	2	4	6	8	10	12	14	16	18	20	22	24
3	0	3	6	9	12	15	18	21	24	27	30	33	36
4	0	4	8	12	16	20	24	28	32	36	42	44	48
5	0	5	10	15	20	25	30	35	40	45	50	55	60
6	0	6	12	18	24	30	36	42	48	54	60	66	72
7	0	7	14	21	28	35	42	49	56	63	70	77	84
8	0	8	16	24	32	40	48	56	64	72	80	88	96
9	0	9	18	27	36	45	54	63	72	81	90	99	108
10	0	10	20	30	40	50	60	70	80	90	100	110	120
11	0	11	22	33	44	55	66	77	88	99	110	121	132
12	0	12	24	36	48	60	72	84	96	108	120	132	144

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d Multiplying by 1

6 fish tanks with 1 fish in each gives us 6 fish.

1 fish tank with 6 fish in it is still 6 fish.

1 × 6 = 6 × 1 = 6

Any number multiplied by 1 is equal to itself.

Complete and colour in those multiplication facts where a number is multiplied by 1.

e Multiplying by 2

Multiplying a number by 2 is the same as doubling the number. Practise doubling numbers up to 12, then colour the numbers in the '2' row and the '2' column.

f Multiplying by 5

What do you notice about numbers multiplied by 5?

What digits do they end in? Now colour in the multiples of 5.

×	0	1	2	3	4	5	6	7	8	9	10	11	12
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10	11	12
2	0	2	4	6	8	10	12	14	16	18	20	22	24
3	0	3	6	9	12	15	18	21	24	27	30	33	36
4	0	4	8	12	16	20	24	28	32	36	42	44	48
5	0	5	10	15	20	25	30	35	40	45	50	55	60
6	0	6	12	18	24	30	36	42	48	54	60	66	72
7	0	7	14	21	28	35	42	49	56	63	70	77	84
8	0	8	16	24	32	40	48	56	64	72	80	88	96
9	0	9	18	27	36	45	54	63	72	81	90	99	108
10	0	10	20	30	40	50	60	70	80	90	100	110	120
11	0	11	22	33	44	55	66	77	88	99	110	121	132
12	0	12	24	36	48	60	72	84	96	108	120	132	144

g **Multiplying by 10**

What do you notice about numbers multiplied by 10?

What digit do they always end in? Now colour in the multiples of 10.

h **Multiplying by 11**

What happens when you multiply a number less than 10 by 11?

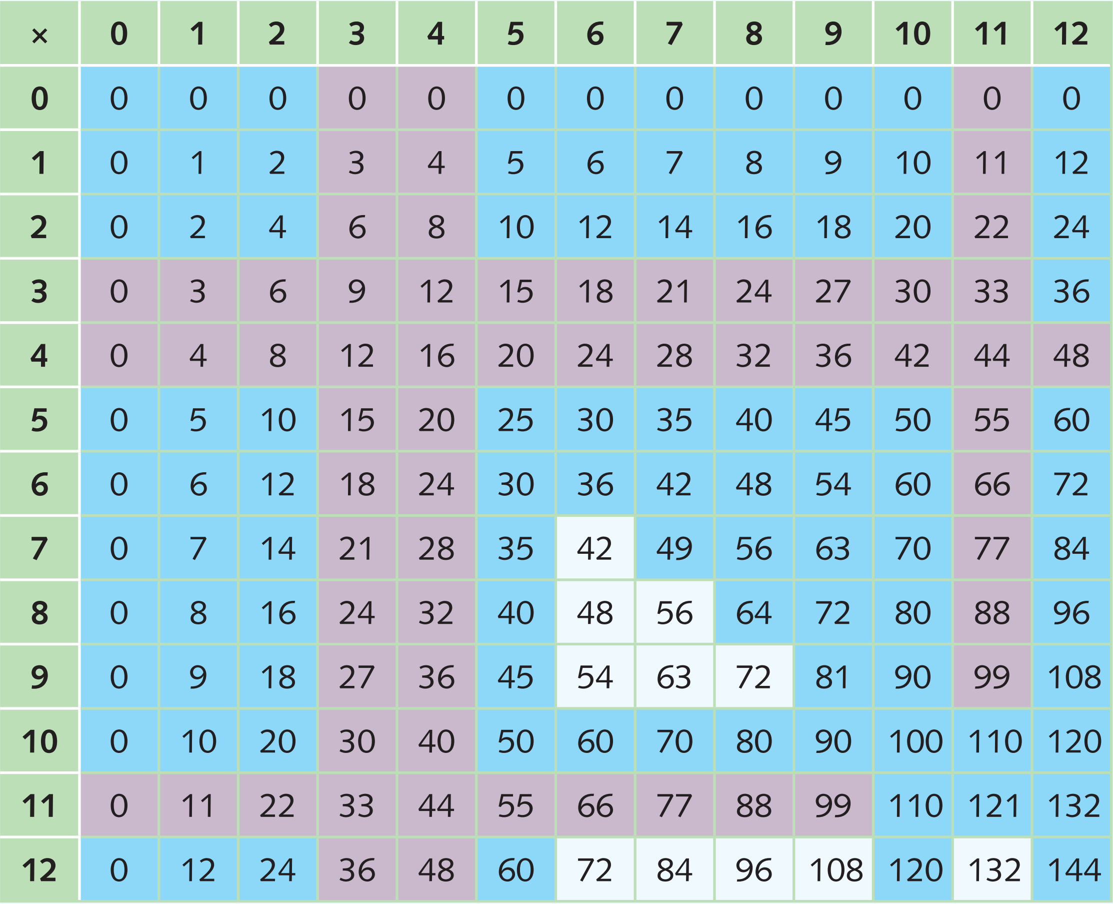
Colour in the multiples of 11 up to 99.

i **Multiplying by 3**

To multiply a number by 3, double the number and then add the number again. For example, 8 × 3: double 8 to get 16, then add 8 to get 24. Multiply the numbers up to 12 by 3, then colour all of the multiples of 3 on your chart.

j **Multiplying by 4**

To multiply a number by 4, you double it, then double it again. For example, to multiply 7 by 4: double 7 to get 14, then double 14 to get 28. Colour in the multiples of 4.



×	0	1	2	3	4	5	6	7	8	9	10	11	12
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10	11	12
2	0	2	4	6	8	10	12	14	16	18	20	22	24
3	0	3	6	9	12	15	18	21	24	27	30	33	36
4	0	4	8	12	16	20	24	28	32	36	42	44	48
5	0	5	10	15	20	25	30	35	40	45	50	55	60
6	0	6	12	18	24	30	36	42	48	54	60	66	72
7	0	7	14	21	28	35	42	49	56	63	70	77	84
8	0	8	16	24	32	40	48	56	64	72	80	88	96
9	0	9	18	27	36	45	54	63	72	81	90	99	108
10	0	10	20	30	40	50	60	70	80	90	100	110	120
11	0	11	22	33	44	55	66	77	88	99	110	121	132
12	0	12	24	36	48	60	72	84	96	108	120	132	144

The numbers that are not coloured are the multiplication facts that you need to work on. List these facts and start learning one or two each week. For example, write ‘7 × 8 = 56’ on a sticker and place it on the television remote control. Then say 7 × 8 = 56 to yourself each time you turn on the television.

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2 Tricky products

Which multiplication facts are the hardest to remember? These are the tricky products. Make a list of these tricky products and think of ways to learn them.

You could choose one product and:

- write it 10 times
- recite it over and over until you ‘get it’
- write it on a sticky note and keep it on your bedroom wall, the television remote control or the breakfast cereal packet.

3 Open sesame

The teacher or one of the students selects a new tricky product each day, such as 7×8. Students have to give the answer to the day’s tricky product before they can ask a question, leave the room or go to lunch. By the end of the day, every student will know the day’s tricky product answer!

4 Leaping on a number line

Allocate students to mixed-ability groups of five.

a You will need sticks of chalk. Draw a number line in the playground. Mark your number line every 10 centimetres or so with the numbers 0 to 100.

b Practise your tables by jumping along the number lines. For example, jump in increments of 3 and call out the answers as you go.

5 **BLM 7:** Play the game ‘Product practice’ (download from the Interactive Textbook).

6 **BLM 8:** Play the game ‘More product practice’ (download from the Interactive Textbook).

3B Individual

1 Multiply each number by 5.

a 6 **b** 9 **c** 11 **d** 10 **e** 8 **f** 7

2 Multiply each number by 3.

a 4 **b** 5 **c** 8 **d** 12 **e** 7 **f** 9

3 Multiply each number by 11.

a 2 **b** 0 **c** 6 **d** 10 **e** 9 **f** 12

4 **a** Ian is coaching the tennis team. He needs 4 tennis balls for every player on his team. How many tennis balls does he need for a team of 9 tennis players?

b Kate has 7 horses in a stable. She needs to give each horse new shoes. How many shoes does she need?

5 John noticed that when he multiplied 4 by 3 and added 3, it was the same as multiplying 5 by 3. Use John's trick to solve these problems. The first one has been done for you.

a If 4 × 3 is 12, what is 5 × 3? $5 \times 3 = 4 \times 3 + 3$
$= 12 + 3$
$= 15$

b If 3 × 3 is 9, what is 4 × 3?
c If 6 × 5 is 30, what is 7 × 5?
d If 5 × 8 is 40, what is 6 × 8?
e If 11 × 4 is 44, what is 12 × 4?
f If 5 × 7 is 35, what is 6 × 7?
g If 7 × 7 is 49, what is 8 × 7?
h If 8 × 8 is 64, what is 9 × 8?
i If 6 × 8 is 48, what is 7 × 8?
j If 8 × 6 is 48, what is 9 × 6?
k If 11 × 8 is 88, what is 12 × 8?
l If 11 × 11 is 121, what is 12 × 11?
m If 11 × 9 is 99, what is 12 × 9?
n If 11 × 6 is 66, what is 12 × 6?
o If 12 × 8 is 96, what is 13 × 8?

6 Chloe noticed that when she multiplied 10 by 6 and subtracted 6, it was the same as multiplying 9 by 6. Use Chloe's idea to solve these problems. The first one has been done for you.

a $10 \times 6 = 60$, so $9 \times 6 = 60 - 6$
$= 54$

b 10 × 8 = ______, so 9 × 8 = ______.
c 10 × 9 = ______, so 9 × 9 = ______.

7 When I multiply a number by 5, it is the same as multiplying by 10 and then dividing by 2. Use this rule to solve the following. The first one has been done.

a $10 \times 8 = 80$, so $5 \times 8 = 80 \div 2$
$= 40$

b 10 × 12 = ______, so 5 × 12 = ______.
c 10 × 7 = ______, so 5 × 7 = ______.

Homework

1 To help you learn your square numbers, ask somebody to ask you to answer these questions.

a 1 × 1
b 2 × 2
c 3 × 3
d 4 × 4
e 5 × 5
f 6 × 6
g 7 × 7
h 8 × 8
i 9 × 9
j 10 × 10
k 11 × 11
l 12 × 12

2 **a** List the perfect squares up to 144.
b Where are the perfect squares on the multiplication chart?
c Try to learn the perfect squares so that you can recall them quickly.

3 List the multiplication tables that you do not know. Select one or two of them and practise them each night for a few days. Ask someone to help you learn them.

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3C Multiples

We get **multiples** when we skip-count. These are some of the multiples of 7:

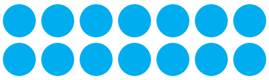
7, 14, 21, 28, 35, 42, 49, 56, 63, 70, 77, 84, 91 …

We get multiples by building up rectangular arrays.

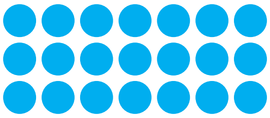
These arrays show the first 6 multiples of 7:

$1 \times 7 = 7$

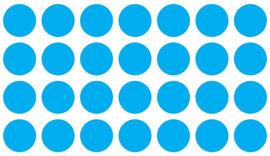
$2 \times 7 = 14$



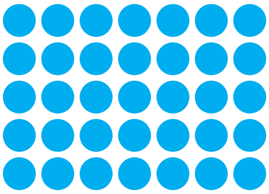
$3 \times 7 = 21$



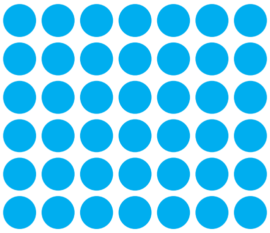
$4 \times 7 = 28$



$5 \times 7 = 35$



$6 \times 7 = 42$



Whenever you multiply a whole number by another whole number, you get a multiple. So we see that 7, 56, 609 and 700 are multiples of 7.

$7 \times 1 = 7$ $\quad$ $7 \times 8 = 56$ $\quad$ $7 \times 87 = 609$ $\quad$ $7 \times 100 = 700$

Example 1

List the first 10 multiples of 8.

Solution

The multiples are the answer to each multiplication fact up to 10×8.

$1 \times 8 = 8$ $\quad$ $2 \times 8 = 16$ $\quad$ $3 \times 8 = 24$ $\quad$ $4 \times 8 = 32$ $\quad$ $5 \times 8 = 40$

$6 \times 8 = 48$ $\quad$ $7 \times 8 = 56$ $\quad$ $8 \times 8 = 64$ $\quad$ $9 \times 8 = 72$ $\quad$ $10 \times 8 = 80$

This is the same as skip-counting by eight, stopping at the tenth number in the sequence.

8, 16, 24, 32, 40, 48, 56, 64, 72, 80

Lowest common multiple (LCM)

Here are the first few multiples of 3 and 4.

3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42, 45 …

4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48 …

The numbers 12, 24, 36 … are in both lists. We say that they are common multiples of both 3 *and* 4.

The **lowest common multiple (LCM)** of 3 and 4 is 12. It is the smallest common multiple. Finding the lowest common multiple will be a useful skill for later on when you start adding fractions.

Example 2

Find the LCM of 3 and 5.

Solution

List the multiples of 3.

3, 6, 9, 12, 15, 18, 21, 24, 27, 30 …

List the multiples of 5.

5, 10, 15, 20, 25, 30 …

The first two common multiples are 15 and 30. The lowest common multiple (LCM) is 15.

3C Whole class CONNECT, APPLY AND BUILD

1 Timed team task

Use a clock with a second hand to keep track of 1-minute intervals. See how far you can get with correct answers in 1 minute when you skip-count by:

a two	**b** five	**c** three	**d** four
e ten	**f** six	**g** twenty	**h** seven
i one hundred	**j** twenty-five	**k** eleven	**l** seventy-five

2 Which numbers between 2 and 18:

a are multiples of 3?

b are multiples of 3 and 4?

c are multiples of 4 but not 3?

d are multiples of 3 but not 4?

3 Invite a student to draw four bags on the board and label them as shown. Discuss as a class how to sort each number from 1 to 28 into the correct bag.

4 Find the LCM of the following pairs of numbers.

a 2 and 3   **b** 3 and 4   **c** 3 and 7
d 4 and 5   **e** 10 and 12

5 True or False?

a The LCM of 4 and 8 is 16.
b The LCM of two numbers is the product of the two numbers.
c The LCM of 3, 4 and 5 is 60.

3C Individual

1 List the first five multiples of:

a 2   **b** 9   **c** 8   **d** 7   **e** 10
f 9   **g** 7   **h** 11   **i** 100   **j** 50

2 List the first 10 multiples of:

a 4   **b** 7   **c** 13   **d** 15   **e** 20
f 25   **g** 75   **h** 21   **i** 60   **j** 125

3 **a** Which of these numbers are multiples of 3?
16, 12, 6, 10, 23, 18, 21, 17, 33, 31, 43, 50, 22
b Which of these numbers are multiples of 5?
12, 10, 52, 45, 34, 25, 100, 28, 105

4 **a** Write the multiples of 3 that are between 20 and 32.
b Write the multiples of 4 that are between 30 and 45.

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5 **a** What is the largest multiple of 5 between 1 and 14?

b What is the largest multiple of 7 between 60 and 68?

6 Draw four bags in your book and label them as shown below. Sort each number from 1 to 36 into the correct bag.

3D Mental strategies

Here are some neat ideas to help you multiply 'in your head'. Read and discuss each strategy. Always try to use the most efficient strategy.

Multiplying by 10

Numbers that are multiples of 10 end in zero. For example:

$1 \times 10 = 10$ $\quad$ $2 \times 10 = 20$ $\quad$ $3 \times 10 = 30$

When we write multiples of 10 in words, the *ty* ending is to remind us of tens.

Thirty is 3 tens. We say thirty because 'threety' is harder to say.

Forty is 4 tens.

To multiply a whole number by 10, place a zero at the end of the number.

$23 \times 10 = 230$ $\quad$ $99 \times 10 = 990$ $\quad$ $789\,302 \times 10 = 7\,893\,020$

Multiplying by 9

If we want to get 9 lots of something, it's easier to find 10 lots and take 1 lot away.

An example is on the next page.

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Example 3

Calculate 9×16.

Solution

9 'lots of' 16 is 10 'lots of' 16 take away 1 'lot of' 16.

$$\begin{aligned} 9 \times 16 &= 10 \times 16 - 1 \times 16 \\ &= 160 - 16 \\ &= 144 \end{aligned}$$

Multiplying by 11

If we want to get 11 lots of something, we find 10 lots and add 1 lot.

Example 4

Calculate 16×11.

Solution

$$\begin{aligned} 16 \times 11 &= 16 \times 10 + 16 \times 1 \\ &= 160 + 16 \\ &= 176 \end{aligned}$$

Multiplying by 20

If we want to multiply by 20, we double the number, then multiply it by 10. This works because $20 = 2 \times 10$.

Example 5

Calculate 12×20.

Solution

$$\begin{aligned} 12 \times 20 &= 12 \times 2 \times 10 \\ &= 24 \times 10 \\ &= 240 \end{aligned}$$

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Multiplying by 6

We can use a shortcut to multiply a number by 6. First multiply the number by 2, then by 3. This works because $6 = 2 \times 3$.

Example 6

Calculate 25×6.

Solution

$$\begin{aligned} 25 \times 6 &= 25 \times 2 \times 3 \\ &= 50 \times 3 \\ &= 150 \end{aligned}$$

Sometimes there is a more efficient strategy.

Example 7

Calculate 19×6.

Solution

You can use a variation of the multiplying-by-20 strategy, because $19 = 20 - 1$:

$$\begin{aligned} 19 \times 6 &= 20 \times 6 - 1 \times 6 \\ &= 120 - 6 \\ &= 114 \end{aligned}$$

There are many different strategies you can use to multiply ‘in your head’. You need to become flexible enough to look at mental arithmetic in different ways.

3D Whole class CONNECT, APPLY AND BUILD

1 Open sesame

The teacher or a student selects a different mental multiplication strategy to work on each day. Students have to give the answer to the day’s mental multiplication strategy – for example, multiply by 9 – before they can ask a question, leave the room or go to lunch. They have to correctly answer a question such as 13×9 and 21×9. By the end of the day, every student will know the day’s mental multiplication strategy!

2 Play a board game such as 'Snakes and Ladders'. Use two dice and multiply the numbers instead of adding them.

3 

Beachball

Write the digits 0–9 on stickers placed randomly on a large beachball. Pass the beachball around the classroom. Whoever catches the ball multiplies the digit nearest to their right thumb by:

a 2 **b** 10 **c** 4 **d** 5 **e** 3 **f** 9 **g** 11

4 Work in pairs to complete each calculation. First, use the suggested strategy. Then think of another way to calculate the answer.

a Calculate 15 × 4 by doubling and doubling again.

b Calculate 13 × 5 by working out 10 lots of 5 and adding 3 lots of 5.

c Calculate 25 × 4 by skip-counting by twenty-five.

3D Individual

1 Mentally multiply each number by 10.

a 18 **b** 56 **c** 789 **d** 200 **e** 4800

2 Mentally multiply each number by 20.

a 8 **b** 9 **c** 11 **d** 15 **e** 16 **f** 50 **g** 21

3 Mentally multiply each number by 4. Remember: the quick way is to double, then double again.

a 7 **b** 8 **c** 9 **d** 11 **e** 50 **f** 25 **g** 75

4 Mentally multiply each number by 9.

a 13 **b** 15 **c** 17 **d** 16 **e** 14 **f** 21 **g** 25

5 Mentally multiply each number by 11.

a 12 **b** 14 **c** 15 **d** 21 **e** 26 **f** 31 **g** 29

6 Mentally multiply each number by 6, by doubling and then multiplying by 3.

a 9 **b** 10 **c** 15 **d** 25 **e** 13 **f** 21 **g** 55

7 **a** If 7 children ate 20 lollies each, how many lollies did they eat in total?

b Hampton Hills school has 9 classes, with 26 children in each class. How many children are there in Hampton Hills school?

8 If there are 11 chocolate biscuits in each packet, how many biscuits in:

a 16 packets? **b** 29 packets? **c** 121 packets?

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9 **a** Write a rule for multiplying any number by 30. Test your rule on five numbers.

b Write a rule for multiplying any number by 300. Test your rule on five numbers.

Reflection

1 List the first 20 multiples of 3.

2 List the first 20 multiples of 4.

3 List the first five common multiples of 3 and 4.

4 Complete this sentence: Numbers which are multiples of 3 *and* 4 are also multiples of ____.

Homework

1 Calculate these 'in your head' as quickly as you can. Write the answers.

a 15 × 10 **b** 10 × 17 **c** 21 × 10 **d** 100 × 10

e 13 × 9 **f** 22 × 9 **g** 24 × 9 **h** 41 × 9

i 18 × 11 **j** 22 × 11 **k** 62 × 11 **l** 73 × 11

m 12 × 20 **n** 13 × 20 **o** 14 × 20 **p** 21 × 20

q 141 × 20 **r** 1800 × 20

2 You now know how to multiply by 10 and by 20. Multiply each of these numbers by 30.

a 12 **b** 13 **c** 14 **d** 21 **e** 50

f 120 **g** Write in words the rule you used.

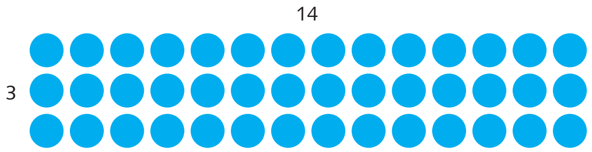
3 Multiply the age of each member of your family by 40. Record your working out.

4 Calculate each of these, then write in words the strategy you used. You might need to use a mix of different strategies.

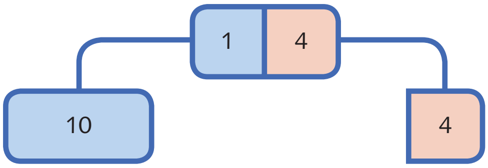
a 19 × 9 **b** 29 × 9 **c** 39 × 9 **d** 49 × 9 **e** 79 × 9 **f** 109 × 9

3E Breaking a multiplication apart

This is the rectangular array for 3 × 14.



We can split 14 into 1 ten and 4 ones.



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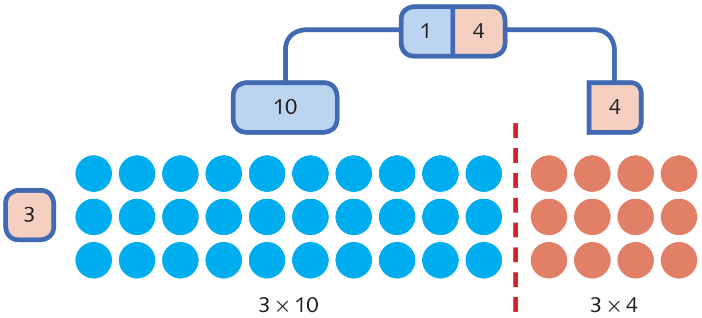
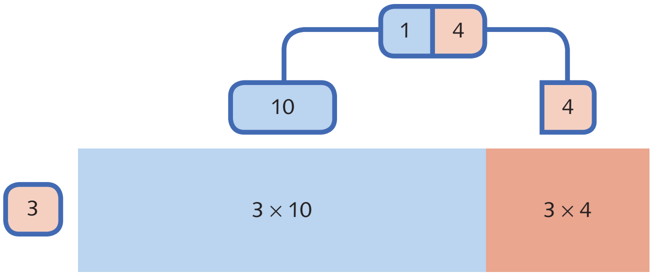
This breaks the array apart to show **multiplication chunks**.



Do the multiplications first, then add the chunks to find the product of 3 and 14.

$$\begin{aligned}3 \times 14 &= 3 \times 10 + 3 \times 4\\ &= 30 + 12\\ &= 42\end{aligned}$$

Instead of drawing arrays, you can draw multiplication diagrams to help you 'see' the multiplication. This multiplication diagram uses the chunks 3 × 10 and 3 × 4 to show 3 × 14.



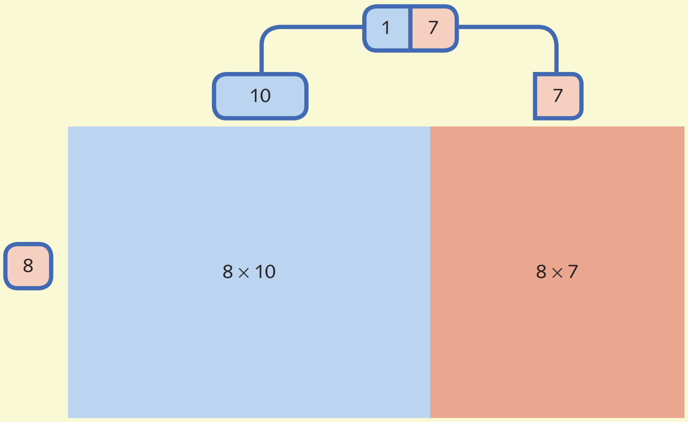
Example 8

Use a multiplication diagram to calculate 8 × 17.

Solution

$$\begin{aligned}8 \times 17 &= 8 \times 10 + 8 \times 7\\ &= 80 + 56\\ &= 136\end{aligned}$$

(Do the multiplication before the addition.)



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With practice, you can do this type of multiplication mentally.

Example 9

Calculate 17 × 4 mentally.

Solution

Split 17 into 10 and 7 and do these steps in your head.

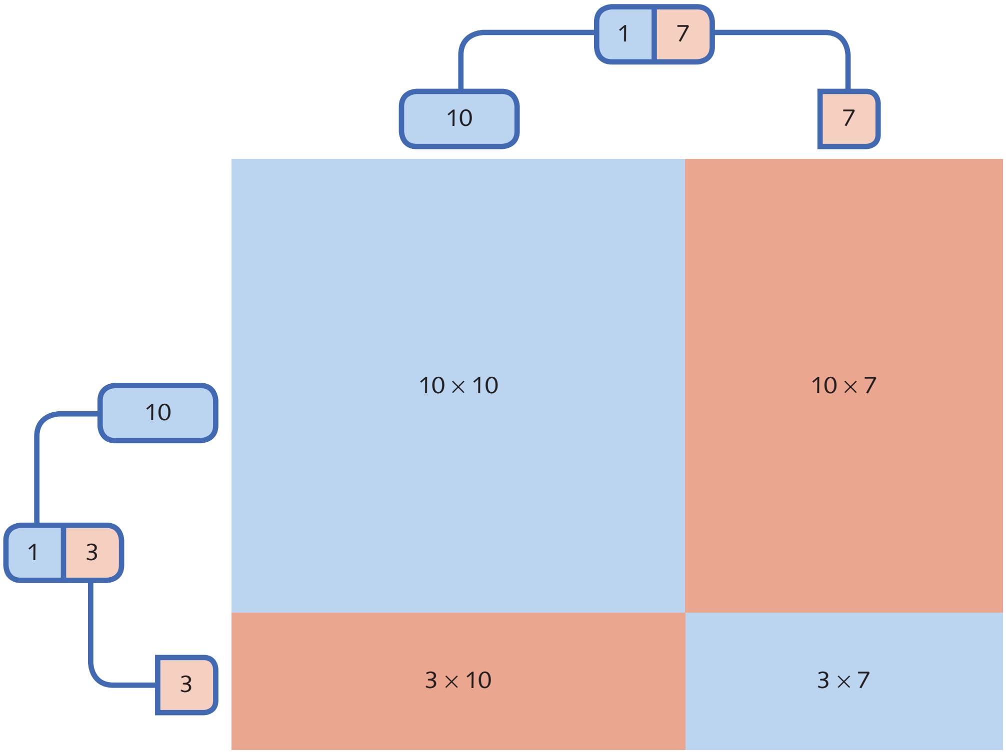
$$\begin{aligned} 17 \times 4 &= 10 \times 4 + 7 \times 4 \quad \text{(Do the multiplications first.)} \\ &= 40 + 28 \\ &= 68 \end{aligned}$$

Multiplying larger numbers

Multiplication diagrams can also be used to break apart larger products.

Here is the multiplication diagram for 13 × 17. It has been shaded to show the chunks.

10 × 10 10 × 7 3 × 10 3 × 7



If we want to draw a multiplication diagram for 13 × 17, we first split the numbers 13 and 17 into tens and ones. This works because 13 = 10 + 3 and 17 = 10 + 7.

Add the products in the chunks to get the product of 13 and 17.

$$\begin{aligned} 13 \times 17 &= 10 \times 10 + 10 \times 7 + 3 \times 10 + 3 \times 7 \\ &= 100 + 70 + 30 + 21 \\ &= 221 \end{aligned}$$

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Example 10

a Draw a multiplication diagram to find the product of 16 × 19.

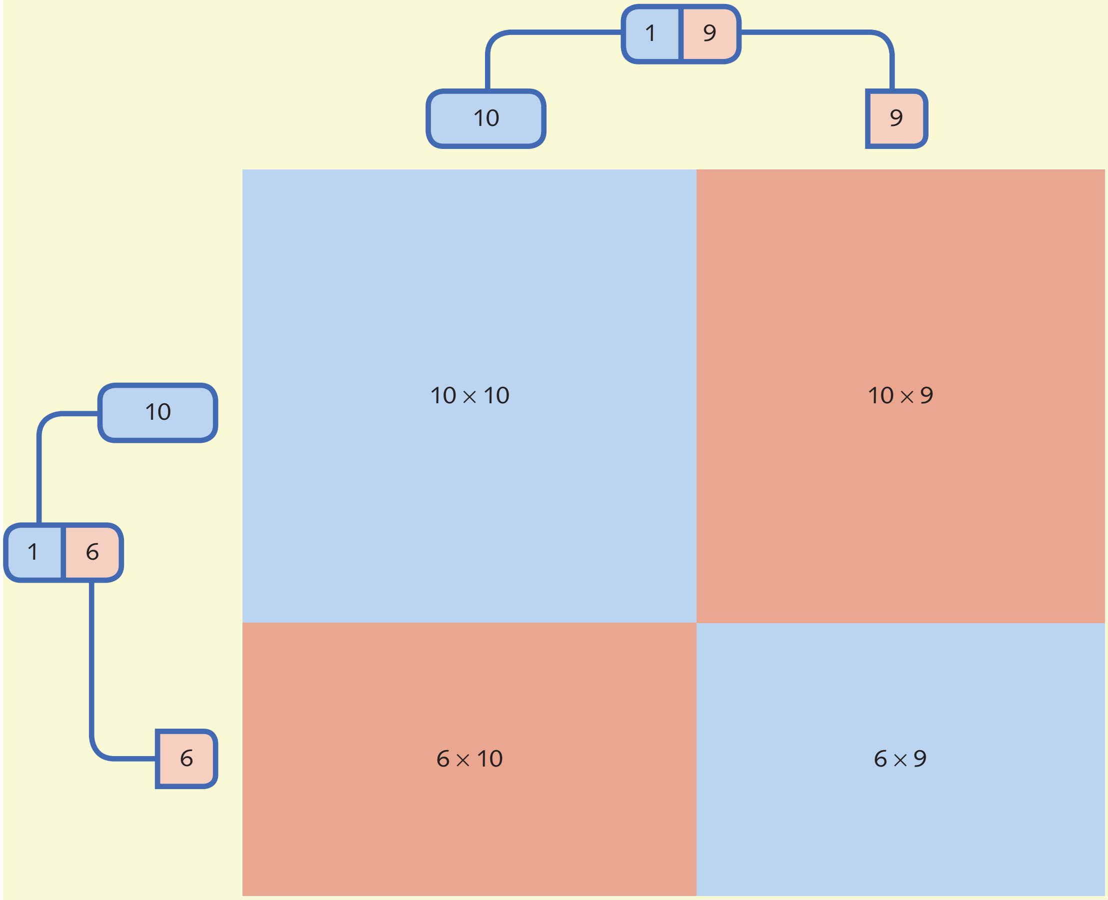
b Show 16 and 19 split into tens and ones. Show the chunks you get when you split the numbers into tens and ones.

c Write the products inside each chunk.

d Calculate the products and find their sum. This is the answer to the multiplication 16 × 19.

Solution

a, b, c



d $16 \times 19 = 10 \times 10 + 10 \times 9 + 6 \times 10 + 6 \times 9$

$= 100 + 90 + 60 + 54$

$= 304$

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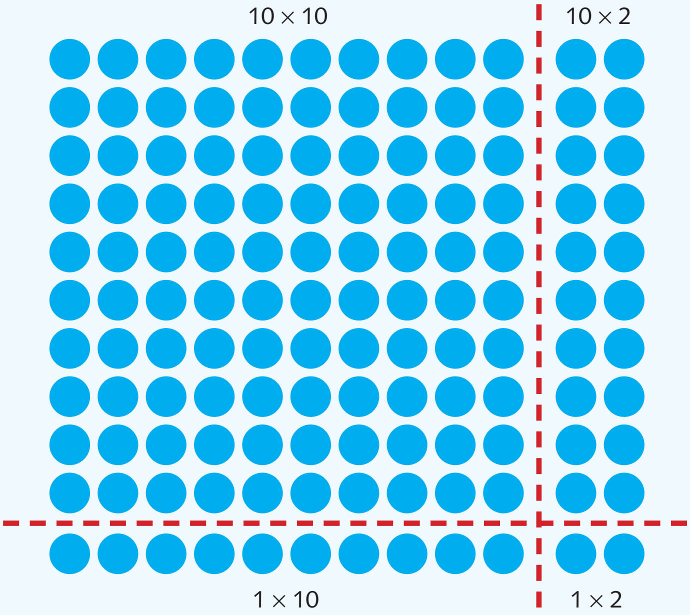
3E Whole class CONNECT, APPLY AND BUILD

1 Use counters to make rectangular arrays for the products below. Then use a ruler or string to show how each number can be split into tens and ones, as shown.

Find the product by calculating the sum of the products written beside each chunk. The first one has been done for you.

a 11 × 12



$$\begin{aligned} 11 \times 12 &= 10 \times 10 + 10 \times 2 + 1 \times 10 + 1 \times 2 \\ &= 100 + 20 + 10 + 2 \\ &= 132 \end{aligned}$$

b 13 × 7 **c** 6 × 15 **d** 23 × 5 **e** 34 × 21

2 Draw multiplication diagrams for the products below, then solve them in the same way as question **1**.

a 23 × 13 **b** 36 × 19 **c** 72 × 28

3E Individual

1 Download **BLM 9** ‘Multiplication diagrams’ from the Interactive Textbook and complete.

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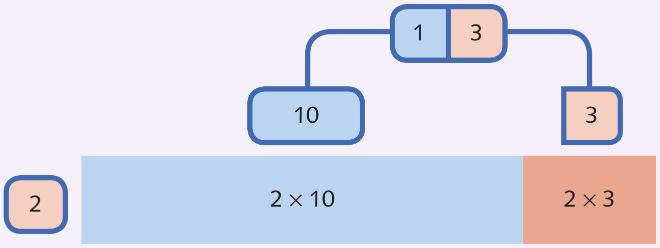
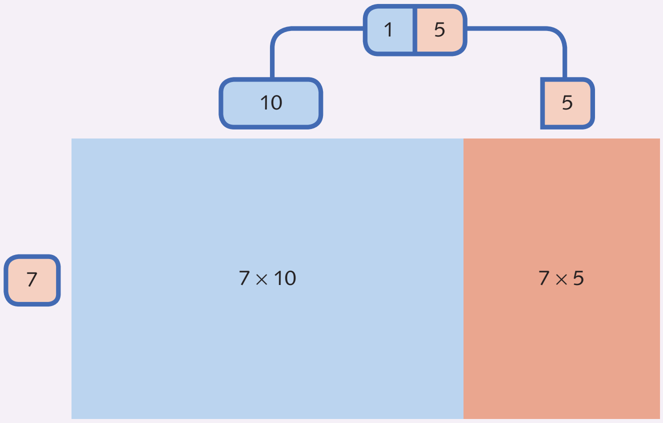
2 Copy these multiplication diagrams, then complete each multiplication by writing the missing numbers.

a



$$\begin{aligned} 2 \times 13 &= 2 \times \_\_ + 2 \times 3 \\ &= \_\_ + 6 \\ &= 26 \end{aligned}$$

b



$$\begin{aligned} 7 \times 15 &= \_\_ \times 10 + \_\_ \times 5 \\ &= 70 + \_\_\_ \\ &= \_\_\_ \end{aligned}$$

3 **a** Draw a multiplication diagram for 21 × 4.

b Shade and label your multiplication diagram to show the numbers split into tens and ones. Write the product for each chunk.

c Add the two products to calculate 21 × 4.

4 Draw a multiplication diagram to show each product. Shade and label the product for each chunk. Work out the answers.

a 32 × 12 **b** 21 × 43 **c** 38 × 41 **d** 23 × 92

5 Use a multiplication diagram to calculate 34 × 26.

Homework

1 **a** Ask someone to give you two numbers that are greater than 50.

b Draw a multiplication diagram for the product of the two numbers. Shade and label the multiplication diagram, then calculate the product of the two numbers.

c Ask someone to help you check your diagram.

d Show your diagram to your classmates when you get back to school.

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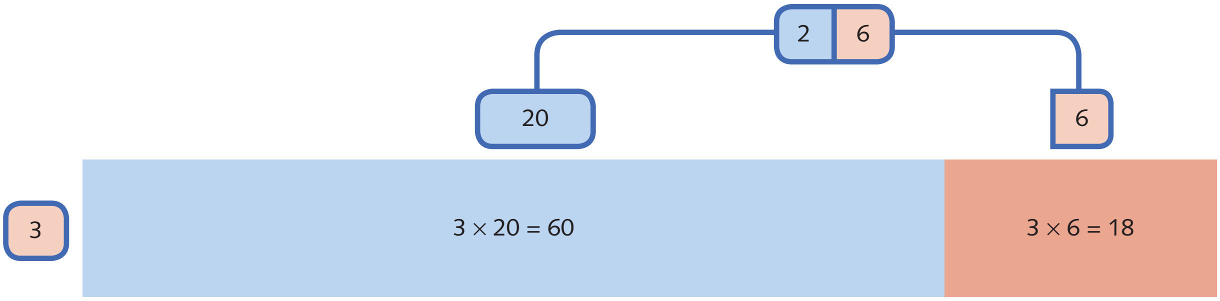
3F Multiplication by a single-digit number

The multiplication **algorithm** is a quick way to show what we did with the multiplication diagrams. An algorithm is like a recipe that gives you steps to follow.

We can use a multiplication diagram to see that 26 × 3 is 78.



Or we can use the multiplication algorithm. To calculate 26 × 3, set out the numbers according to the place value of their digits.

	Tens	Ones
	2_1	6
×		3
		8

First, we work with the ones.

We say 3 × 6 is 18.

We know 18 is 1 ten and 8 ones, so we write 8 in the ones column and carry the 1 to the tens column.

	Tens	Ones
	2_1	6
×		3
	7	8

Now we go to the tens column.

We say 3 times 2 is 6. Add the carried 1 to the 6 to give 7. Write 7 in the tens column.

What we are actually doing is multiplying 3 by 2 tens. Then we add the 1 ten carried before. That is why we put 7 in the tens column.

We get this answer:

$$26 \times 3 = 78$$

We can do the same kind of multiplication with a 3-digit number, like in the example on the next page.

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Example 11

Multiply 103 by 6 using the multiplication algorithm.

Solution

$$\begin{array}{r} 1\,0_1\,3 \\ \times \qquad 6 \\ \hline 6\,1\,8 \\ \hline \end{array}$$

Start with the ones.
Say '6 times 3 is 18'. 18 is 8 ones plus 1 ten.
Write 8 in the ones column and carry the 1 ten.
Multiply 6 by 0, which is 0, then add the carried 1.
Write 1 in the tens column.
Multiply 6 by 1. Write 6 in the hundreds column.
The answer to 103 × 6 is 618.

3F Whole class CONNECT, APPLY AND BUILD

1 Draw a multiplication diagram on the board for each of these, then shade and label the product in each chunk. Discuss how each diagram connects to the multiplication algorithm.

a 13 × 4 **b** 21 × 5 **c** 78 × 9

2 These products can be solved using the multiplication algorithm. Work through each multiplication as a class. Which ones did you do without any carrying? What happened when you had a zero?

a 14 × 3 **b** 17 × 5 **c** 31 × 4 **d** 46 × 7

e 60 × 3 **f** 98 × 8 **g** 122 × 3 **h** 120 × 4

3 Each person in a class of 26 students eats 4 slices of bread every day. How many slices of bread does the whole class eat in one day?

a Calculate this using the multiplication algorithm.

b Calculate this mentally.

c Discuss the different mental strategies used.

4 Calculate each of these using the multiplication algorithm.

a How many legs do 3947 chickens have?

b How many vertices do 49 643 triangles have?

c How many legs do 78 994 spiders have?

d How many vertices do 593 574 hexagons have?

e How many legs do 233 995 ants have?

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3F Individual

1 Use the multiplication algorithm to calculate each product. These have no carrying.

a 14 × 2 **b** 13 × 3 **c** 21 × 4 **d** 31 × 3

These carry from the ones into the tens.

e 16 × 4 **f** 23 × 4 **g** 12 × 6 **h** 34 × 3

These carry from the tens into the hundreds.

i 61 × 3 **j** 41 × 9 **k** 72 × 4 **l** 83 × 3

These carry in the ones, tens and hundreds.

m 32 × 9 **n** 68 × 7 **o** 78 × 6 **p** 84 × 9

These multiply by a multiple of 10.

q 50 × 7 **r** 80 × 6 **s** 130 × 4 **t** 560 × 8

These involve numbers in the hundreds and thousands.

u 343 × 2 **v** 1201 × 4 **w** 5693 × 3 **x** 8874 × 7

2 Gobstoppers come in packets of 7. How many gobstoppers are there in:

a 13 packets? **b** 28 packets? **c** 53 packets? **d** 87 packets?

3 A group of 8 boys counted their toy cars. Each boy had 32 cars. How many cars were there in total?

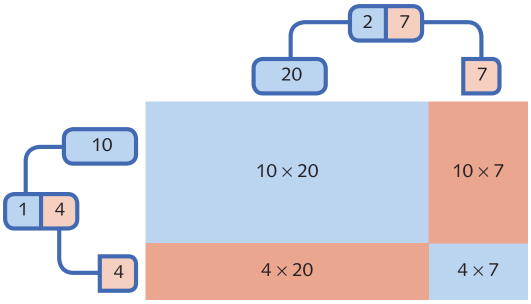
4 During the holidays, 17 friends saw 9 movies each. How many movie tickets did they buy altogether?

5 Helen's front yard has 39 rows of 8 concrete pavers. How many concrete pavers are there in total?

3G Multiplication by a 2-digit number

The standard algorithm for multiplying by a number with two or more digits is known as **long multiplication**.

On the right is a multiplication diagram for the product 14 × 27.



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The sum of the products in the chunks is:

$$\begin{aligned} 14 \times 27 &= 10 \times 20 + 10 \times 7 + 4 \times 20 + 4 \times 7 \\ &= 200 + 70 + 80 + 28 \\ &= 378 \end{aligned}$$

Long multiplication is a quicker way of doing the same thing.

	Hundreds	Tens	Ones
		1_2	4
×		2	7
			8

First, set out the numbers so the digits line up according to their place value.

Start with the ones. Multiply the ones digit in 27 by the ones digit in 14.

Say '7 times 4 is 28'. Write 8 in the ones column and carry the 2 into the tens column.

	Hundreds	Tens	Ones
		1_2	4
×		2	7
		9	8

Now work with the tens. Multiply 7 (the ones digit in 27) by 1 (the tens digit in 14).

Say '7 times 1 is 7', meaning 7 times 1 ten is 7 tens.

Add the 2 you carried from before, making 9 tens.

Write 9 in the tens column.

	Hundreds	Tens	Ones
		1_2	4
×		2	7
		9	8
		8	0

Now multiply 2 (the tens digit in 27) by 4 (the ones digit in 14). This will give a certain number of tens. So write 0 in the ones column *now*.

Say '2 times 4 is 8', meaning 2 tens times 4 is 8 tens.

Write 8 in the tens column.

	Hundreds	Tens	Ones
		1_2	4
×		2	7
		9	8
		8	0

Next, multiply 2 (the tens digit in 27) by 1 (the tens digit in 14).

Say '2 times 1 is 2', meaning 2 tens times 1 ten is 2 hundreds.

Write 2 in the hundreds column.

	Hundreds	Tens	Ones
		1_2	4
×		2	7
		9	8
	$^{1}2$	8	0
	3	7	8

The final step is to add 280 to 98.

The product of 14 × 27 is 378.

Example 12

Calculate 123 × 45.

Solution

$$\begin{array}{rrrr} & 1_1 & 2^1_1 & 3 \\ \times & & 4 & 5 \\ \hline & {}^{1}6 & 1 & 5 \\ 4 & 9 & 2 & 0 \\ \hline 5 & 5 & 3 & 5 \\ \hline \end{array}$$

The first carry:
We say '5 × 3 = 15'
Write down 5 and carry 1.

Multiplication algorithms can be extended to numbers with any number of digits.

3G Whole class CONNECT, APPLY AND BUILD

1 Draw a multiplication diagram for each product. Then discuss how the diagram relates to the long multiplication algorithm for each product.

a 12 × 12 **b** 21 × 39 **c** 78 × 91

2 These products can be calculated using the long multiplication algorithm. Work through each one as a class.

a 14 × 12 **b** 32 × 21 **c** 11 × 47

3 Calculate the total number of each item if each person in your class eats:

a 14 biscuits **b** 28 apples **c** 143 chicken nuggets

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3G Individual

1 Use the long multiplication algorithm to calculate these products.

a 13 × 12 **b** 14 × 21 **c** 22 × 13 **d** 44 × 22

e 19 × 21 **f** 12 × 61 **g** 15 × 21 **h** 12 × 17

2 Twelve children each own 18 T-shirts. How many T-shirts are there in total?

3 Sixteen students earned $14 each over the holidays. How much did they earn in total?

4 There are 27 rows of gum trees in a plantation. If there are 16 trees in each row, how many trees are there in total?

5 Calculate these products.

a 35 × 17 **b** 24 × 18 **c** 19 × 26 **d** 26 × 34

e 83 × 37 **f** 61 × 28 **g** 64 × 30 **h** 19 × 91

6 Peter rides 18 kilometres each day. How far does he ride in:

a 1 week? **b** 28 days? **c** 13 weeks?

7 Rhiannon earns $36 per hour. How much does she earn if she works:

a 3 hours? **b** 17 hours? **c** 24 hours?

d 8 shifts, each 7 hours long? **e** 25 shifts, each 9 hours long?

8 Calculate:

a 146 × 13 + 217 × 8 **b** 464 × 7 – 29 × 24 **c** 85 × 73 + 215 × 4

9 Danny measured his heart rate as 127 beats per minute. If his heart beats at the same rate, how many times will it beat in:

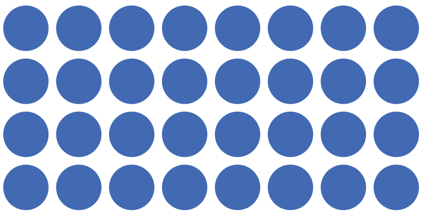
a 4 minutes? **b** 72 minutes? **c** 923 minutes?

d 1 hour? **e** 5 hours? **f** 7 hours 23 minutes?

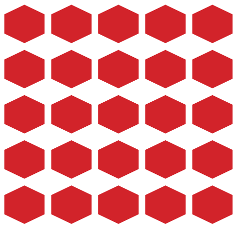
3H Review questions

1 Write the product for each array.

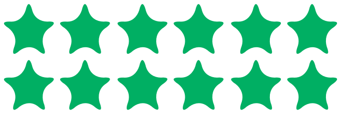
a



b



c



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2 Draw a rectangular array for each product, then write the answer.

a 6 × 7 = ____ **b** 8 × 9 = ____ **c** 18 × 3 = ____

3 Draw the possible rectangular arrays for 36. Write the product for each array.

4 Draw a picture of a car park with 8 rows of 4 cars. How many cars are there?

5 Mentally multiply each number by 4.

a 6 **b** 9 **c** 11 **d** 10 **e** 8

6 Mentally multiply each number by 6.

a 2 **b** 0 **c** 6 **d** 10 **e** 9

7 Mentally multiply each number by 20.

a 13 **b** 15 **c** 17 **d** 25 **e** 43

8 There are 9 chocolate biscuits in each packet of Crunchy Biscuits. How many biscuits are there in:

a 14 packets? **b** 32 packets? **c** 144 packets?

9 Rohan noticed that when he multiplied 4 × 3 and added 3, it was the same as multiplying 5 × 3. Use Rohan's trick to solve these.

a If 5 × 3 is 15, what is 6 × 3? **b** If 8 × 4 is 32, what is 9 × 4?

c If 6 × 8 is 48, what is 7 × 8? **d** If 8 × 8 is 64, what is 9 × 8?

e If 12 × 8 is 96, what is 12 × 9? **f** If 11 × 11 is 121, what is 11 × 12?

10 List the first five multiples of:

a 6 **b** 4 **c** 7 **d** 25 **e** 50

11 Draw a multiplication diagram to illustrate each product. Then shade and label the products in each chunk.

a 12 × 8 **b** 19 × 5 **c** 15 × 11

12 Use a multiplication diagram to calculate 27 × 43.

13 Calculate these products.

a 85 × 7 **b** 120 × 18 **c** 149 × 26 **d** 26 × 800

e 88 × 87 **f** 61 × 28 **g** 60 × 80 **h** 9 × 91

14 Last year, the 23 students in Steven's class read 48 books each. How many books did they read in total?

15 Kailani's backyard has 72 rows of 198 concrete pavers. What is the total number of concrete pavers?

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CHAPTER 4 Preparation

Useful skill for this chapter:

- knowledge of the multiplication tables to 12 × 12.
  (For skill consolidation activities see **3B** ‘The multiplication table’ on page 48.)

KICK OFF

You will need a hundred chart, a 10-sided die and a number of counters of the same colour for each player. Use a different colour for each player. Work in groups of three or four.

Take turns rolling the 10-sided die. For each turn, say three numbers that are multiples of the number rolled. Cover the three multiples with your counters on the hundred chart. If a number is already covered, you need to think of another number. If you cannot think of three multiples that are on the hundred chart, you miss a turn and do not cover any numbers. The first person with nine counters on the chart is the winner.

Show what you know

1 Solve the following questions mentally and then sort each answer into the correct paper bag.

- 2×12
- The number of threes in 30
- The product of 12 and 3
- The difference between 25 and 20
- $40 \div 10$
- 3×36
- 12×7
- The sum of 25 and 20

CHAPTER

4

Number and Algebra

Division

Whenever we share something equally with other people we are using **division**.

For example, when we share a packet of lollies equally among some friends we are using division.

There are 24 lollies in a packet. If four friends want to share the lollies, we can give them out one at a time, so that everyone has one lolly.

There are still lollies left, so we give everyone another lolly so that they have two each. We can keep sharing them out so that everyone has three each, then four each, then five each. Finally, each friend has six lollies and there are no more to share out.

Division is about splitting or sharing quantities equally.

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4A Factors and prime numbers

Factors

Six stars can be arranged in rectangular arrays in different ways.

three rows of two

$6 = 3 \times 2$

two rows of three

$6 = 2 \times 3$

six rows of one

$6 = 1 \times 6$

one row of six

$6 = 6 \times 1$

We describe the rectangular arrays using multiplication. The product of these pairs of numbers is 6.

$$3 \times 2 = 6 \qquad 2 \times 3 = 6 \qquad 6 \times 1 = 6 \qquad 1 \times 6 = 6$$

We say that the numbers 1, 2, 3 and 6 are **factors** of 6. The number 2 is a factor of 6 because we can find a number to multiply by 2 to give 6.

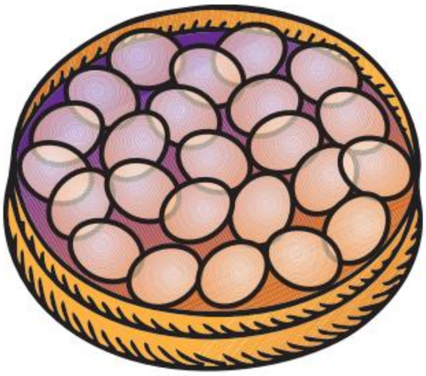
Arrays

Every whole number has at least two factors.

Let's look at how arrays can be used to find the factors of a number.

Here are 24 eggs.

Can we arrange 24 eggs into a rectangular array? In how many different ways can this be done? When we find all of the possible arrays for 24, we get the factors of 24.



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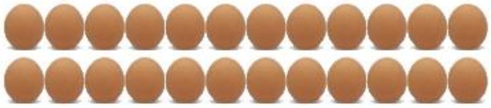
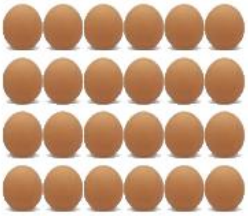
Here are the possible arrays for 24.

1 × 24 = 24



2 × 12 = 24

3 × 8 = 24

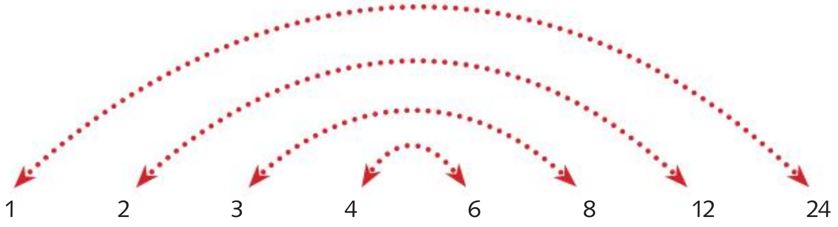


4 × 6 = 24

Of course, writing 1 × 24 = 24 is the same as writing 24 × 1 = 24, and 3 × 8 is the same as writing 8 × 3, and so on.

From now on we will write 1 × 24 when we mean either 1 × 24 or 24 × 1.

It's a good idea to pair the factors to remind you which other factor you multiply by to get the original number.



The numbers 1, 2, 3, 4, 6, 8, 12 and 24 are the factors of 24.
The number 24 is a multiple of each of its factors.

Example 1

a Draw the possible rectangular arrays for 20 and label them with the corresponding multiplication.

b List the factors of 20, pairing them to make sure that you have them all.

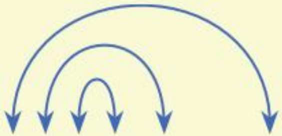
Solution

a

1 × 20

2 × 10

4 × 5



b The factors of 20 are 1, 2, 4, 5, 10 and 20.

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Multiplication table

We can see factors on the multiplication table. To find the factors of 36, we look for 36 within the multiplication table. We follow the column up and the row to the left to find numbers that have 36 as their product.

×	0	1	2	3	4	5	6	7	8	9	10	11	12
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10	11	12
2	0	2	4	6	8	10	12	14	16	18	20	22	24
3	0	3	6	9	12	15	18	21	24	27	30	33	36
4	0	4	8	12	16	20	24	28	32	36	42	44	48
5	0	5	10	15	20	25	30	35	40	45	50	55	60
6	0	6	12	18	24	30	36	42	48	54	60	66	72
7	0	7	14	21	28	35	42	49	56	63	70	77	84
8	0	8	16	24	32	40	48	56	64	72	80	88	96
9	0	9	18	27	36	45	54	63	72	81	90	99	108
10	0	10	20	30	40	50	60	70	80	90	100	110	120
11	0	11	22	33	44	55	66	77	88	99	110	121	132
12	0	12	24	36	48	60	72	84	96	108	120	132	144

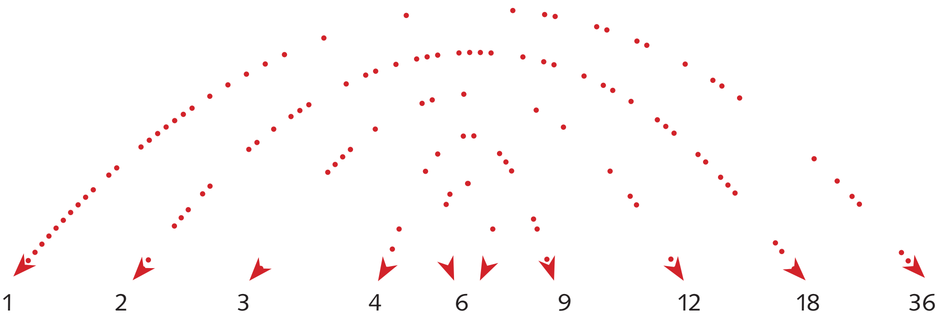
We know there are some repeated facts. We also know that 1 × 36 is 36 and 2 × 18 is 36, though these factors are not on the multiplication table.

Factors appear on this multiplication table if both factors are less than 13.

The numbers that multiply to give 36 are:

$3 \times 12 = 36$ $9 \times 4 = 36$ $6 \times 6 = 36$ and $1 \times 36 = 36$ $2 \times 18 = 36$

Again, pairing the factors helps us make sure that we have them all.
The factors of 36 are:



Note that 6 × 6 is 36, so 6 is paired with itself.

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Example 2

a Locate 15 on the multiplication table.

b Write all the products that have 15 as the answer.

c List the factors of 15, pairing them to make sure that you have them all.

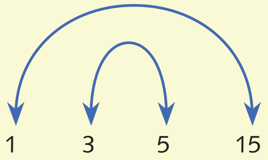
Solution

x	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10	11	12
2	0	2	4	6	8	10	12	14	16	18	20	22	24
3	0	3	6	9	12	15	18	21	24	27	30	33	36
4	0	4	8	12	16	20	24	28	32	36	42	44	48
5	0	5	10	15	20	25	30	35	40	45	50	55	60
6	0	6	12	18	24	30	36	42	48	54	60	66	72
7	0	7	14	21	28	35	42	49	56	63	70	77	84
8	0	8	16	24	32	40	48	56	64	72	80	88	96
9	0	9	18	27	36	45	54	63	72	81	90	99	108
10	0	10	20	30	40	50	60	70	80	90	100	110	120
11	0	11	22	33	44	55	66	77	88	99	110	121	132
12	0	12	24	36	48	60	72	84	96	108	120	132	144

a Locate 15 on the multiplication table.

b 3 × 5 is shown on the multiplication table.
1 × 15 is a product with 15 as the answer (not shown on the multiplication table).

c



Prime numbers

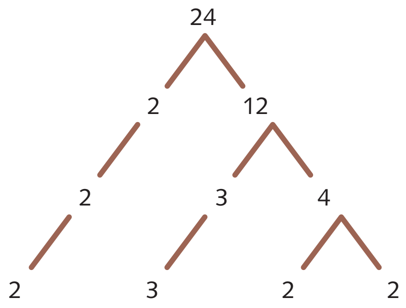
A **prime number** is a number with only two factors: itself and 1. Complete question **6** in the whole-class activities to find out more about the prime numbers less than 100.

Numbers that are not prime are called **composite numbers**. The number 1 is neither prime nor composite.

Factor trees

Factor trees are used to help us find the **prime** factors of a number. Factor trees do not always give us all of the factors of that number.

In this example, 24 is first split into 12 and 2. Then each of these is split into its factors until it cannot be split further.



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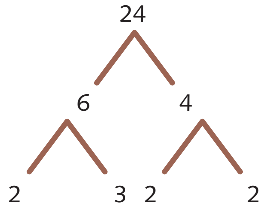
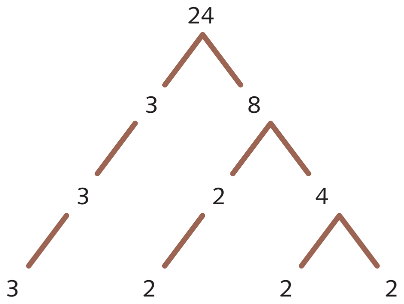
It is not always necessary to start with the smallest and largest factors (other than the number itself and 1). Sometimes it is helpful to start with a factor you know.





Do you notice something about the last row in each factor tree? They are all prime numbers.

What is their product?

$2 \times 2 \times 2 \times 3 = 24$

We split the numbers until we can go no further and we write 24 = 2 × 2 × 2 × 3. This is known as the **prime factorisation** of 24. We could swap the factors around so that we get 24 = 2 × 3 × 2 × 2 or 24 = 3 × 2 × 2 × 2. Each of these are the same, except the order of the factors is different.

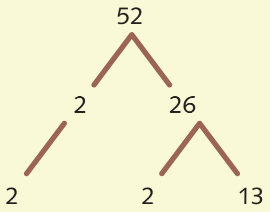
We can see that even though the factor trees are different, they all give us the prime factorisation for 24.

Each number has exactly one prime factorisation if we write the primes in increasing order. Mathematicians say that the prime factorisation of each number is *unique*.

Example 3

Draw a factor tree for 52. Check that your working is correct by multiplying the numbers in the last row.

Solution



$$\begin{aligned} 2 \times 2 \times 13 &= 2 \times 26 \\ &= 52 \end{aligned}$$

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Remember

When we write a number as a product of two numbers, those two numbers are factors of the first number.

A number with only two factors – itself and 1 – is a prime number.

A composite number has more than two factors.

The number 1 is neither prime nor composite.

Factor trees help us find the prime factors of a number.

Every number has a unique prime factorisation, with primes written in increasing order.

4A Whole class CONNECT, APPLY AND BUILD

1 Draw rectangular arrays for the numbers 1 to 30. Each person could have responsibility for a different number. Some numbers will have more than one possible array. Use counters or bottle tops to help you find the possibilities.

Write statements about your arrays using mathematical language, symbols and numbers.

Discuss the different arrangements as a class. What do you notice? Which numbers have only one array? What is the connection between the number of arrays a number has and its factors?

2 Work with a partner to find all factors of each number, pairing the factors to make sure you have them all.

a 15 **b** 12 **c** 30 **d** 33 **e** 72

3 **a** List the factors for each number from 1 to 20.

b Label each number from 2 to 20 as either a prime number or a composite number.

4 Draw factor trees for these numbers.

a 45 **b** 72 **c** 1680 **d** 1000

5 Find four 2-digit numbers that have both digits as factors. 15 is one such number, but 82 is not.

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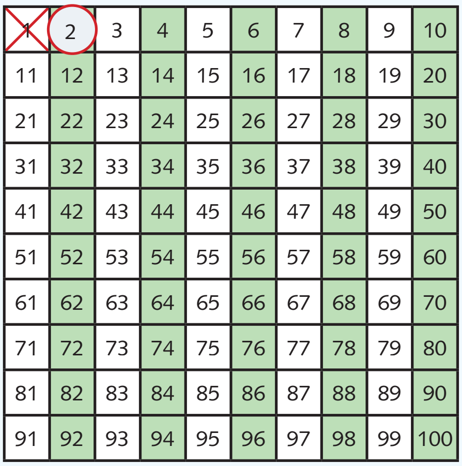
6 Prime numbers less than 100

In this activity you are going to work out which numbers between 1 and 100 are prime. Remember that 1 is not prime. Any other number larger than 1 is prime if it has only two factors: itself and 1. This strategy is an ancient algorithm for finding prime numbers called the Sieve of Eratosthenes. Eratosthenes lived around 500 BCE.

a You will need a 1 to 100 chart like this. Cross out 1 because it is neither prime nor composite.

b Start with the number 2. It is prime. Put a circle around it. Then colour in all of the multiples of 2 larger than 2 because they are composite. Your chart should now look like this.

c Go to the next number that has not been coloured in. It is 3. Circle it because 3 is prime. Now cross out all of the numbers larger than 3 that are multiples of 3 and not already coloured in.



1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

d Continue in this way until you cannot go any further. Circle all of the prime numbers on your chart.

e The numbers that have circles around them when you have finished are the prime numbers less than 100. List them.

4A Individual

1 **a** Which factor is paired with 3 to give 6?

b Which factor is paired with 5 to give 15?

c Which factor is paired with 10 to give 90?

d Which factor is paired with 8 to give 24?

2 **a** List the factors of 30.

b List the factors of 36.

c Draw four bags in your book as shown. Sort each number from 1 to 36 into the correct bag.

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3 Ari and Min can share a packet of 30 lollies equally among their children. How many children might Ari and Min have?

4 Which group sizes are possible if a class of 28 children is to be divided into equal-sized groups?

5 How many rectangular arrays can be drawn for each number?

a 7　**b** 17　**c** 23　**d** 29

e Write the factors of each number.

f What do you notice?

g What are these numbers called?

6 What are the prime numbers between 20 and 30?

7 List the prime numbers between 40 and 50.

8 Find the prime number that is closest to:

a 40　**b** 50　**c** 60

9 List the prime numbers less than 100 that contain the digit 4.

10 Why does a prime that is not 5 never end in 5 or 0?

11 Why is 327 not prime?

12 Find the next prime number after 110.

13 Draw factor trees for these numbers and give the prime factorisation for each one.

a 30　**b** 84　**c** 63　**d** 44　**e** 120

f 444　**g** 396　**h** 176　**i** 261　**j** 7000

14 Here is the last row of some factor trees. What number did they start with?

a $2 \times 3 \times 5$　**b** $5 \times 2 \times 7 \times 2$　**c** $3 \times 3 \times 11$

d $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$　**e** $2 \times 3 \times 5 \times 7 \times 11$

Homework

1 List the factors of each number. Draw arrays to help you if necessary.

a 8　**b** 7　**c** 9　**d** 16　**e** 50

2 Draw factor trees for these numbers and write the prime factorisation for each one.

a 38　**b** 648　**c** 2420

4B Making a connection between multiplication and division

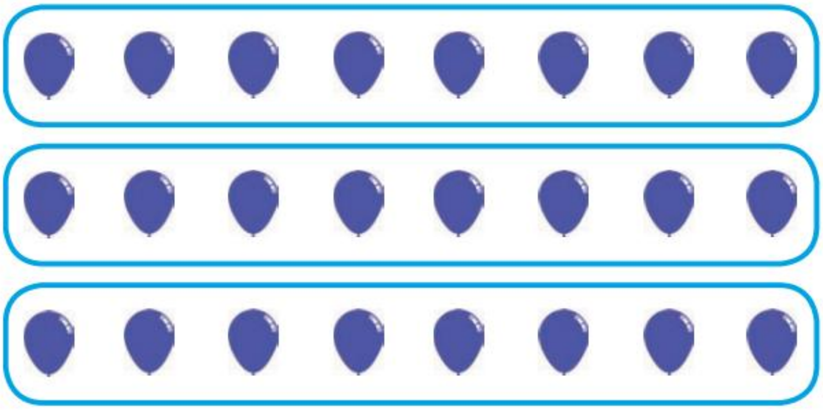
If we have a number of balloons to share equally, we can do it in two ways.

1 How many groups?

If we have 24 balloons and we give 8 balloons to each child, how many children are there?

If we split 24 balloons into groups of 8, three children get 8 balloons each.

We can draw an array to show this.



3 lots of 8 make 24, or we can write $3 \times 8 = 24$.

We say that '24 divided by 8 is 3' because we can break up 24 into 3 equal groups of 8. We write the division like this:

$24 \div 8 = 3$

The symbol $\div$ is used for division and means 'divided by' or 'how many groups'.

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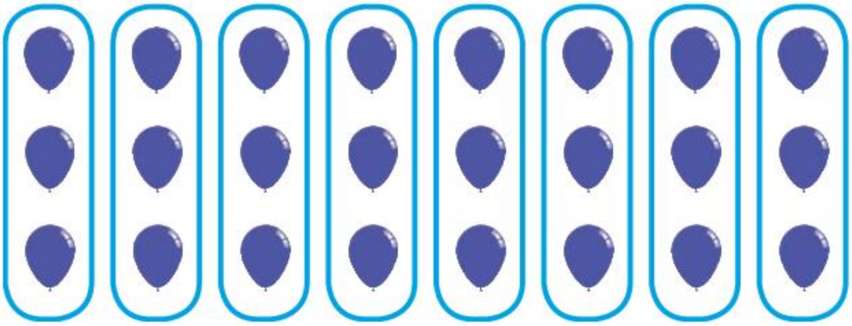
2 How many in each group?

If we share 24 balloons among 8 children, how many does each child receive?

We want to make 8 equal groups. We do this by handing out one balloon to each child. This uses 8 balloons. Then we do the same again. We can do this 3 times, so each child gets 3 balloons.

We can see this from the array.



We can write this in different ways.

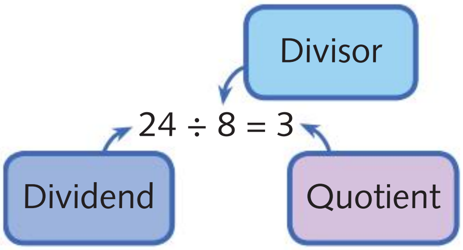
8 lots of 3 make 24 $8 \times 3 = 24$ $24 \div 8 = 3$

So dividing 24 by 8 is the same as asking:

'Which number do I multiply 8 by to get 24?'

Some special names

In the division, 24 is the **dividend**, 8 is the **divisor** and 3 is the **quotient**.



The divisor is the number you divide by.

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Inverse operations

We say that division is the **inverse operation** to multiplication. For example, taking off your shoes is the inverse of putting them on. Mathematically, we mean division undoes multiplication.

As soon as you know a multiplication, you immediately get two division facts.

Let's look at the multiplication table.

×	0	1	2	3	4	5	6	7	8	9	10	11	12
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10	11	12
2	0	2	4	6	8	10	12	14	16	18	20	22	24
3	0	3	6	9	12	15	18	21	24	27	30	33	36
4	0	4	8	12	16	20	24	28	32	36	42	44	48
5	0	5	10	15	20	25	30	35	40	45	50	55	60
6	0	6	12	18	24	30	36	42	48	54	60	66	72
7	0	7	14	21	28	35	42	49	56	63	70	77	84
8	0	8	16	24	32	40	48	56	64	72	80	88	96
9	0	9	18	27	36	45	54	63	72	81	90	99	108
10	0	10	20	30	40	50	60	70	80	90	100	110	120
11	0	11	22	33	44	55	66	77	88	99	110	121	132
12	0	12	24	36	48	60	72	84	96	108	120	132	144

We can see two ways of multiplying to get 54:

$9 \times 6 = 54$ and $6 \times 9 = 54$

We can reverse the multiplications to find:

$54 \div 6 = 9$ and $54 \div 9 = 6$

We can use the multiplication table in reverse to do calculations involving division.

Example 4

Complete the sentence by filling in the gaps.

If $2 \times 3 = 6$, then $6 \div 3 =$ ___ and $6 \div 2 =$ ___.

Solution

If $2 \times 3 = 6$, then $6 \div 3 = 2$ and $6 \div 2 = 3$.

Remember

Division can be thought of as splitting into equal groups, or as sharing.

Division is the inverse operation to multiplication.

4B Whole class CONNECT, APPLY AND BUILD

1 Make one array for each number below using counters or bottle tops. Then write the corresponding multiplication and division statements. The first one has been done for you.

a 12

4 × 3 = 12 and 3 × 4 = 12

12 ÷ 3 = 4 and 12 ÷ 4 = 3

b 18

c 21

d 32

2 Halve each number by mentally dividing it by 2. (Check your answer by doubling the result.)

a 4 **b** 10 **c** 18 **d** 22 **e** 30 **f** 110

3 Mentally divide each number by 4 by halving and halving again. (Check your answer by doubling the result and doubling again.)

a 8 **b** 16 **c** 24 **d** 44 **e** 36 **f** 100

4 Numbers that are multiples of 10 have a zero at the end. Divide each number by 10 by mentally 'chopping off' the end zero. Say your answer to the person next to you.

a 20 **b** 50 **c** 100 **d** 110 **e** 170 **f** 2780

5 Here are the factors of 18.

1 2 3 6 9 18

Now complete each statement.

a ____ × 3 = 18 **b** 18 = 3 × ____ **c** ____ × 2 = 18

d 18 = 9 × ____ **e** 1 × ____ = 18 **f** 18 ÷ 2 = ____

g 18 ÷ ____ = 18 **h** ____ ÷ 9 = ____ **i** 18 ÷ 6 = ____

j 18 ÷ ____ = 1 **k** ____ × 18 = 18 **l** 3 × ____ × ____ = 18

6 **a** Write the factors of 36, then complete each statement.

b ____ × 6 = 36 **c** 36 = 3 × ____ **d** 36 = 9 × ____

e 4 × ____ = 36 **f** 2 × ____ = 36 **g** 36 ÷ 6 = ____

h 36 ÷ ____ = 18 **i** ____ ÷ 9 = 4 **j** 36 ÷ ____ = 36

k 36 ÷ ____ = 4 **l** 1 × ____ = 36 **m** 36 = 2 × ____ × 2 × ____

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4B Individual

1 Complete each statement. The first one has been done for you.

a If 3 × 5 = 15, then 15 ÷ 3 = 5 and 15 ÷ 5 = 3.

b If 2 × 4 = 8, then 8 ÷ 4 = ____ and 8 ÷ 2 = ____.

c If 6 × 3 = 18, then 18 ÷ 6 = ____ and 18 ÷ 3 = ____.

d If 7 × 8 = 56, then 56 ÷ 8 = ____ and 56 ÷ 7 = ____.

e If 313 × 279 = 87 327, then 87 327 ÷ 279 = ____ and 87 327 ÷ 313 = ____.

2 Here are the factors of 12.

1 2 3 4 6 12

Now complete each statement.

a 2 × ____ = 12

b ____ ÷ 12 = 1

c 3 × ____ = 12

d ____ × 4 = 12

e 12 ÷ 3 = ____

f 12 ÷ 6 = ____

g 12 = ____ × 1

h ____ × 2 = 12

i 4 × 3 = ____

j 12 ÷ ____ = 6

k 12 ÷ ____ = 3

l 2 × ____ × 3 = 12

3 Check whether each division calculation is correct by using your knowledge of the multiplication table. The first two have been done for you.

a Does 121 ÷ 11 = 11? Yes, because 11 × 11 = 121.

b Does 98 ÷ 8 = 12? No, because 12 × 8 = 96.

c 24 ÷ 8 = 3

d 37 ÷ 4 = 9

e 54 ÷ 6 = 9

f 132 ÷ 12 = 11

g 72 ÷ 6 = 12

h 100 ÷ 9 = 11

i 144 ÷ 12 = 12

j 43 ÷ 2 = 22

k 42 ÷ 6 = 7

4 Check whether each division calculation is correct by doing the corresponding multiplication. The first two have been done for you.

a Does 504 ÷ 63 = 7? No, 504 ÷ 63 does not equal 7 because 63 × 7 = 441.

$$\begin{array}{rrr} & 6_{2} & 3 \\ \times & & 7 \\ \hline 4 & 4 & 1 \\ \hline \end{array}$$

b Does 243 ÷ 9 = 27? Yes, 243 ÷ 9 = 27 because 27 × 9 = 243.

$$\begin{array}{rrr} & 2_{6} & 7 \\ \times & & 9 \\ \hline 2 & 4 & 3 \\ \hline \end{array}$$

c Does 72 ÷ 3 = 24?

d Does 478 ÷ 239 = 2?

e Does 161 ÷ 7 = 23?

f Does 612 ÷ 9 = 68?

g Does 181 ÷ 16 = 12?

h Does 200 ÷ 23 = 9?

i Does 343 ÷ 49 = 7?

j Does 1836 ÷ 68 = 27?

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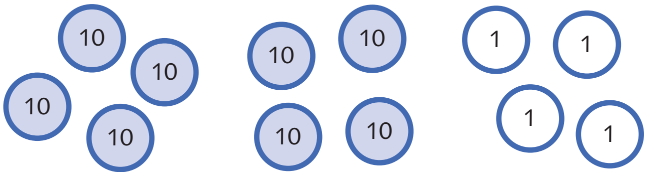
4C The long division algorithm

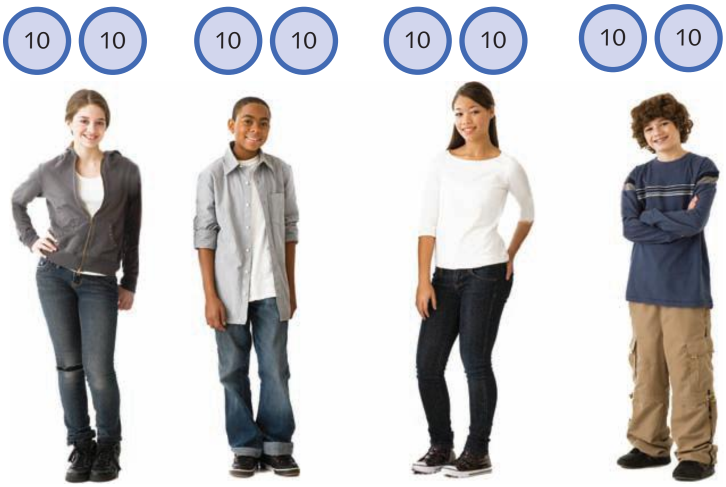
The division algorithm is unusual because it starts on the left of the number and shares out the biggest pieces first.

Let's divide 84 by 4. You probably know the answer, or can work it out using other methods, but it is easier to use a simple example the first time we use the division algorithm.

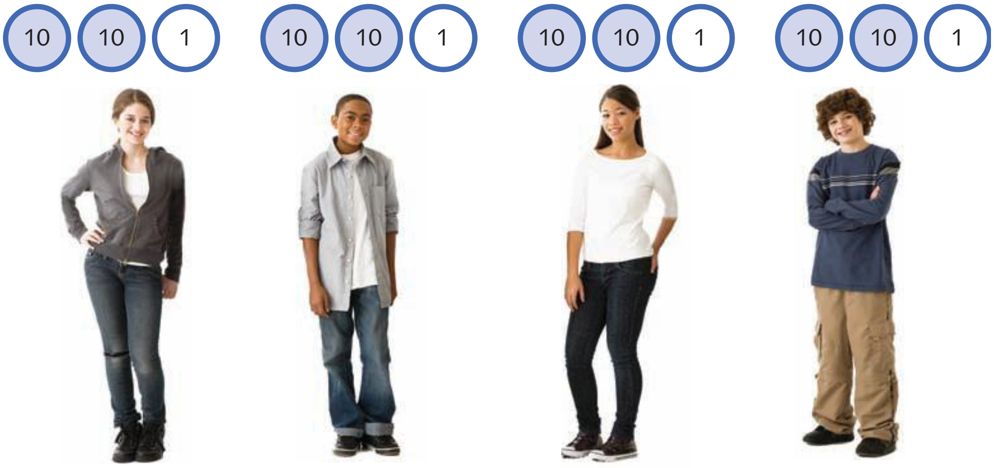
This picture shows the number 84.



To divide 84 by 4 we try to make 4 equal groups. We begin with the tens. There are 8 tens. If we share 8 tens among 4 people, each person's share is 2 tens. So, 8 tens divided by 4 is 2 tens.



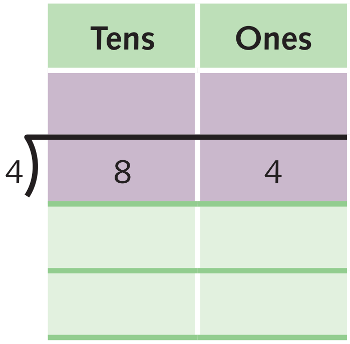
Next we share the ones. There are 4 ones. If we share 4 ones among 4 people, each person's share is 1 one.



If we share 84 among 4 people, each person gets 2 tens and 1 one, which is the same as 21.

$$\begin{aligned} 84 \div 4 &= 2 \text{ tens} + 1 \text{ one} \\ &= 21 \end{aligned}$$

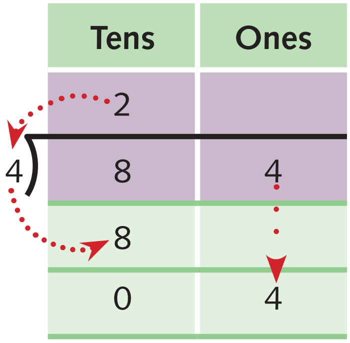
We record this using the algorithm $4\overline{)84}$.



	Tens	Ones
4)	8	4

Set out the dividend and the divisor as shown.

It is helpful to label the place-value columns.



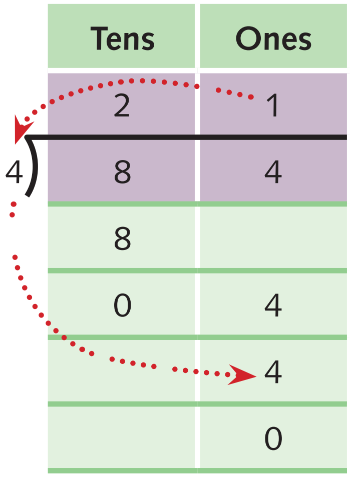
	Tens	Ones
	2	
4)	8	4
	8	
	0	4

Start with the tens. There are 8 tens in 80. This is 4 lots of 2 tens. We shorten that and say 4 goes into 8 two times.

Write 2 above the line in the tens place.

Say 2 tens × 4 is 8 tens.

Subtract 8 tens from 8 tens and write 0 tens on the next line. Then ‘bring down’ the 4 ones.



	Tens	Ones
	2	1
4)	8	4
	8	
	0	4
		4
		0

Now work with the ones. There are 4 ones. This are 4 lots of 1 one. We say 4 goes into 4 once.

Write 1 above the line in the ones place.

Say 1 one × 4 is 4 ones. Subtract 4 ones from 4 ones.

Write 0 on the next line. The calculation is complete.

$84 \div 4 = 21$

We can check the division by using the multiplication algorithm.

$$\begin{array}{r} 2\ 1 \\ \times \quad 4 \\ \hline 8\ 4 \\ \hline \end{array}$$

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Example 5

Calculate 9063 ÷ 3 using the long division algorithm and check your answer using the multiplication algorithm.

Solution

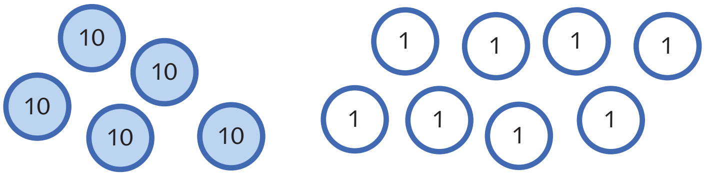
$$\begin{array}{r} 3\ 0\ 2\ 1 \\ 3\overline{)9\ 0\ 6\ 3} \\ \underline{9} \\ 0\ 0\ 6 \\ \underline{6} \\ 0\ 3 \\ \underline{3} \\ 0 \end{array}$$

$$\begin{array}{r} 3\ 0\ 2\ 1 \\ \times \qquad 3 \\ \hline 9\ 0\ 6\ 3 \\ \hline \end{array}$$

So 9063 ÷ 3 = 3021.

Most calculations involving division do not work out as neatly as the examples above. Let's look at how to calculate 58 ÷ 4.

This picture shows the number 58.



To divide 58 by 4 we try to make 4 equal groups. We begin with the tens. There are 5 tens. When we share 5 tens among 4 people, each person's share is 1 ten and there is 1 ten left over.

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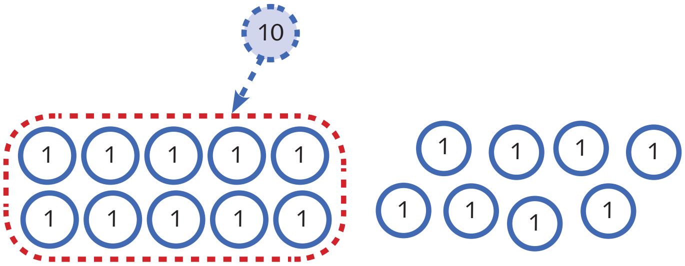
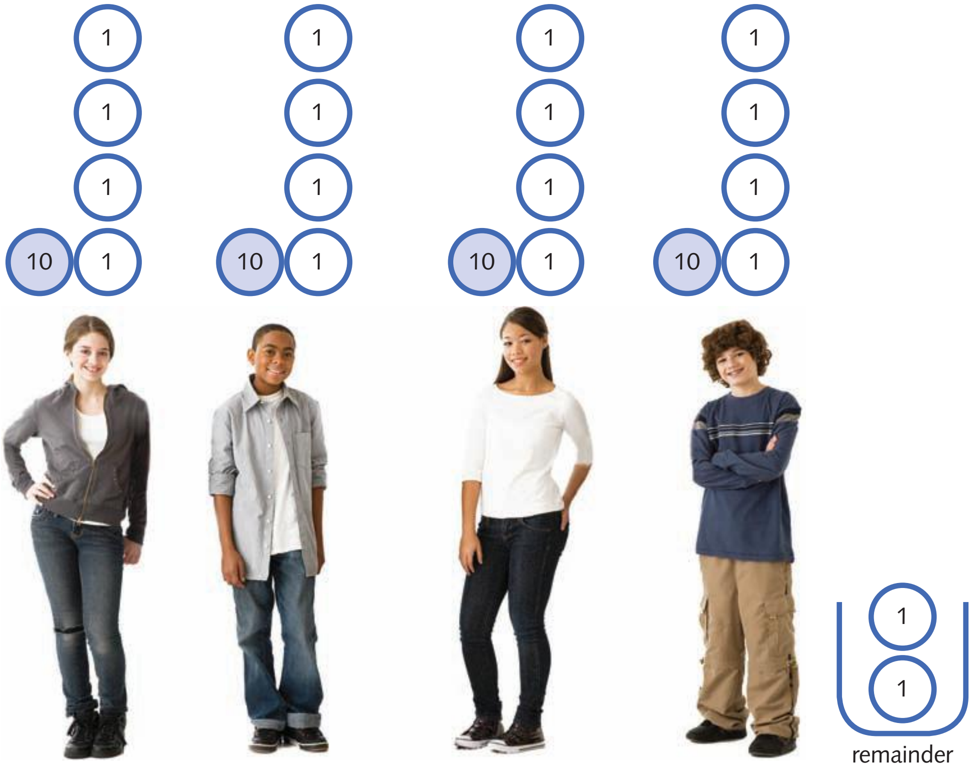
Now we deal with the 1 ten and the 8 ones. Convert the ten into 10 ones and try to make 4 equal groups.



When we share 18 ones among 4 people, each person gets 4, with 2 left over. So, 18 ones divided by 4 is 4 ones with 2 left over.



When we share 58 among 4 people, each person gets 1 ten and 4 ones and there are 2 ones left over. This is the same as 14 with a remainder of 2.

58 ÷ 4 = 1 ten + 4 ones, remainder 2
= 14 remainder 2

We record this using the algorithm $4\overline{)58}$.

Set out the dividend and the divisor as shown.

	Tens	Ones
4)	5	8

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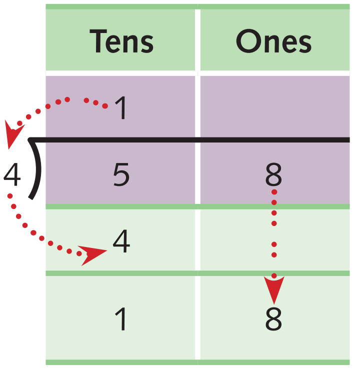
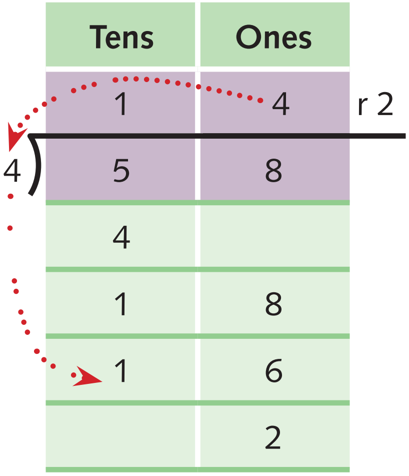


Start with the tens. There are 5 tens in 50. This is 4 lots of 1 ten with 1 ten left over. We shorten that and say 4 goes into 5 once.

Write 1 above the line in the tens place.

Say 1 ten × 4 is 4 tens. Write 4 in the tens place on the next line.

Subtract 4 tens from 5 tens and write 1 ten on the next line. Then ‘bring down’ the 8 ones.



Now work with the ones. There are 18 ones. This is 4 lots of 4 ones. We say 4 goes into 18 four times with 2 left over.

Write 4 above the line in the ones place.

Say 4 ones × 4 is 16 ones. Subtract 16 ones from 18 ones.

Write 2 on the next line. The calculation is complete.

58 ÷ 4 = 14 remainder 2

We can check the division by using the multiplication algorithm and adding the remainder.

$$\begin{array}{rr} & 1\ 4 \\ \times & 4 \\ \hline & 5\ 6 \\ \hline \end{array}$$

56 + 2 = 58. The calculation is correct.

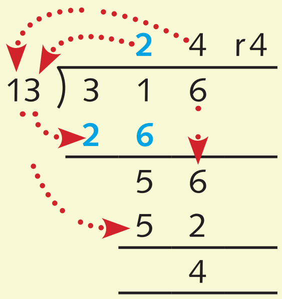
Example 6

Calculate 316 ÷ 13 using long division and check your work by doing the multiplication.

Solution

It is a good idea to calculate all of the multiples of 13 up to 9 × 13 first. You should be able to do this mentally.

For example, $6 \times 13 = 6 \times 10 + 6 \times 3 = 60 + 18 = 78$.



13 into 3 won't go.

How many 'lots of 13' are there in 31? At least 2, but not 3.

Two lots of 13 is 26. Write 26 below 31. Subtract 26 from 31. Write the 5 and 'bring down' the 6.

There are four 'lots of 13' in 52. Write 52 below the 56. Subtract 52 from 56. There is a remainder of 4.

We can make no more groups of 13.

$1 \times 13 = 13$
$2 \times 13 = 26$
$3 \times 13 = 39$
$4 \times 13 = 52$
$5 \times 13 = 65$
$6 \times 13 = 78$
$7 \times 13 = 91$
$8 \times 13 = 104$
$9 \times 13 = 117$

316 ÷ 13 = 24 reminder 4

Check that this is correct by multiplying 24 × 13 and adding the remainder.

$$\begin{array}{cccc} & & 2_1 & 4 \\ \times & & 1 & 3 \\ \hline & & {}^{1}7 & 2 \\ & 2 & 4 & 0 \\ \hline & 3 & 1 & 2 \\ \hline \end{array}$$

312 + 4 = 316. The calculation is correct.

4C Whole class CONNECT, APPLY AND BUILD

1 Use place-value blocks to work out these divisions. Then use the long division algorithm.

a 84 ÷ 3 **b** 1000 ÷ 5 **c** 725 ÷ 4 **d** 799 ÷ 17

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4C Individual

1 Calculate these divisions using the long division algorithm, then check your work by multiplying.

These single-digit divisions have no remainder.

a 864 ÷ 2 **b** 125 ÷ 5 **c** 304 ÷ 8 **d** 364 ÷ 7

These single-digit divisions have a remainder.

e 176 ÷ 3 **f** 1026 ÷ 4 **g** 190 ÷ 9 **h** 482 ÷ 6

2 Calculate these divisions using the long division algorithm, then check your work by multiplying.

These two-digit divisions have no remainder.

a 792 ÷ 11 **b** 234 ÷ 13 **c** 252 ÷ 21 **d** 8892 ÷ 36

3 Divide 392 by each number.

a 4 **b** 7 **c** 8 **d** 9 **e** 13

4 Tyson ate 1001 chocolate buttons over a period of 7 days. He ate the same number each day. How many was that?

5 Liz walked 4 kilometres each hour she was bushwalking on her holidays. She walked a total of 148 kilometres. For how many hours did Liz walk?

6 Stevie bought everything he needed to make 81 sandwiches to put in the freezer for school lunches. If he ate 3 sandwiches each day, how many days would the sandwiches last?

7 A full toilet flush uses 8 litres of water, and the quick-flush uses 5 litres. Copy and complete the table to show the different combinations of full flushes and quick-flushes that are possible from these different-sized water storage tanks.

	Full flush	Quick flush	Remainder
24-litre tank	1 × 8	3 × 5	1 litre
	2 × 8	_____ × 5	_____ litres
	3 × 8	_____ × 5	_____ litres
33-litre tank	1 × 8	_____ × 5	_____ litres
	2 × 8	_____ × 5	_____ litres
	3 × 8	_____ × 5	_____ litres
	4 × 8	_____ × 5	_____ litres
40-litre tank	1 × 8	_____ × 5	_____ litres
	2 × 8	_____ × 5	_____ litres
	3 × 8	_____ × 5	_____ litres
	4 × 8	_____ × 5	_____ litres
	5 × 8	_____ × 5	_____ litres

4D The short division algorithm

In the previous section we looked at the long division algorithm. Even if you do not use long division all the time, it is good to understand how it works. In this section we look at a shortcut for long division known as **short division.** This method can be used when you are dividing by a 1-digit number. You do all the same work as in long division, but do most of it in your head and write the 'carry' numbers on the same line. That is why it is called short division.

If we want to divide 336 by 7 we can use short division.

$$\begin{array}{r} 4\;\;8 \\ 7\overline{)3\;\;3\;\;{}^{5}6} \end{array}$$

7 into 3 hundreds will not go. There are not enough hundreds.

7 goes into 33 tens 4 times with 5 tens left over.

Write 4 tens in the answer line and carry the 5.

Now divide 7 into 56: 56 = 7 × 8.

Write 8 ones in the answer line.

So 336 ÷ 7 = 48.

Example 7

Calculate 708 ÷ 7 and check your work by doing the multiplication.

Solution

$$\begin{array}{r} 1\;\;0\;\;1\;\;\text{r}1 \\ 7\overline{)7\;\;0\;\;8\;\;\;\;\;} \end{array}$$

$$\begin{array}{r} 1\;0\;1 \\ \times\quad\;\; 7 \\ \hline 7\;0\;7 \\ \hline \end{array}$$

707 + 1 = 708

4D Individual

1 Use the short division algorithm to calculate:

a 268 ÷ 2

b 185 ÷ 5

c 574 ÷ 7

d 988 ÷ 4

e 268 ÷ 3

f 185 ÷ 6

g 574 ÷ 8

h 988 ÷ 9

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2 Use the short division algorithm to check which of these numbers has 3 as a factor.

12 23 36 81 73 999 1003 1008

3 Use the short division algorithm to check which of these numbers has 4 as a factor.

24 34 28 49 147 100 167 396

4 Do you need to use the short division algorithm to check which of these numbers has 5 as a factor? Explain a shortcut that you could use, then write down the list of numbers that have 5 as a factor.

24 34 49 147 100 168 395 672

5 Manny works in a fruit shop making up bags of 9 bananas. Write the number of bags that can be made up and the remainder out of:

a 99 bananas
b 127 bananas
c 593 bananas
d 1026 bananas

6 Footballs are sold in boxes of 6. Write the number of boxes and the remainder for:

a 666 footballs
b 302 footballs
c 888 footballs
d 1000 footballs

7 Hannah stores her beads in small packets of 9. How many small packets will Hannah have if she has:

a 2007 beads?
b 585 beads?
c 5283 beads?
d 18 324 beads?
e Do the multiplication for each of the above to make sure you are correct.

4E Review questions

1 Find the factors of each number. Pair the factors to make sure you have them all.

a 8 **b** 10 **c** 42 **d** 36 **e** 144

2 **a** List the factors of 50.
b List the factors of 54.

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3 **a** Which of these numbers are not factors of 24?

2 3 4 5 6 7

b Which of these numbers are not factors of 20?

1 2 3 4 5 6

c Which of these numbers are not factors of 48?

6 7 8 9 10 11

4 Complete each statement.

a If 9 × 8 = 72, then 72 ÷ 9 = ____ and 72 ÷ 8 = ____.

b If 12 × 8 = 96, then 96 ÷ 12 = ____ and 96 ÷ 8 = ____.

c If 87 × 93 = 8091, then 8091 ÷ 87 = ____ and 8091 ÷ 93 = ____.

5 Complete these statements.

a 78 ÷ 3 = 26, so 3 × 26 = ____.

b 208 ÷ 16 = 13, so 13 × 16 = ____.

c 472 ÷ 8 = 59, so 59 × 8 = ____.

d 15 × 32 = 480, so 480 ÷ 15 = ____.

e 84 × 31 = 2604, so 2604 ÷ 84 = ____.

f 52 × 23 = 1196, so 1196 ÷ 23 = ____.

6 Flowers come in containers that hold exactly the following amounts.

Which containers could be used for:

a bunches of 6? **b** bunches of 4? **c** bunches of 8?

7 Check that each division calculation is correct by doing the corresponding multiplication.

a 117 ÷ 9 = 13 **b** 126 ÷ 18 = 7 **c** 578 ÷ 34 = 17 **d** 2224 ÷ 8 = 278

8 Divide 1890 by each number.

a 2 **b** 3 **c** 5 **d** 6 **e** 9

9 Divide 2304 by each number.

a 2 **b** 3 **c** 4 **d** 6 **e** 12

10 Use a division algorithm to check which of these numbers has 7 as a factor.

105 743 177 119 602 6174

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11 Copy this number grid onto 1-centimetre grid paper.

45	55	85	25	15	25	5	85	40	75
25	21	55	20	50	14	15	60	66	72
25	56	28	15	77	63	20	72	25	60
15	70	25	49	5	42	45	48	6	12
10	77	5	75	45	14	15	12	80	95
5	84	65	85	95	7	75	18	24	72
10	80	25	40	15	20	5	65	25	75

Colour the grid using this code.

- Colour the numbers divisible by 6 green.
- Colour the numbers divisible by 7 red.
- Leave the numbers divisible by 5 blue.

Which word can you see?

12 Calculate these divisions using a division algorithm, then check your work by multiplying.

a $471 \div 3$
b $1304 \div 4$
c $6237 \div 7$
d $2530 \div 5$
e $5838 \div 7$
f $4962 \div 6$
g $16\,824 \div 8$
h $20\,763 \div 9$
i $3263 \div 13$
j $2816 \div 22$
k $9996 \div 51$
l $30\,018\,386 \div 43$

13 There are 330 schoolbags to be placed on hooks. How many rows are there if there are:

a 5 hooks per row?
b 3 hooks per row?
c 11 hooks per row?
d 2 hooks per row?

14 There are 6048 light globes in a carton.

a How many boxes of 4 light globes is this?
b How many boxes of 8 light globes is this?
c How many boxes of 7 light globes is this?
d How many boxes of 9 light globes is this?

15 Sort the numbers between 15 and 35 into prime numbers and composite numbers.

16 What is the prime number closest to:

a 10?
b 27?
c 100?

17 Draw factor trees for these numbers.

a 18
b 20
c 24
d 32

18 Draw factor trees for these numbers and give the prime factorisation for each.

a 28
b 72
c 50
d 242
e 336

19 Write the number for each prime factorisation.

a $2 \times 2 \times 2 \times 2$
b $3 \times 5 \times 7$
c $2 \times 2 \times 7$
d $13 \times 2 \times 2 \times 2$

CHAPTER 5 Preparation

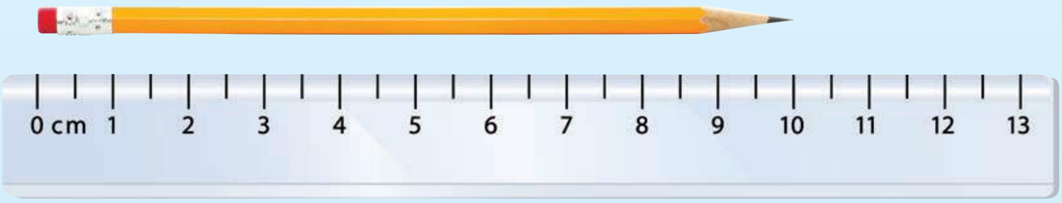
Useful skills for this chapter:

- the ability to measure lengths and distances in centimetres and metres using rulers and tape measures
- being able to record lengths and distances in centimetres and metres.

Show what you know

1 Read the length of each pencil to your teacher.

a



b

2 Use a ruler to measure:

- **a** the length of your pencil in centimetres
- **b** the width of your eraser in millimetres
- **c** the length of the fingernail on your middle finger in millimetres
- **d** the length of your foot in centimetres

3 Which would you use (millimetres, centimetres or metres) to measure:

- **a** the length of a car?
- **b** the nail of your little finger?
- **c** the length of this book from top to bottom?

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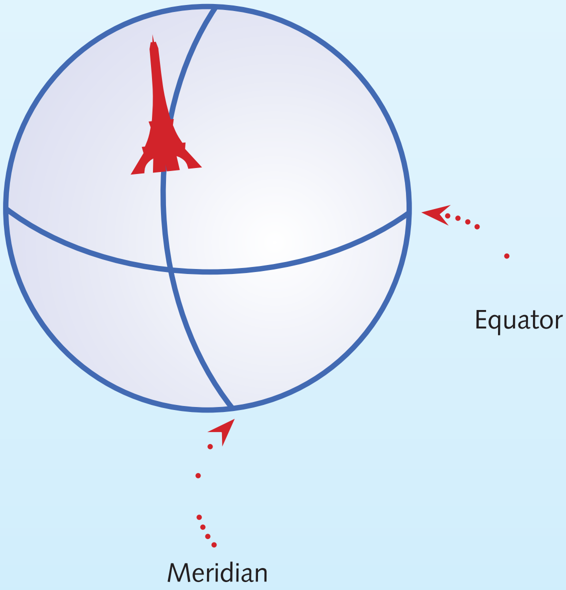
CHAPTER

5

Measurement and Geometry

Length and perimeter



In Australia we use the **metric system** of measurement. The units of length in the metric system are based on the metre (m).

In 1790, the French Academy of Sciences decided that 1 metre would be defined as $\frac{1}{10\,000\,000}$ of the distance from the equator to the North Pole, measured along the meridian that runs through Paris.

Today we use the International Bureau of Weights and Measures definition of 1 metre: this is the distance travelled by light in $\frac{1}{299\,792\,458}$ of a second.

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5A Measuring length

We use metres to measure items that could be stepped out and counted in paces. A metre is about the length of one adult pace.

The word **metre** is often abbreviated to **m** when it is written.

The bed is 1 metre wide and 2 metres long.

The swimming pool is 50 metres long.

About 1 metre

As well as the metre, we also use the centimetre, millimetre and kilometre to measure length.

The prefix before the word 'metre' tells us about the size of the unit.

The prefix **centi** tells us that the unit is one-hundredth of the base unit.

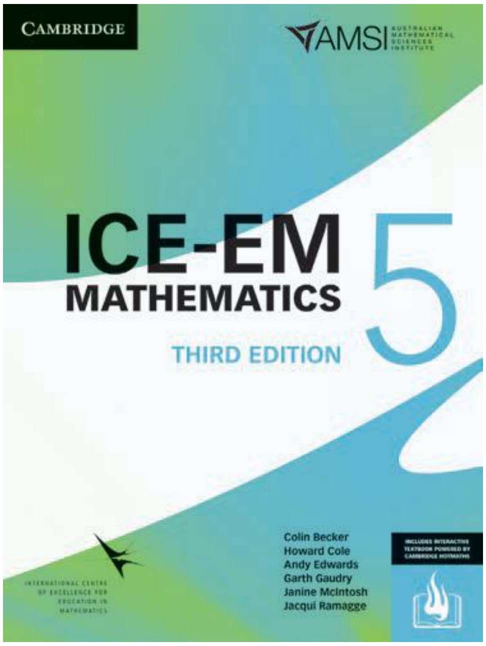
So 1 centimetre = $\frac{1}{100}$ metre

and 1 metre = 100 centimetres.

We abbreviate the word **centimetre** to **cm** as a short way of writing it.

You would probably use centimetres to measure items that are about the size of your hand.

The cover of your maths book is 28 cm long and 21 cm wide.



The prefix **milli** tells us that the unit is one thousandth of the base unit.

So 1 millimetre = $\frac{1}{1000}$ metre

and 1 metre = 1000 millimetres.

We abbreviate **millimetres** to **mm**. We would use millimetres to measure items that are about the size of your fingernail.

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Builders, furniture makers, architects and electricians nearly always use millimetres, even for very large measurements.

The stamp is 24 mm high and 29 mm wide.

The paper clip is 32 mm long and 8 mm wide.

The prefix **kilo** tells us that the unit is one thousand times the base unit.

So, 1 **kilo**metre = 1000 metres

and 1 metre = $\frac{1}{1000}$ kilometre.

We abbreviate the word 'kilometre' to km.

We use kilometres to measure large distances. For example, it is about 4500 km from Perth to Brisbane by road.

Choosing units

We need to make sensible choices when using measurement units.

The length of your house would be about 15 000 millimetres. The length of your fingernail would be about 0.008 metres.

Can you think of better units to use for these measurements?

Example 1

a Jane wants to measure Wang's shoe. Which unit of measurement should she use?

b Ali wants to measure the width of the football oval. Which unit of measurement should he use?

Solution

a Jane can use her ruler to find the length of Wang's shoe, so centimetres or millimetres are the best units to use.

b Ali can pace out the distance, so he could use a tape measure or a trundle wheel and record the distance in metres.

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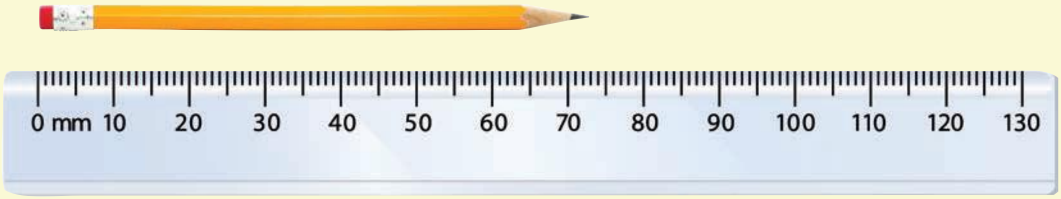
Example 2

Measure the length of this pencil to the nearest millimetre.

Solution



The pencil is 73 millimetres long.

Remember

The standard unit of measurement is the **metre**.
We abbreviate this to **m**.

There are 100 **centi**metres in 1 metre.

There are 1000 **milli**metres in 1 metre.

There are 1000 metres in 1 **kilo**metre.

5A Whole class CONNECT, APPLY AND BUILD

1 Arrange the whole class in order of height, from shortest to tallest. Then copy and complete this statement:

The heights of the people in our class range from _____ centimetres to ___ centimetres.

2 Draw lines of these lengths. Label the lines A, B, C, and so on.

A = 6 cm B = 10 cm C = 20 mm D = 95 mm E = 12 cm F = 5 mm
G = 9 cm H = 125 mm I = 140 mm J = 165 mm K = 15 cm L = 3 mm

Ask another person to measure each line and check that your lengths are correct.

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3 Estimate each of these lengths, then measure each item. Compare your results with the results of three other people.

- **a** the length of this page in millimetres
- **b** the length of your middle finger in millimetres
- **c** the width of your table in centimetres
- **d** the length of your shoe in centimetres

4 **Estimating measurements**

- **a** Work in pairs. Person 1 names five items in the classroom that could be measured, then Person 2 estimates the length of each item. Use a ruler or tape measure to check each estimate. For example, Marc asks Terri to estimate the width of the classroom door. Terri thinks the door is about 1 metre wide because the blackboard ruler is that length. They measure the door to find that it is 1 metre and 10 centimetres wide.
- **b** Record the name of each item, your estimate and an accurate measurement you made using a ruler or tape measure.
- **c** How could you work out who was more accurate at estimating lengths?

5 Without using a ruler, estimate and cut pieces of streamer to the following lengths. Then ask another person to use a ruler to check your estimates.

a 20 mm **b** 50 mm **c** 100 mm **d** 300 mm

6
- **a** Measure each student's height in centimetres, then cut a length of streamer to match the height. Write each student's name and height on their streamer.
- **b** Measure each student's arm span in centimetres, from fingertip to fingertip with arms stretched out. Cut a length of streamer of a different colour to match this length. Write each student's name and arm span on their streamer.
- **c** Compare each student's arm span with their height, then discuss the results.

7 One pace is approximately equal to 1 metre. Use paces to find a measurement in your school that is:

- **a** less than 1 metre
- **b** between 3 metres and 5 metres

8 Estimate each measurement, then measure each item to check. Compare your results with the results of other students.

- **a** the width of three different classroom doors
- **b** the distance from your classroom door to the nearest tap

9 List five objects in your classroom that you think have a length between 15 cm and 25 cm.

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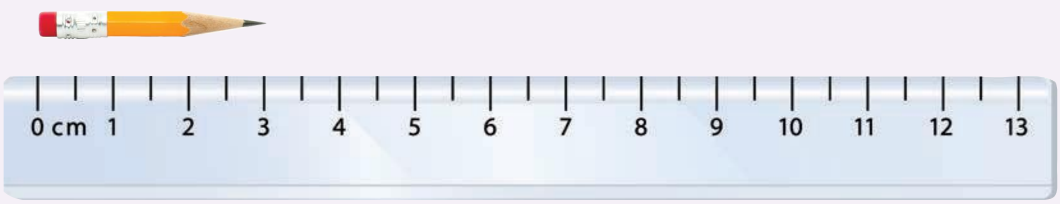
5A Individual

1 Write the length of each pencil in centimetres.

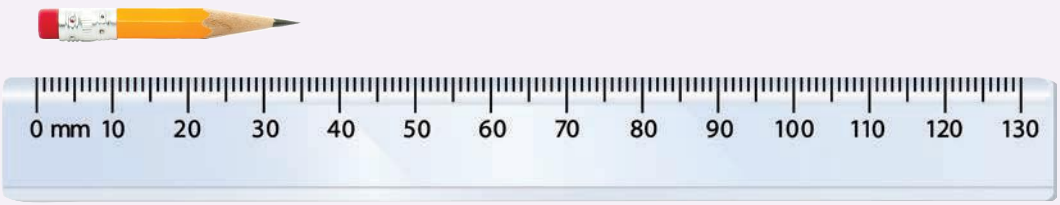
a



b

2 Write the length of each pencil in millimetres.

a

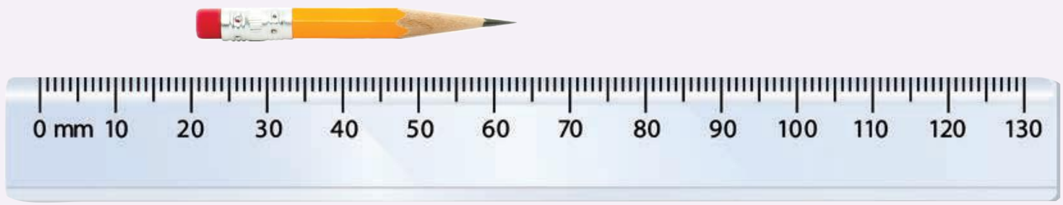


b

3 Write the length of each pencil.

a

b



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4 **a** How much is left when 50 cm is cut from a 1 m piece of ribbon?

b How much is left when 80 cm is cut from a 1 m piece of ribbon?

c How much is left when 5 cm is cut from a 1 m piece of ribbon?

d How much is left when 97 cm is cut from a 1 m piece of ribbon?

e How much is left when 53 cm is cut from a 1 m piece of ribbon?

f How much is left when 62 cm is cut from a 1 m piece of ribbon?

5 Harry put 7 matchbox cars end to end on his lounge-room floor. If each car is 4 cm long, how long is the line of cars?

6 How many 5 cm pieces of ribbon can Elizabeth cut from a 35 cm length?

7 **a** Albert measured the width of his bedroom door. It was as wide as 5 of his shoe lengths. Albert's shoe is 15 centimetres long. How wide is Albert's door?

b Albert's brother Edward measured the same door. He found it to be as wide as 3 of his shoe lengths. Is Edward's shoe smaller or larger than Albert's shoe?

8 Marti needs 7 pieces of ribbon, each 12 cm long. Ribbon is sold in rolls of 50 cm, 1 m and 1.2 m.

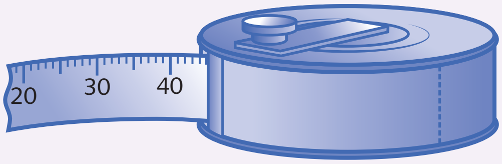
a Which is the best roll for Marti to buy?

b How much will be left over from that roll?

9 Carla cut a 60 cm piece of rope into 4 pieces of equal length. What was the length of each piece?

10 A storage room can fit exactly 8 boxes along its width, 11 boxes along its length and 6 boxes from floor to ceiling. If all the boxes are identical cubes with each side equal to 60 cm, what are the dimensions of the room? You might need to draw a picture or make a model using cubes to help you.

11 Joseph's class were measuring the distance they could throw a shot-put. The tape measure they were using was broken off at the 20-centimetre mark. It looked like this.



a Joseph threw 6 metres 40 centimetres. What did the tape measure show?

b When Joshua measured another throw, the tape measure showed 6 metres 15 centimetres. What was the true measurement?

c To be able to use this tape measure to accurately measure the distance of a shot-put throw, the user must add/subtract 20 centimetres. (Choose the right word.)

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5B Converting measurements

We use different units to measure different lengths. Sometimes we want to change from one unit to another.

Metres and centimetres

We know that 1 metre is equal to 100 centimetres, so to convert from centimetres to metres we make 'lots of 100 centimetres'. For example:

382 centimetres = 3 'lots of 100 centimetres' + 82 centimetres
= 3 metres 82 centimetres.

Example 3

Convert 412 centimetres to metres.

Solution

412 centimetres = 4 'lots of 100 centimetres' + 12 centimetres
= 4 metres 12 centimetres

We convert metres to centimetres by changing each metre into 100 centimetres.

Example 4

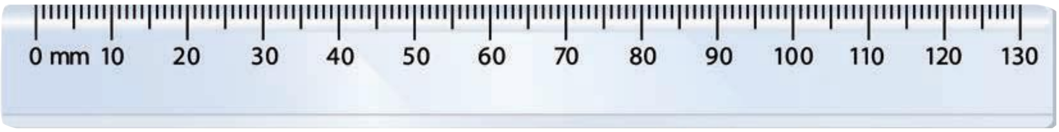
Convert 6 metres 43 centimetres to centimetres.

Solution

6 metres 43 centimetres = 6 'lots of 100 centimetres' + 43 centimetres
= 643 centimetres

Centimetres and millimetres

Since there are 100 centimetres in 1 metre and 1000 millimetres in 1 metre, we know that there are 10 millimetres in one centimetre. You can also see this on a ruler or tape measure.



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To convert from millimetres to centimetres we make 'lots of 10 millimetres'.

Example 5

Convert 30 millimetres to centimetres.

Solution

30 millimetres = 3 'lots of 10 millimetres'
= 3 centimetres

Remember

To convert from metres to centimetres, change each metre into 100 centimetres.

To convert from centimetres to metres, change each 'lot of 100 centimetres' into 1 metre.

To convert from centimetres to millimetres, change each centimetre into 10 millimetres.

To convert from millimetres to centimetres, change each 'lot of 10 millimetres' into 1 centimetre.

5B Whole class CONNECT, APPLY AND BUILD

1 Convert each measurement below to the unit written in brackets. Look at a ruler or tape measure to help you check your answers.

a 130 cm (metres)
b 168 cm (metres)
c 1 m 32 cm (centimetres)
d 43 mm (centimetres)
e 62 cm (millimetres)
f 1 m 27 cm (millimetres)

2 **a** Record your height and the heights of three friends in metres and centimetres. For example, Cedric is 1 metre 32 centimetres tall.

b Convert each height measurement to centimetres.

c Convert each height measurement to millimetres.

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3 Imagine that you and your three friends were placed on the floor in a straight line, foot to head. What would be the total length in centimetres? Convert this measurement to millimetres.

4 Measure one of the diagonals of your classroom, along the floor from corner to corner, in metres and centimetres.

a How many people 173 cm tall could you fit along a diagonal?

b How many paces of 98 cm would fit along the diagonal?

c How many thumbnails of 12 mm would fit along the diagonal?

5B Individual

1 Write each measurement in metres.

a 200 cm **b** 500 cm **c** 800 cm **d** 1100 cm

2 Write each measurement in metres and centimetres.

a 125 cm **b** 387 cm **c** 514 cm **d** 644 cm

3 Convert each measurement to centimetres.

a 6 m **b** 9 m **c** 10 m **d** 1 m 85 cm
e 2 m 37 cm **f** 4 m 44 cm **g** 3 m 10 cm **h** 7 m 8 cm

4 Convert each measurement to centimetres.

a 40 mm **b** 70 mm **c** 80 mm **d** 300 mm
e 600 mm **f** 1000 mm **g** 120 mm **h** 180 mm

5 Convert each measurement to centimetres and millimetres.

a 12 mm **b** 26 mm **c** 87 mm
d 125 mm **e** 215 mm **f** 775 mm

6 Convert each measurement to millimetres.

a 4 cm **b** 7 cm **c** 12 cm **d** 80 cm
e 130 cm **f** 200 cm **g** 6 cm 5 mm **h** 7 cm 8 mm
i 9 cm 9 mm **j** 10 cm 3 mm **k** 15 cm 2 mm **l** 135 cm 9 mm

7 Mark and his mother measured a window so that they would know what size curtains to buy. The width of the window was 340 cm and the height was 180 cm. The curtain shop needed the measurements in millimetres. Convert Mark's measurements to millimetres.

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8 a How much is left when 2 m is cut from a 3 m piece of ribbon?

b How much is left when 50 cm is cut from a 3 m piece of ribbon?

c How much is left when 1 m 50 cm is cut from a 3 m piece of ribbon?

d How much is left when 2 m 80 cm is cut from a 3 m piece of ribbon?

e How much is left when 188 cm is cut from a 3 m piece of ribbon?

f How much is left when 1 m 74 cm is cut from a 3 m piece of ribbon?

9 Shadae needs 7 pieces of string. Each piece must be 6 centimetres in length. How much will Shadae have left from a 500-millimetre piece of string?

10 Bill cut 5 pieces of timber from a 5-metre length. Each piece measured 700 millimetres. How long was the remaining piece of timber?

11 Tahlia needed 20-centimetre lengths of wool to make a tassle. How many pieces of wool would Tahlia get from 9 metres of wool?

12 Bailey has a row of 8 blocks. Each block is 10 millimetres in length. How many centimetres long is Bailey's row of blocks?

13 Fatima has 9 pencil sharpeners. Each pencil sharpener is 25 millimetres long. If she placed them all in a line, how long would the line be in centimetres and millimetres?

14 Calum cut a 16-centimetre piece of streamer into 8 equal pieces. How long was each piece in millimetres?

15 It is $2\frac{1}{2}$ metres from the bathroom door to the bath. Each tile on the floor is 25 cm long. How many tiles fit in this space?

16 James is making labels. He makes 10 that are 45 mm long, 10 that are 75 mm long and 10 that are 95 mm long. What is the total length of all labels in metres and centimetres?

Homework

1 Use a tape measure to measure the distance around the head of everyone at home. Write down the measurements. (If you don't have a tape measure use a piece of string. Then measure the string against a ruler.)

2 Measure the length of both feet of everyone in your family. If everyone in your family placed their feet heel-to-toe in a straight line, what length would they make?

3 Measure yourself and one other family member using these directions.

a Ankle to knee

b Knee to hip

c Hip to shoulder

d Shoulder to elbow

e Elbow to wrist

f Wrist to tip of middle finger

g Shoulder to top of head

Discuss your results. What would be the total length of all these measurements?

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5C Converting kilometres

There are 1000 metres in 1 kilometre. To convert metres to kilometres we make 'lots of 1000 metres'.

Example 6

Convert 4213 metres to kilometres.

Solution

4213 metres = 4 'lots of 1000 metres' + 213 metres
= 4 kilometres 213 metres

We convert kilometres to metres by changing each kilometre into 1000 metres.

Example 7

Convert 7 kilometres 802 metres to metres.

Solution

7 km 802 m = 7 'lots of 1000 m' + 802 m
= 7000 + 802 m
= 7802 m

5C Individual

1 Convert each measurement to kilometres or to kilometres and metres.

a 2000 m **b** 7000 m **c** 10 000 m **d** 8000 m
e 12 000 m **f** 280 000 m **g** 3450 m **h** 6270 m
i 1009 m **j** 7750 m **k** 2680 m **l** 23 780 m

2 Convert each measurement to metres.

a 3 km **b** 7 km **c** 11 km **d** 10 km
e 100 km **f** 1000 km **g** 4 km 825 m **h** 5 km 123 m
i 8 km 462 m **j** 2 km 38 m **k** 6 km 90 m **l** 7 km 3 m

3 Tania cycled 2304 metres. How far did she ride in kilometres and metres?

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4 **a** How much of a 4 km journey is left when Navin has travelled 2 km?
  b How much of a 4 km journey is left when Sally has travelled 1 km 500 m?
  c How much of a 4 km journey is left when Keegan has travelled 800 m?
  d How much of a 4 km journey is left when Holly has travelled 1 km 300 m?
  e How much of a 4 km journey is left when Ming has travelled 1340 m?

5 **a** How much of a 7 km journey is left when Marta has travelled 4 km?
  b How much of a 2 km journey is left when Lara has travelled 800 m?
  c How much of a 5 km journey is left when Kieren has travelled 1700 m?
  d How much of a 9 km journey is left when Louisa has travelled 5 km 600 m?
  e How much of an 8 km journey is left when Wen has travelled 3333 m?

6 Ben lives 500 metres from his local shop. He walks to the shop and home again every day for 4 weeks. How many kilometres has he walked?

7 Ella walked around the school oval 7 times. Each lap was 400 metres. How many kilometres and metres did Ella walk?

8 Hamish lives 450 metres from school. He walks to and from school each day. How many kilometres and metres does he walk in 5 days?

9 Massoud and Larry ran laps of a 400 m athletics track. They both ran for 15 minutes. Massoud ran 6 laps and Larry ran 3 laps. How much further did Massoud run than Larry?

10 Each section of a car park is 30 metres long. What is the total distance if there are 15 sections altogether?

11 It takes Jack 15 minutes to walk 500 metres. How long will it take him to walk 2 kilometres if he walks at the same speed?

12 Kath swims 10 laps of a 25-metre swimming pool each weekday. She swims 20 laps on Saturday and Sunday. How far does she swim in kilometres and metres over the whole week?

13 Each fence of a square paddock is 350 metres long. What is the total length of the 4 fences?

14 These are the travel distances from home to school by school bus for five students traveling on the same route.

Zhi:	12 kilometres 400 metres
Jason:	13 kilometres 200 metres
Brock:	12 kilometres 800 metres
Gordon:	5 kilometres 200 metres
Sue:	4 kilometres 500 metres

  a How much further is it for Brock and Gordon to travel than for Sue and Jason?
  b Jason missed the bus. Whose stop will he need to get to and how far is it?

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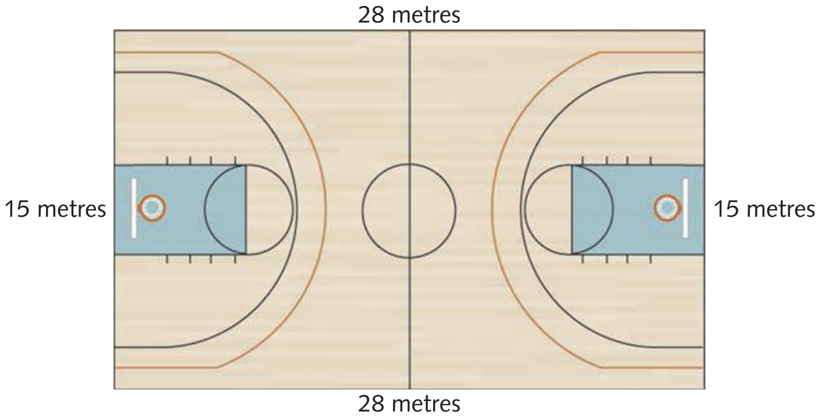
5D Calculating perimeter

The word ‘perimeter’ comes from two Greek words: *peri*, meaning ‘around’ and *metron*, meaning ‘measure’. So ‘perimeter’ means the measure or distance around something. It is the length around the edge.

Imagine walking around the edge of a basketball court and counting each metre as you pace it out. You would walk 15 metres, 28 metres, 15 metres, then 28 metres again, as you walked all four sides of the rectangle.

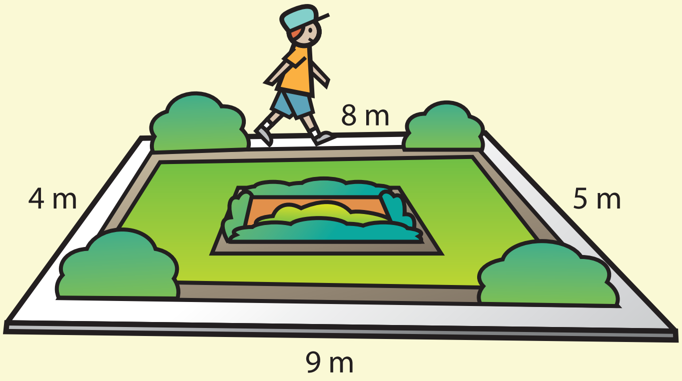


The perimeter of the basketball court is the sum of these lengths.

Perimeter = 15 + 28 + 15 + 28
= 86 metres

Example 8

This is Max’s garden. Calculate the perimeter of Max’s garden.



Solution

If Max walks around the edge of his garden, he walks:

perimeter = 8 + 5 + 9 + 4
= 26 m

The perimeter of Max's garden is 26 metres.

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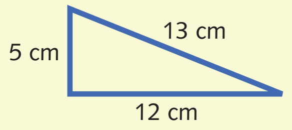
Example 9

Calculate the perimeter of this triangle.



Solution

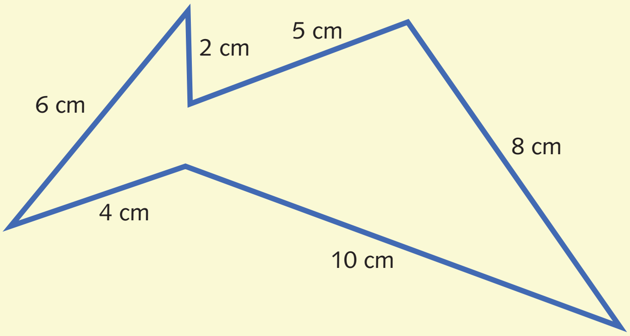
The perimeter of the triangle is the sum of the lengths of its sides.

$$\begin{aligned}\text{Perimeter} &= 13 + 12 + 5\\ &= 30 \text{ cm}\end{aligned}$$

The perimeter of the triangle is 30 centimetres.

Example 10

Calculate the perimeter of this irregular hexagon.



Solution

The perimeter of the hexagon is the sum of the lengths of its sides.

$$\begin{aligned}\text{Perimeter} &= 6 + 2 + 5 + 8 + 10 + 4\\ &= 35 \text{ cm}\end{aligned}$$

The perimeter of the hexagon is 35 centimetres.

Remember

The perimeter of a straight-sided shape is the sum of the lengths of its sides.

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5D Whole class CONNECT, APPLY AND BUILD

1 Work in groups. Each person chooses an object and a unit for measuring its perimeter. Then each person estimates the perimeter of their object. Score 1 point for the closest estimate. The first person to 5 points is the winner.

2 Work in pairs. Estimate, then measure, the perimeter of:

a the cover of this book

b the top of your desk

c the classroom door

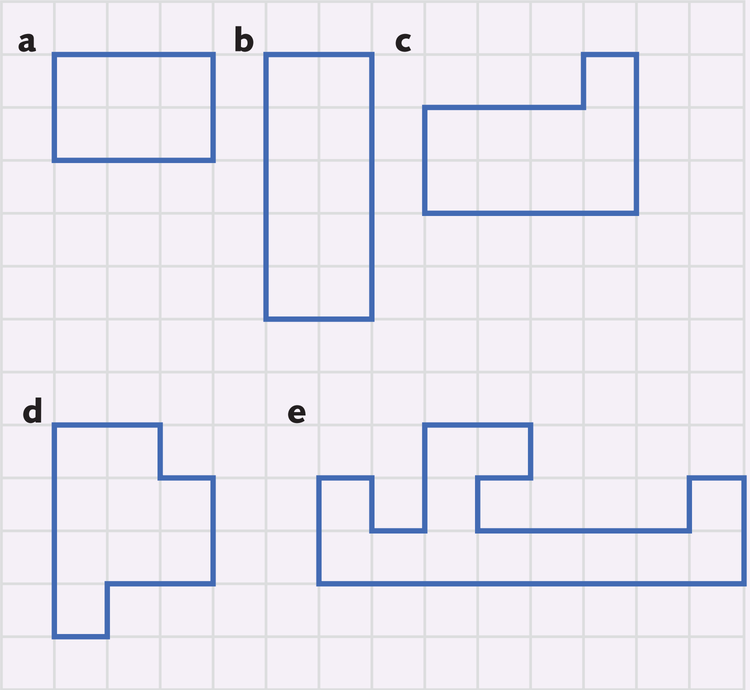
d the door of the classroom cupboard

Ask your partner to check your measurements.

3 Work in pairs. Use a Geoboard and rubber bands or 1-centimetre grid paper to make five different closed shapes. Estimate and calculate the perimeter of each shape. Ask your partner to check your measurements, then swap roles.

5D Individual

1 These shapes are drawn on 1-centimetre grid paper. Calculate the perimeter of each shape. (Not drawn to scale.)



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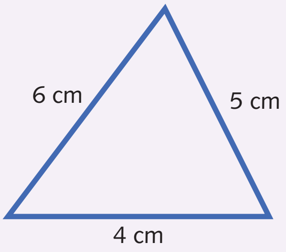
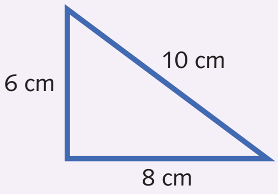
2 Calculate the perimeter of each shape below. All measurements are in centimetres, so remember to put ‘cm’ after each answer. (The shapes are not drawn to scale.)

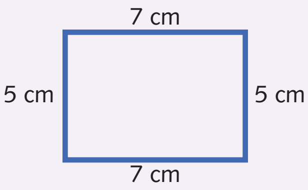
a



b



c



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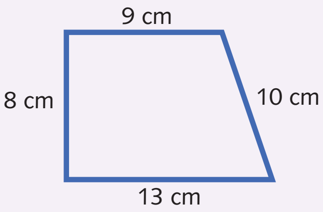

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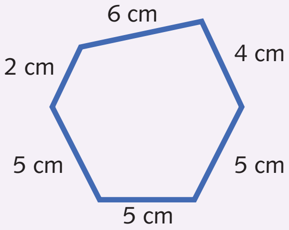

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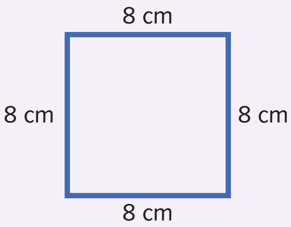

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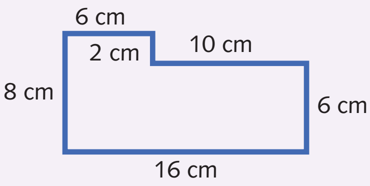

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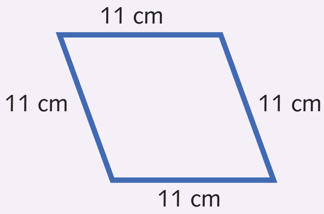

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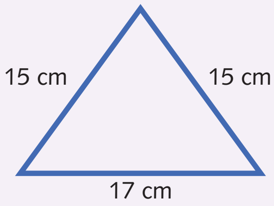


3 Use whole squares on 1-centimetre grid paper. Draw shapes that have a perimeter of:

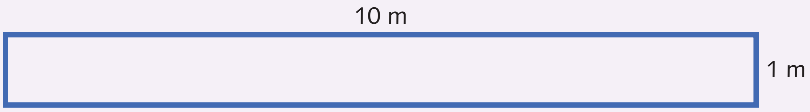
a 8 cm **b** 12 cm **c** 16 cm **d** 20 cm

e Can you draw more than one shape for each perimeter?

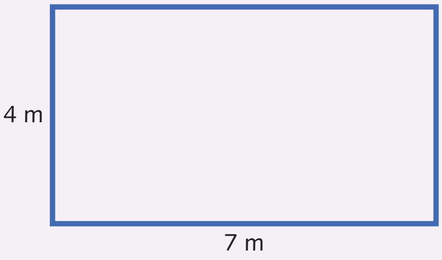
f Which perimeter allows you to draw the largest number of different shapes? Discuss your answer with a friend.

4 You can calculate the perimeter of a rectangle by doubling the lengths of the two adjacent sides' measurements and adding them. Calculate the perimeter of these rectangles.

a



b



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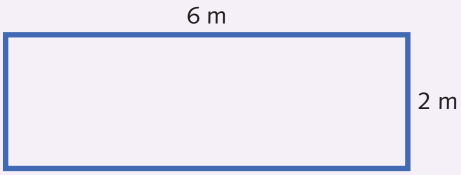
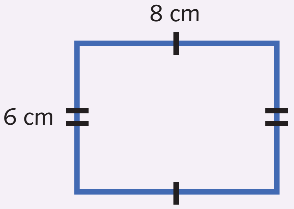


5 Calculate the perimeter of each rectangle by adding the measurements, then doubling them. The – and = marks on the rectangles show which sides are equal in length.

a



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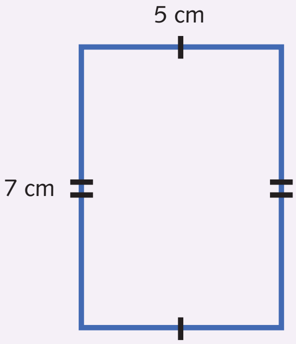

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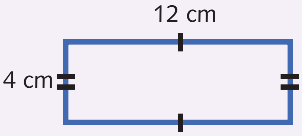

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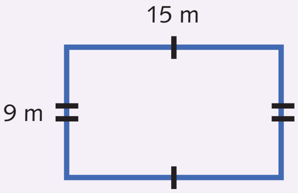
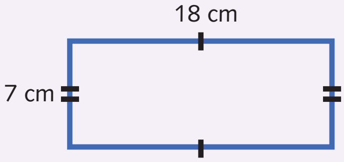


e



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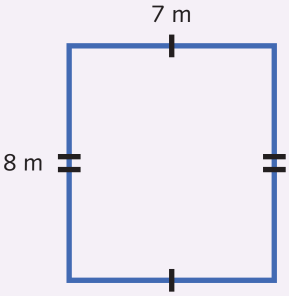


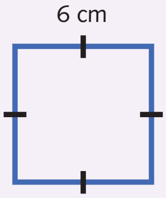
6 Copy and complete this table. Use the lengths and widths given to calculate the perimeter of each rectangle.

Rectangle	Length	Width	Perimeter
a	9 cm	4 cm	______ cm
b	8 cm	5 cm	______ cm
c	19 cm	12 cm	______ cm

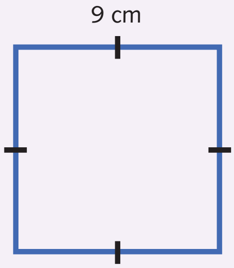
7 The measurement of one side of each square is given below. Sides marked with a dash are equal in length.

Calculate the perimeter of each square by multiplying the side measurement by 4.

a



b



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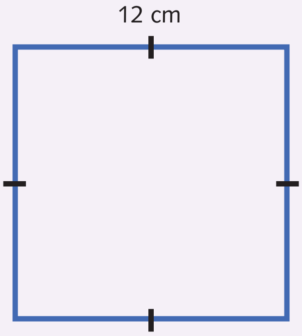

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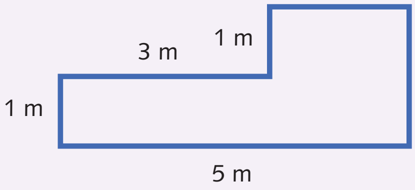
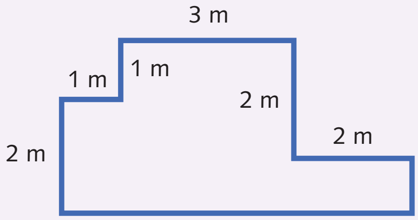
8 Use the measurements for each shape to work out the measurements you do not know. Then calculate the perimeter.

a



b



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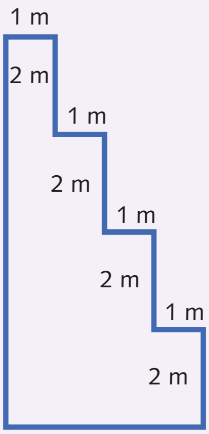
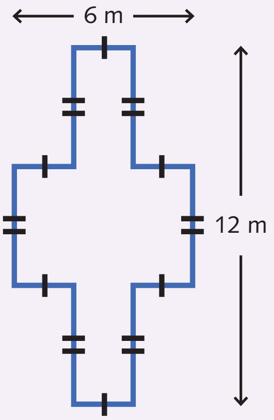
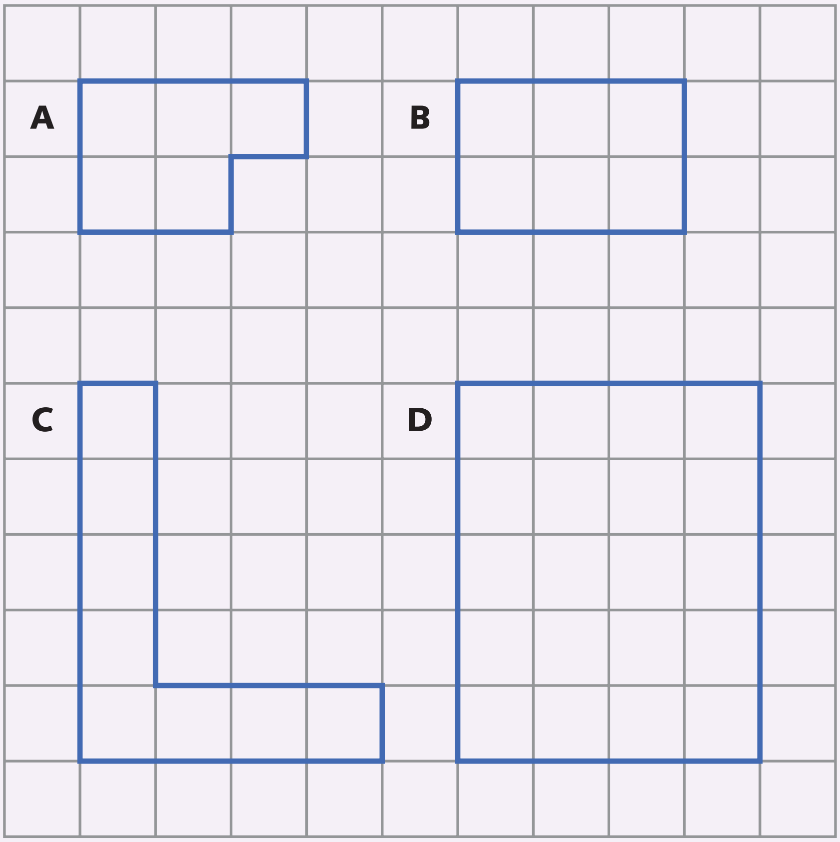


d



9 These shapes have been drawn on 1-centimetre grid paper. Calculate the perimeter of each shape.

a



b What did you notice about the perimeters of shape A and shape B?

c What did you notice about the perimeters of shape C and shape D?

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5E Review questions

1 Write the length of each pencil.

a

b

c

2 **a** How much is left when 75 cm is cut from a 1 m piece of ribbon?
b How much is left when 12 cm is cut from a 1 m piece of ribbon?
c How much is left when 88 cm is cut from a 1 m piece of ribbon?

3 Write these measurements in metres.
a 400 cm **b** 1100 cm **c** 5600 cm

4 Write these measurements in metres and centimetres.
a 648 cm **b** 193 cm **c** 1903 cm

5 Convert these measurements to centimetres.
a 8 m **b** 9 m 34 cm **c** 18 m 81 cm

6 Convert these measurements to centimetres.
a 30 mm **b** 90 mm **c** 800 mm
d 120 mm **e** 660 mm **f** 1010 mm

7 Convert these measurements to centimetres and millimetres.
a 17 mm **b** 48 mm **c** 236 mm

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8 Convert these measurements to millimetres.

a 5 cm **b** 80 cm **c** 67 cm

d 83 cm 5 mm **e** 143 cm 43 mm **f** 209 cm 9 mm

9 Convert these measurements to kilometres and metres or to a whole number of kilometres.

a 4000 m **b** 1893 m **c** 42 670 m

10 Convert these measurements to metres.

a 4 km **b** 6 km 38 m **c** 98 km 103 m

11 Catherine rode her bicycle around the bike track 8 times. Each lap was 1 km 450 m. How many kilometres and metres did Catherine ride?

12 Harry cut three pieces of timber from a 3 m 20 cm length. Each piece Harry cut measured 220 mm. How long was the remaining piece of timber?

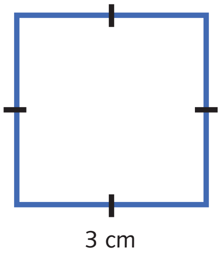
13 a How much of a 7 km journey is left when Martine has travelled 4 km?

b How much of a 7 km journey is left when Rita has travelled 2 km 800 m?

c How much of a 7 km journey is left when Aidan has travelled 4227 m?

14 Calculate the perimeter of each shape. Remember to put **cm** or **m** after each answer to show the unit of measurement. (The shapes are not to scale.)

a



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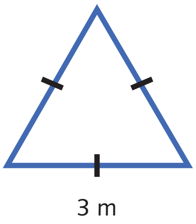
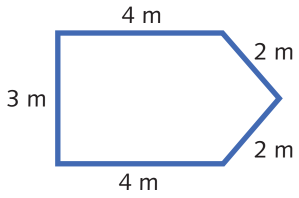


c



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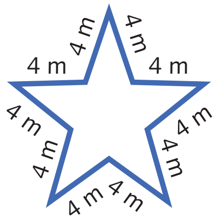

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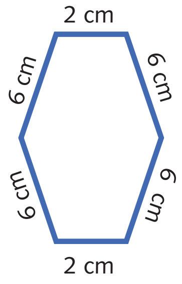

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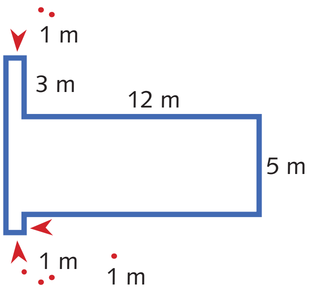

15 Copy this table. Use the lengths and widths given to calculate the perimeter of each rectangle.

Rectangle	Length	Width	Perimeter
a	12 mm	3 mm	_____ mm
b	15 cm	4 cm	_____ cm
c	21 m	8 m	_____ m
d	5 cm	100 cm	_____ cm
e	43 m	17 m	_____ m

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CHAPTER 6 Preparation

Useful skill for this chapter:

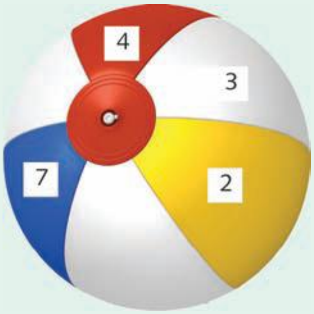
- quick recall of multiplication facts to 12 × 12.

KICK OFF

Beachball

Write the digits 0–9 on stickers placed randomly on a large beachball. Pass the beachball around the classroom. Whoever catches the ball multiplies the digit nearest to their right thumb by:

a 2	**b** 9	**c** 4	**d** 10	**e** 6
f 3	**g** 8	**h** 7	**i** 5	**j** 11



Show what you know

1 Download **BLM 10** 'Multiplication grids' from the Interactive Textbook and complete.

2 Download **BLM 11** 'Squares and rectangles' from the Interactive Textbook and complete.

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CHAPTER

6

Measurement and Geometry

Area

The area of a rectangle is a measure of the amount of material needed to ‘cover’ the rectangle completely, without any gaps or overlaps.

We need to know about measuring area for tasks such as tiling a floor or painting a wall.

How do we go about calculating the area of a rectangle?

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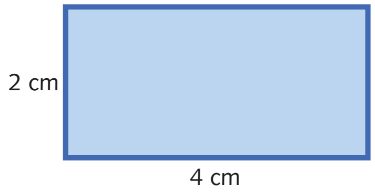
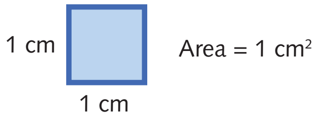
6A Square centimetres

The region inside this rectangle has been shaded.

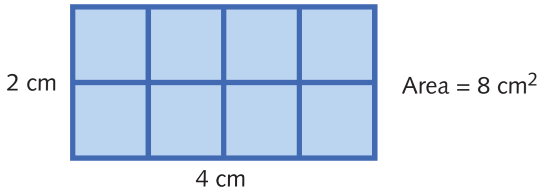


How can we measure how much of the page is covered by the shaded region?
We start with a square that has a side length of 1 unit. We call this a **unit square**.



The rectangle we want to measure is in centimetres, so we use a unit square that measures 1 cm × 1 cm and has an area of 1 square centimetre. The short way of writing 1 square centimetre is 1 cm^2.

To find the area of the rectangle, we count how many square centimetres fit inside it.



We can see that 8 unit squares fit inside, so the rectangle has an area of 8 cm^2.

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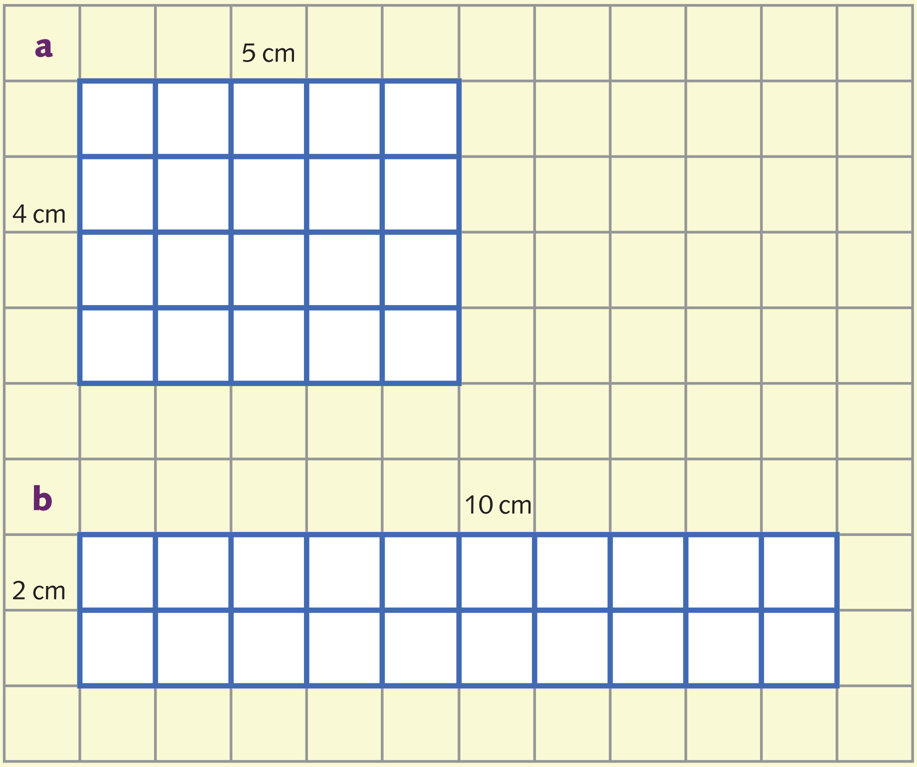
Example 1

These rectangles have been drawn on 1-centimetre grid paper.
Find the area of each rectangle by counting the square centimetres.



Solution

a The rectangle is made up of 20 unit squares. Each unit square covers 1 cm^2, so the area of the rectangle is 20 cm^2.

b The rectangle is made up of 20 unit squares. Each unit square covers 1 cm^2, so the area of the rectangle is 20 cm^2.

Remember

The area of a rectangle is the 'size' of the surface inside it.

We measure area by counting the number of unit squares that fit inside the rectangle without any overlap.

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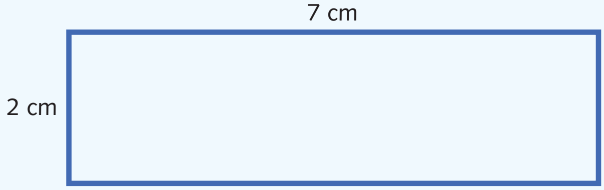
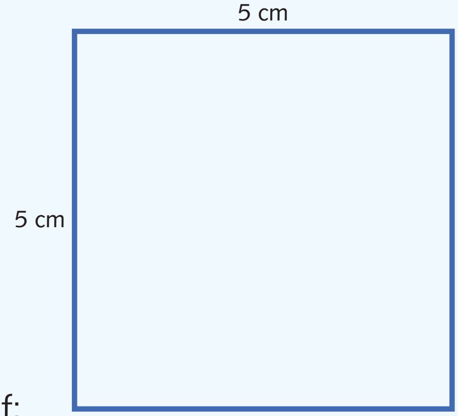
6A Whole class CONNECT, APPLY AND BUILD

1 You will need 1-centimetre grid paper on a transparency to display on an overhead projector (or use gridlines on the interactive whiteboard). Copy these rectangles onto the grid and, as a class, discuss how to find the area of each.

a



b



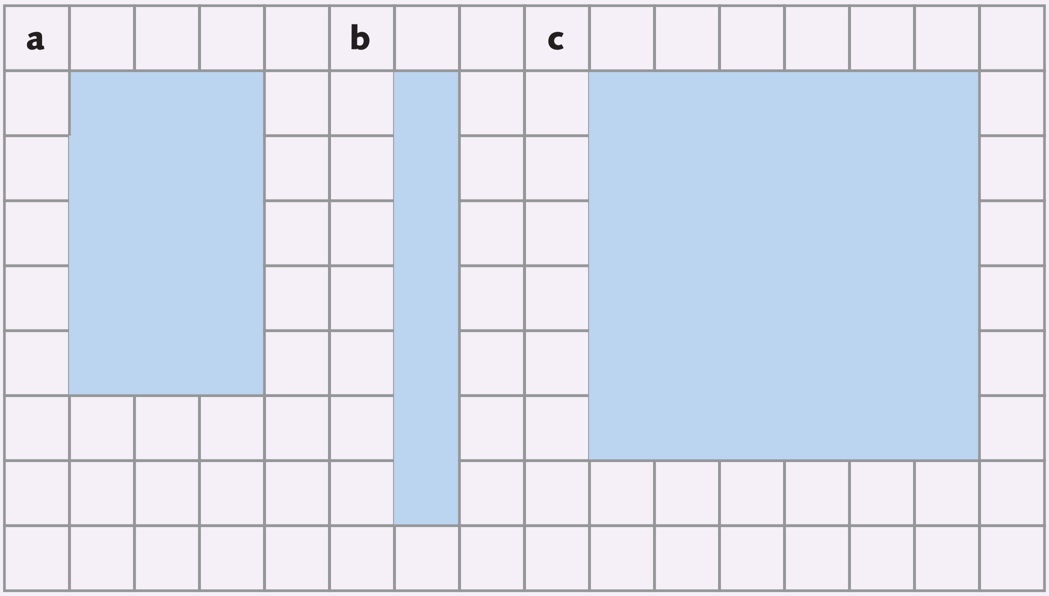
2 Draw two different rectangles, each with an area of:

a 6 cm^2 **b** 12 cm^2 **c** 20 cm^2

3 Draw as many different rectangles as you can that have an area of 24 cm^2. Discuss why you can make so many different rectangles that have the same area.

6A Individual

1 These rectangles are drawn on 1-centimetre grid paper. What is the area of each rectangle?



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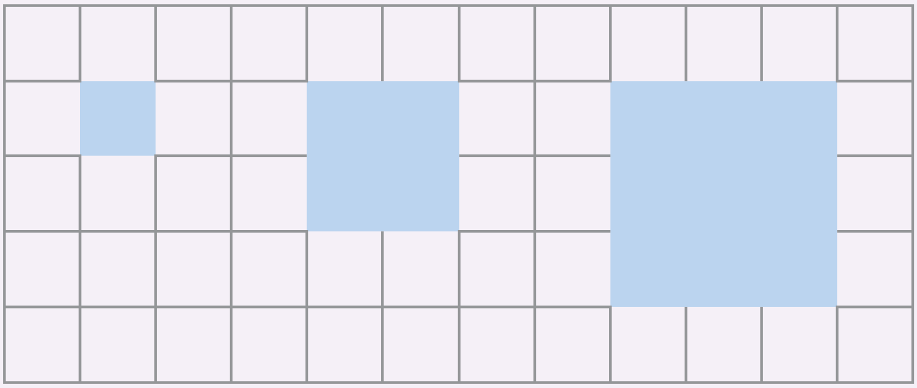
2 What is the area of a:

- **a** 1 cm square?
- **b** 2 cm square?
- **c** 3 cm square?

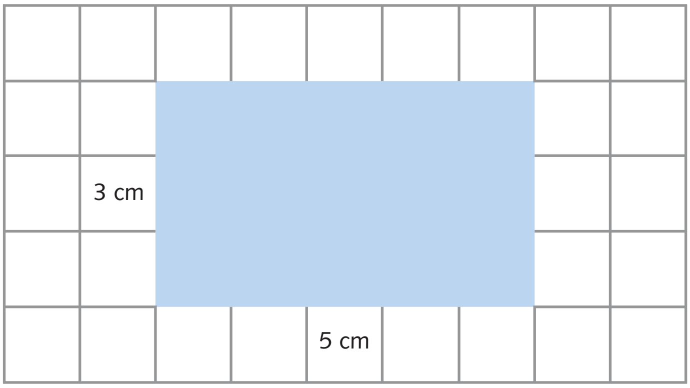


3 Draw the following squares, then mark in the 1 cm gridlines. Calculate the area of each square.

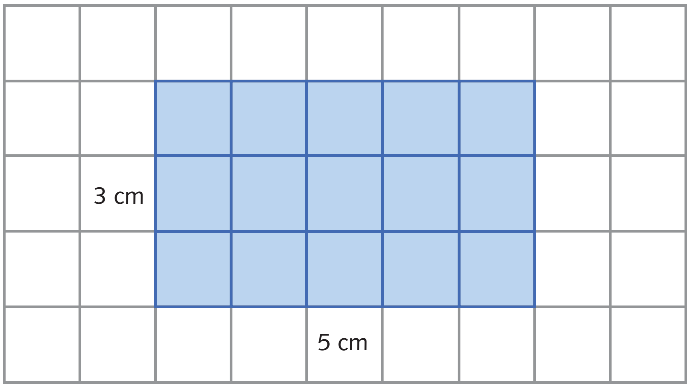
- **a** A square with a side length of 4 cm
- **b** A square with a side length of 5 cm
- **c** A square with a side length of 6 cm
- **d** A square with a side length of 7 cm

6B The formula for calculating area

There is a quicker way of finding the area of a rectangle than counting little squares. We can find the area of a rectangle by finding the product of its length and width.



We can see this by drawing each square centimetre inside the rectangle.



We have 3 rows, each containing 5 unit squares. So we have 3 × 5 squares in total.

The side lengths for the rectangle above are 3 cm and 5 cm.

We can find the area of the rectangle by multiplying its length by its width.

$$\begin{aligned}\text{Area} &= \text{length} \times \text{width}\\ &= 5 \times 3\\ &= 15\text{ cm}^2\end{aligned}$$

This is the formula for calculating the area of a rectangle. It works for all rectangles.

$$\text{Area} = \text{length} \times \text{width}$$

The length and width must use the same unit of measurement and the area will then measure those square units.

A square is a special type of rectangle. Its width and its length are equal.

$$\begin{aligned}\text{Area} &= \text{length} \times \text{length}\\ &= \text{length}^2\end{aligned}$$

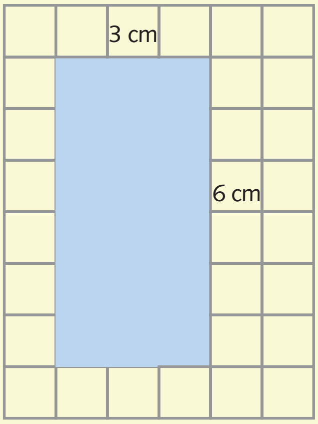
(We read this as 'length squared'.)

Example 2

Calculate the area of a rectangle that is 3 cm wide and 6 cm long.

Solution

$$\begin{aligned}\text{Area} &= \text{length} \times \text{width}\\ &= 6 \times 3\\ &= 18\text{ cm}^2\end{aligned}$$



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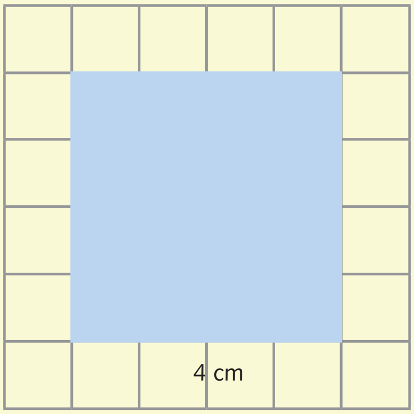
Example 3

Calculate the area of a square with side length 4 cm.

Solution

Area = length^2
= 4×4
= 16 cm^2



Remember

- The formula for calculating the area of a rectangle is:
  area = length × width
- The formula for calculating the area of a square is:
  area = length^2

6B Whole class CONNECT, APPLY AND BUILD

1 Calculate the area of a rectangle with:

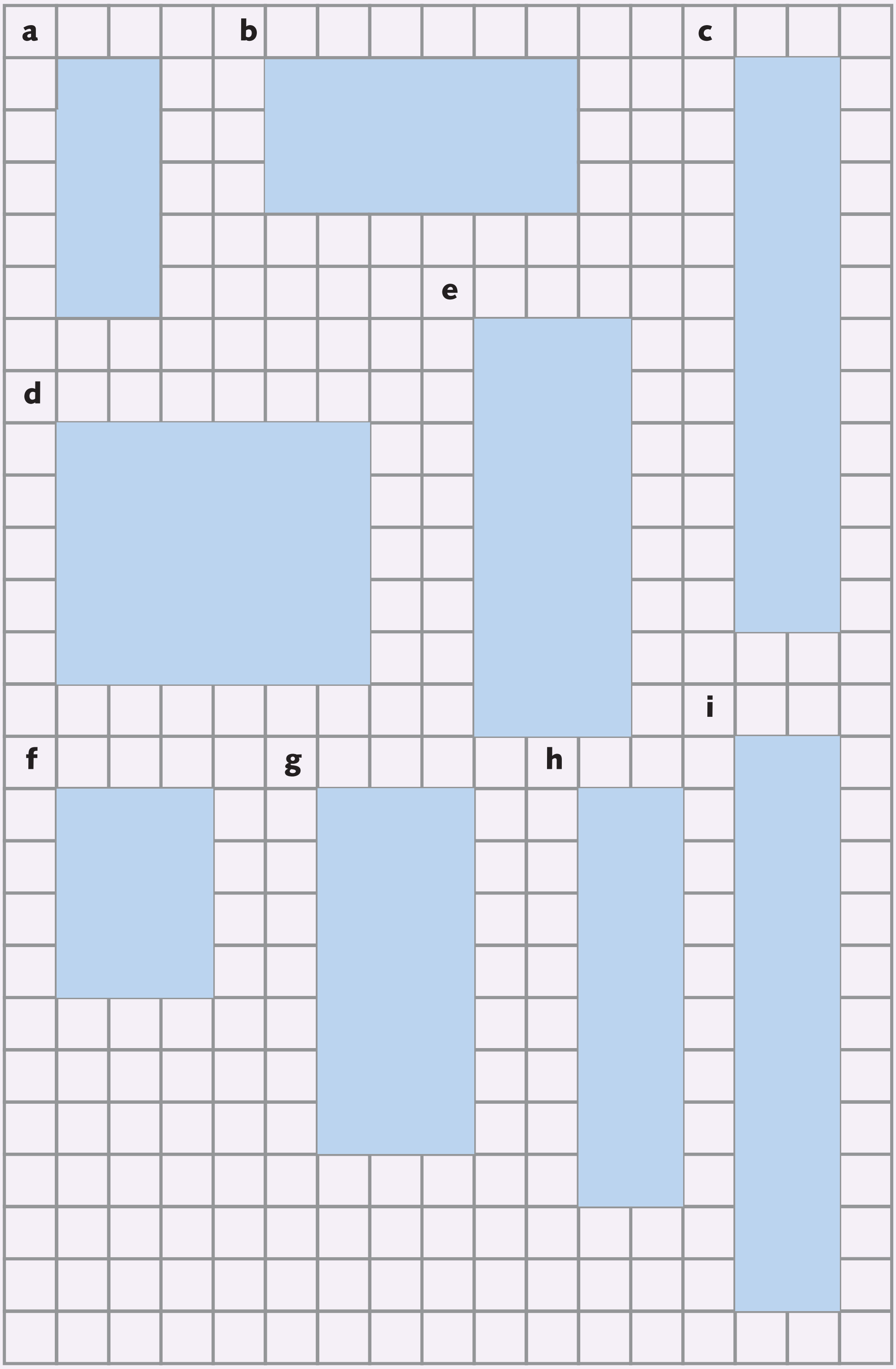
a length = 3 cm, width = 5 cm
b length = 6 cm, width = 3 cm
c length = 15 cm, width = 4 cm
d length = 25 cm, width = 5 cm

2 Samantha drew a rectangle with an area of 24 cm^2. She told her brother Tom that all rectangles with an area of 24 cm^2 have a perimeter of 20 cm. Do you agree with Samantha? Draw three different rectangles, each with an area of 24 cm^2, then discuss whether Samantha's statement is true.

3 Download **BLM 12** 'Another area the same' from the Interactive Textbook and complete.

6B Individual

1 Peta drew these rectangles on 1-centimetre grid paper. Calculate the area of each rectangle using the formula for calculating the area of rectangles.



j Which rectangles have the same area?

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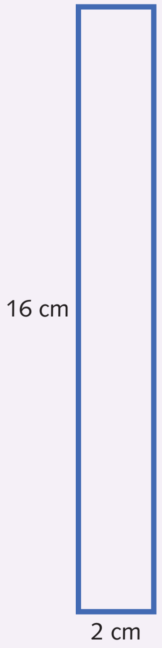
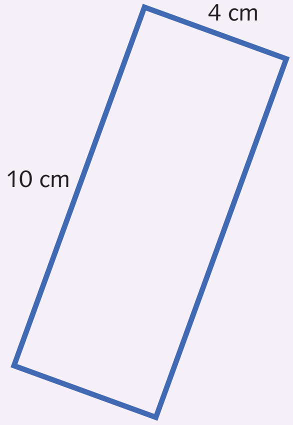
2 Calculate the area of each rectangle. (These rectangles are not drawn to scale.)

a



b



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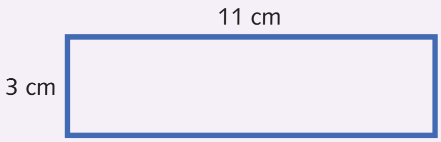

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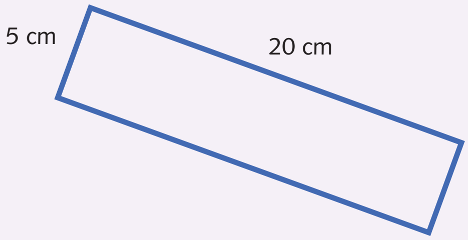

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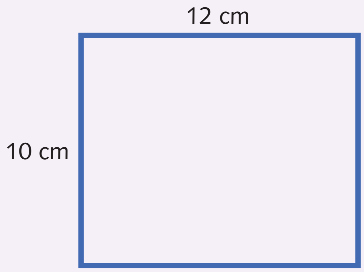

3 Find the area of a square that has a side length of:

a 8 cm **b** 10 cm **c** 7 cm **d** 9 cm

4 Draw three different rectangles, each with an area of 20 cm^2.

5 Copy this table, then calculate the area and perimeter of each rectangle.

	Length	Width	Area	Perimeter
a	9 cm	3 cm	_____ cm^2	_____ cm
b	11 cm	8 cm	_____ cm^2	_____ cm
c	25 cm	10 cm	_____ cm^2	_____ cm
d	100 cm	15 cm	_____ cm^2	_____ cm
e	30 cm	9 cm	_____ cm^2	_____ cm

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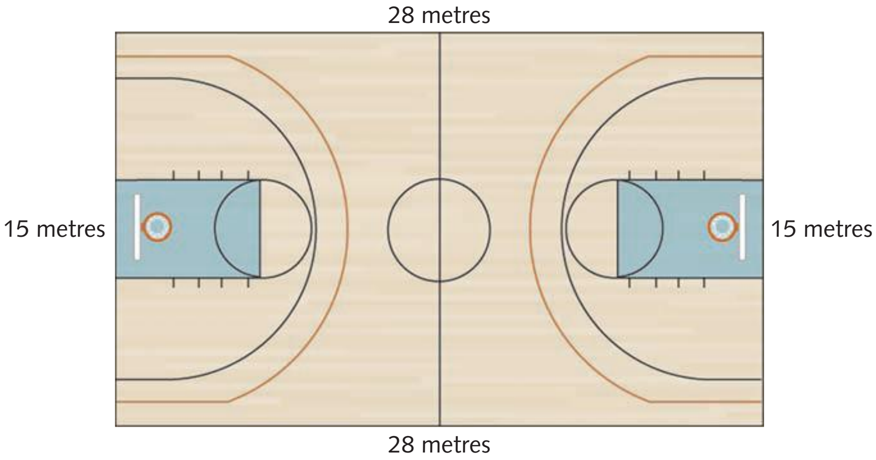
6C Square metres

Square centimetres are useful for measuring and calculating small areas, but a larger unit is needed for measuring larger areas, such as a basketball court or the floor of a classroom. We use square metres.

The basketball court shown below measures 28 metres long and 15 metres wide. To calculate its area, we can use the formula for calculating the area of a rectangle.

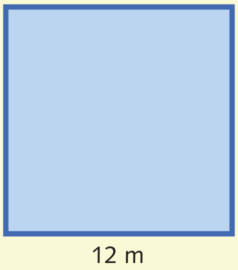


$$\begin{aligned}\text{Area} &= \text{length} \times \text{width}\\ &= 15 \times 28\\ &= 420\ \text{m}^2\end{aligned}$$

The area of the basketball court is 420 square metres. This is written as 420 m^2.

Example 4

Calculate the area of the floor of a square classroom with side length 12 m.



Solution

$$\begin{aligned}\text{Area} &= \text{length}^2\\ &= 12 \times 12\\ &= 144\ \text{m}^2\end{aligned}$$

The area of the classroom is 144 square metres.

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6C Whole class CONNECT, APPLY AND BUILD

1 Calculate the area of:

a one car space in the school car park

b the floor of the school library

c your desktop

d the floorspace taken up by your chair

2 Draw these rectangles and fill in the blanks.

a Length = 3 cm, width = ____cm, area = 12 cm^2

b Width = 10 cm, length = ____cm, perimeter = 24 cm^2, area = ____cm^2

c Perimeter = 28 cm, area = 49 cm^2, length = ____ cm, width = ____ cm

3 **a** Tape together or cut up sheets of newspaper to make:

- **i** a square with side lengths of 1 metre
- **ii** a rectangle with side lengths of 50 centimetres and 2 metres
- **iii** a rectangle with side lengths of 25 centimetres and 4 metres.

b Calculate the perimeter and area of each newspaper shape. What do you notice?

c Could you make another rectangle with the same area? What might the side lengths be?

4 **a** Calculate the area of your classroom floor.

b Calculate the area of one wall in your classroom.

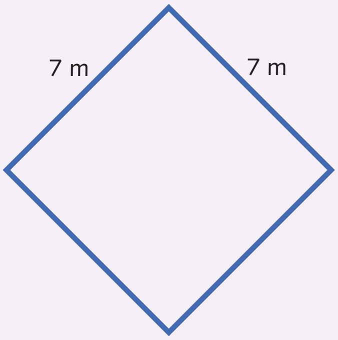
c If it costs $2 to paint one square metre, how much will it cost to paint the wall?

6C Individual

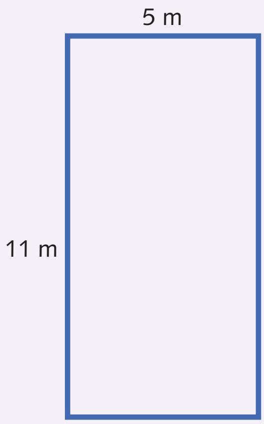
1 Calculate the area of each rectangle.

a

b



c



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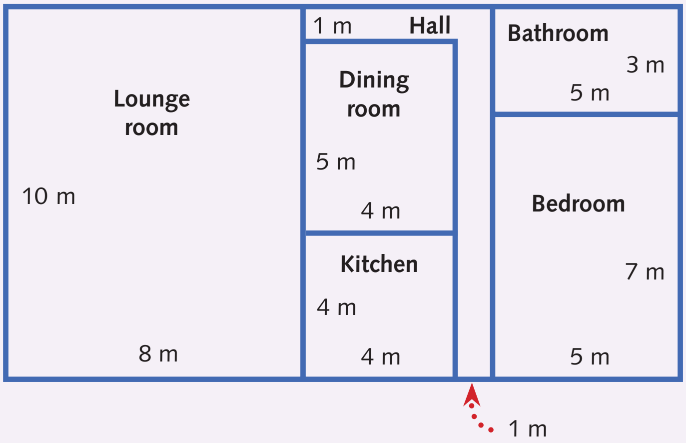
2 Copy this table, then calculate the area and perimeter of each rectangle.

	Length	Width	Area	Perimeter
a	3 m	4 m	_____ m²	_____ m
b	5 m	8 m	_____ m²	_____ m
c	25 m	2 m	_____ m²	_____ m
d	10 m	12 m	_____ m²	_____ m
e	8 m	9 m	_____ m²	_____ m

3 This is a plan of Kim's home. Calculate the area of each room and the hall.



4 **a** Calculate the area of a square that has side lengths of:

i 1 metre
ii 3 metres
iii 1 kilometre
iv 3 centimetres
v 12 millimetres
vi 4 metres
vii 6 kilometres
viii 10 metres

b Where do these areas appear on the multiplication table?

5 Jacqui sells plastic grass at a price of $100 per square metre.

a Adrian wants to cover an area of 27 m². How much will Jacqui charge him?

b Lucas wants to cover a square with side lengths of 6 metres. How much will Jacqui charge him?

Homework

1 Estimate the areas of two different towels. Check your answers by measuring both towels and calculating their areas.

2 Measure the length and width of your bedroom floor. Then measure the length and width of the smallest and largest rooms in your home. Sketch a simple plan and include all of your measurements. Draw up a table showing the measurements and area of each room.

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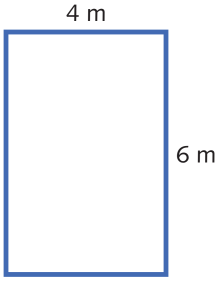
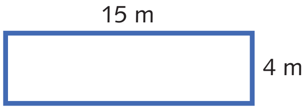
6D Review questions

1 Calculate the area of each rectangle. (They are not drawn to scale.)

a



b



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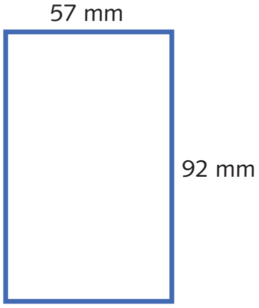

2 Find the area of a square with side length:

a 4 m **b** 15 cm **c** 21 mm

3 Draw a rectangle with an area of:

a 60 cm^2 **b** 36 m^2 **c** 96 mm^2

4 Draw two rectangles with the same area, but different perimeters.

5 Draw two rectangles with the same perimeter, but different areas.

6 **a** Complete the following table.

Rectangle	Length	Width	Area	Perimeter
A	6 cm	8 cm	_____ cm^2	_____ cm
B	5 cm	10 cm	_____ cm^2	_____ cm
C	11 cm	_____ cm	33 cm^2	_____ cm
D	9 cm	_____ cm	36 cm^2	_____ cm
E	_____ cm	5 cm	35 cm^2	_____ cm
F	_____ cm	9 cm	27 cm^2	_____ cm

b Write the order for area from smallest to largest.

c Write the order for perimeter from smallest to largest.

d Which rectangles changed order in parts **b** and **c**?

7 There are six rectangles of these sizes.

A 4 m by 2 m **B** 5 m by 2 m **C** 6 m by 2 m

D 9 m by 2 m **E** 10 m by 2 m **F** 15 m by 2 m

a Calculate the areas of all of the rectangles.

b Which two rectangles have a total area of 50 m^2?

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CHAPTER 7 Preparation

Useful skills for this chapter:

- experience with reading scales on tape measures and measuring containers
- the ability to measure length using a ruler or tape measure
- previous experience drawing three-dimensional objects.

KICK OFF

1 Multiply each number by 2, then by 4.

a 4 **b** 2 **c** 8 **d** 12

2 Multiply each number by 5, then by 3.

a 1 **b** 2 **c** 12 **d** 20

Show what you know

Multiplying three numbers

Play this game with a partner. Take turns to roll three different-coloured dice at the same time. Then multiply the three numbers. For example:

$$5 \times 3 \times 2 = 30$$

Download **BLM 13** 'Multiplying three numbers' from the Interactive Textbook and record your scores as a running total.

CHAPTER

7

Measurement and Geometry

Volume

Volume is a measurement of ‘how large’ the inside of a container is.

We need to know about volume when we are packing boxes, filling a water tank or working out how much sand is needed for a sandpit.

In this chapter we look at the volume of solids and the measurement of liquids, as both use the same ideas.

How do we calculate the volume of a rectangular box? Would sitting inside it help you work it out?

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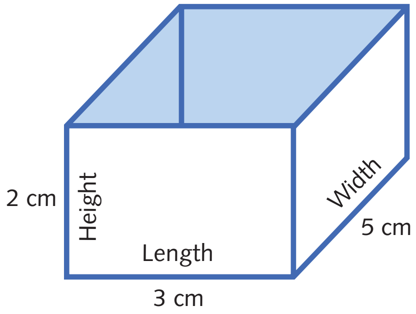
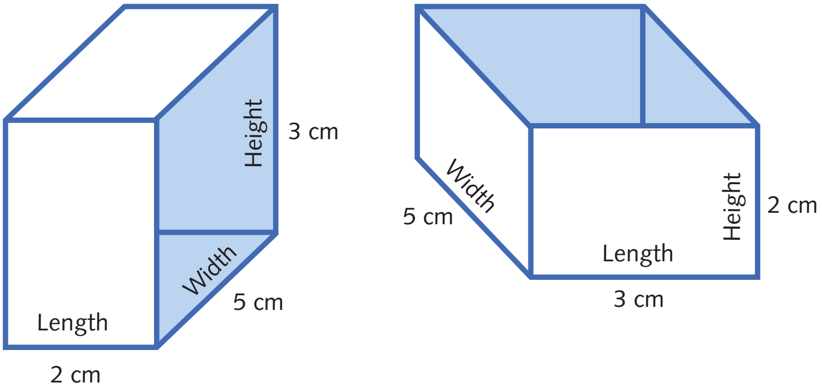
7A Cubic centimetres

This is an open rectangular box. The measurements of this box are:

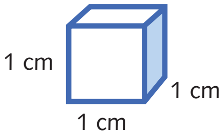
length = 3 cm, width = 5 cm, height = 2 cm



It does not matter which measurements we call the length, width or height. If we turn the box around, its dimensions are the same.



How can we measure the volume of the inside of this box? To do this, we start with a cube of side length 1 cm and call it a 'unit cube'.



Volume = 1 cm^3

We say its volume is 1 cubic centimetre because it is 1 cm × 1 cm × 1 cm. The short way of writing 1 cubic centimetre is 1 cm^3.

A good example of a cubic centimetre (1 cm^3) is a base-10 one. A centicube is also a cubic centimetre. We can use base-10 ones or centicubes to measure how large the inside of a rectangular box is.

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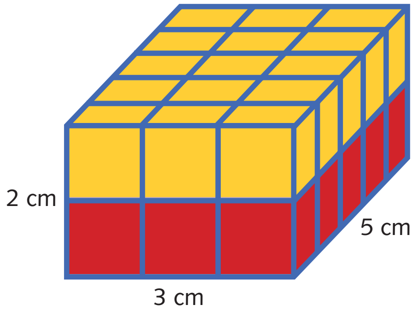
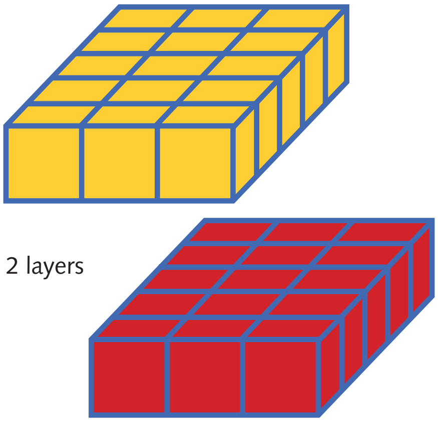
This diagram shows the box filled with unit cubes. It has two layers. Each layer is shown in a different colour.





Each layer contains 3 cubes in its width and 5 cubes in its length, making 3 × 5 = 15. Each unit cube has a volume of 1 cm^3, so this means one layer has a volume of 15 cm^3.

There are 2 layers of cubes. So the volume of the rectangular box is 2 × 15, or $2 \times 3 \times 5$ cm^3, making 30 cm^3.

The volume of a rectangular box in cubic centimetres is the number of centimetre cubes that fit inside it.

A solid in the shape of a rectangular box is called a rectangular prism. It has 6 faces. Each face is a rectangle.

A cube is a special kind of rectangular prism. Each of its 6 faces is a square.

Example 1

Find the volume of a rectangular box measuring 5 cm long, 8 cm wide and 3 cm high.

Solution

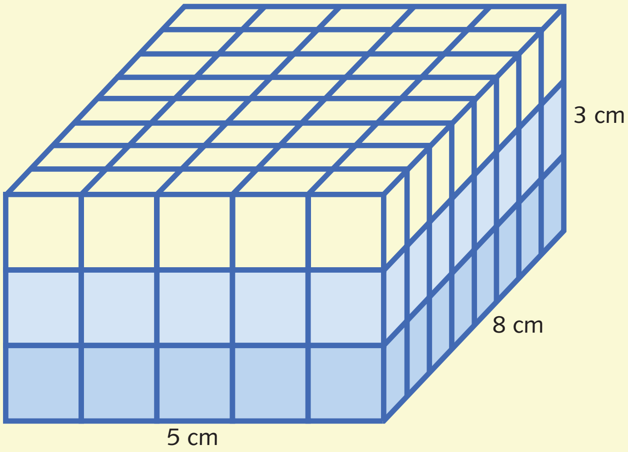
Use base-10 ones to construct the rectangular box.

Each layer has 5 × 8 cubes, or 40 cm^3.

There are 3 layers.

So the volume of the rectangular box:

$$= 5 \times 8 \times 3$$
$$= 120 \text{ cm}^3$$



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Example 2

Find the volume of a cube measuring 3 cm long, 3 cm wide and 3 cm high.

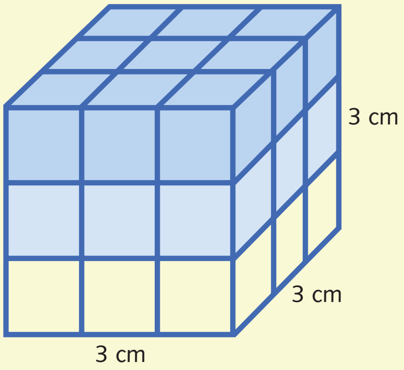
Solution

Each layer has 3 × 3 cubes, or 9 cm^3.

There are 3 layers. The volume:

$= 3 \times 3 \times 3$

$= 27\ cm^3$



Remember

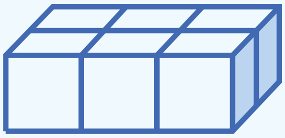
Volume is a measurement of how large the inside of a container is.

The volume of a rectangular box in cubic centimetres is the number of 1 cm × 1 cm × 1 cm cubes that fit inside it.

7A Whole class CONNECT, APPLY AND BUILD

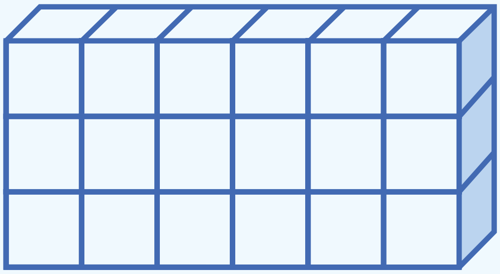
1 Use base-10 ones or centicubes to build these rectangular prisms. Then find the volume of each rectangular prism by counting the number of cubes.

a



Volume = _____ cm^3

b



Volume = _____ cm^3

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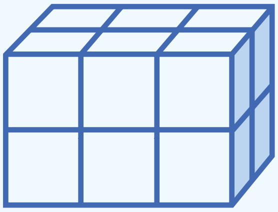
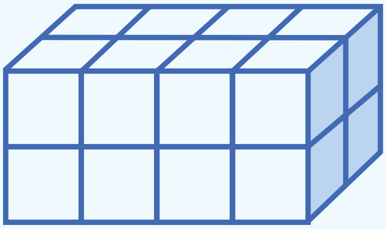
c



Volume = _____ cm^3

d

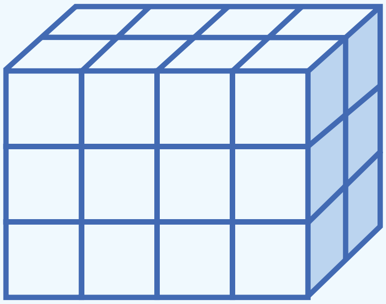


Volume = _____ cm^3

2 **a** Use base-10 ones or centicubes to build the rectangular prism on the right. Then find its volume by counting the number of cubes used.

b Use the same number of cubes to construct three other rectangular prisms, each with the same volume. Sketch your three prisms.

c Look at the prism in part **a**. Work out the number of cubes it contains by multiplying its length, width and height.



7A Individual

1 Write these measurements in cm^3. The first one has been done for you.

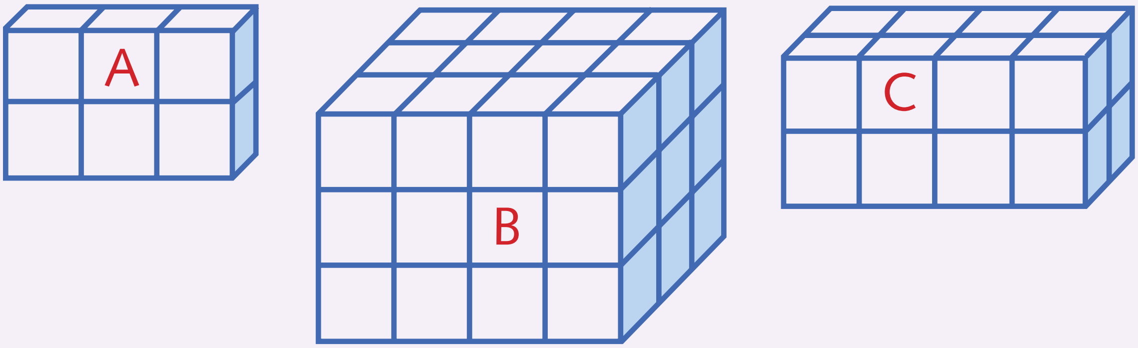
a 10 cubic centimetres = 10 cm^3

b 25 cubic centimetres = ______

c 60 cubic centimetres = ______

d 48 cubic centimetres = ______

2 **a** Use base-10 ones or centicubes to build these rectangular prisms.



b Count the number of blocks you use in each layer, then add them together to find the volume of each prism.

c List the prisms in order of volume, from smallest to largest.

d Work out the number of cubes in each prism by multiplying instead of counting.

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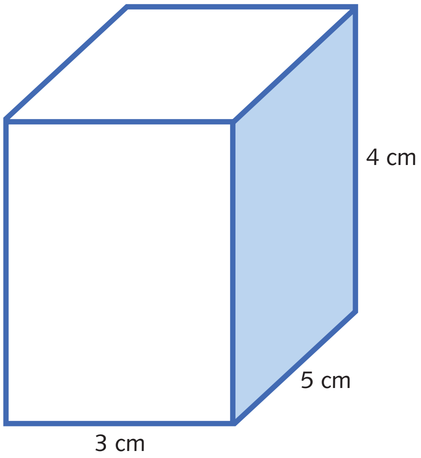
3 Use base-10 ones or centicubes to build rectangular prisms with these dimensions. Count the number of blocks you use and find the volume of each prism.

	Length	Width	Height	Tally	Volume
a	4 cubes	2 cubes	2 cubes		_____ cm^3
b	4 cubes	3 cubes	2 cubes		_____ cm^3
c	5 cubes	2 cubes	2 cubes		_____ cm^3
d	3 cubes	2 cubes	2 cubes		_____ cm^3

7B The formula for calculating volume

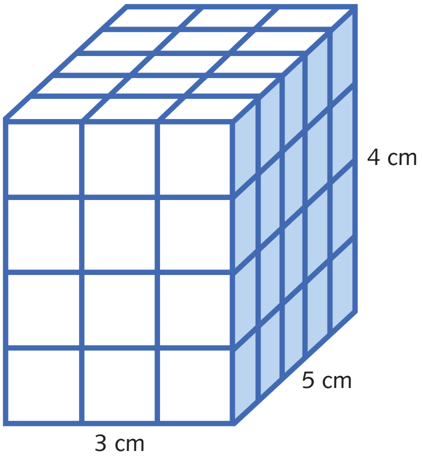
We can find the area of a rectangular prism by finding the product of its length, width and height. This is quicker than counting lots of little cubes.



The side lengths of this rectangular prism are 3 cm, 5 cm and 4 cm.

Each layer of the prism has 3 × 5 = 15 cubic centimetres.

There are 4 layers, so we have
$3 \times 5 \times 4$ cm^3 = 60 cm^3 in total.



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So, the volume of the prism is the product of its length, its width and its height.

$$\begin{aligned}\text{Volume} &= \text{length} \times \text{width} \times \text{height}\\ &= 3 \times 5 \times 4\\ &= 60\ \text{cm}^3\end{aligned}$$

This is the formula for calculating the volume of a rectangular prism.

It works for all rectangular prisms. Make sure you have the same unit for the length, width and height.

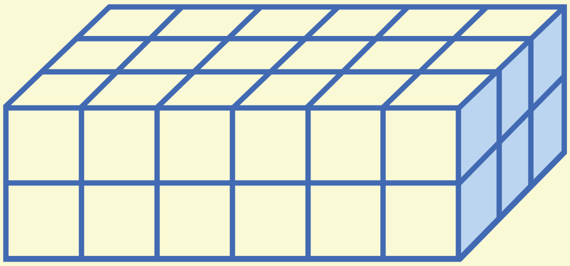
$$\boxed{\text{Volume} = \text{length} \times \text{width} \times \text{height}}$$

Example 3

Calculate the volume of a rectangular prism with length 6 cm, width 3 cm and height 2 cm.

Solution

$$\begin{aligned}\text{Volume} &= \text{length} \times \text{width} \times \text{height}\\ &= 6\ \text{cm} \times 3\ \text{cm} \times 2\ \text{cm}\\ &= 36\ \text{cm}^3\end{aligned}$$



A cube is a special rectangular prism because its length, width and height are equal. The formula for finding the volume of a cube is:

$$\boxed{\begin{aligned}\text{Volume} &= \text{length} \times \text{length} \times \text{length}\\ &= \text{length}^3\end{aligned}}$$

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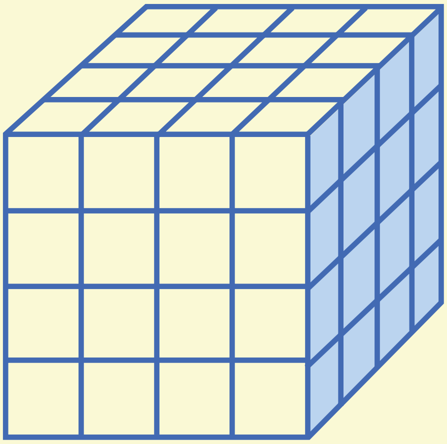
Example 4

Calculate the volume of a cube with side length 4 cm.

Solution

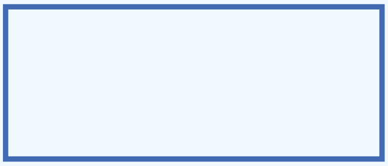
$$\begin{aligned}\text{Volume} &= \text{length}^3 \\ &= 4\text{ cm} \times 4\text{ cm} \times 4\text{ cm} \\ &= 64\text{ cm}^3\end{aligned}$$



7B Whole class CONNECT, APPLY AND BUILD

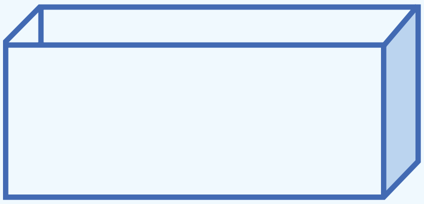
1 Follow these steps for drawing rectangular prisms and cubes.

a Start by drawing a rectangle.



b Draw two more lines at the top and the side.

c Draw short lines to join the sets of long lines together. You now have a drawing of a rectangular prism, or an open box.



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2 **a** Collect some small boxes and measure their length, width and height to the nearest centimetre.

b Use the formula for calculating the volume of a rectangular prism to estimate the volume of each box. (It is not a completely accurate measurement because you have rounded the measurements for length, width and height.)

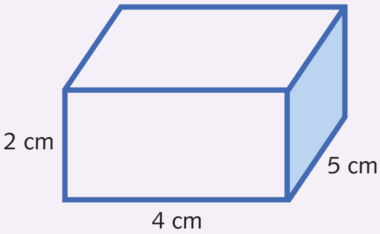
c Write a label for each box explaining how you calculated its volume.

3 Build a model of a cubic centimetre using clay, plasticine, paper or cardboard.

7B Individual

1 Calculate the volume of each rectangular prism. (They are not drawn to scale.)

a



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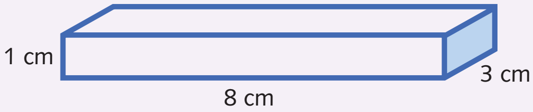

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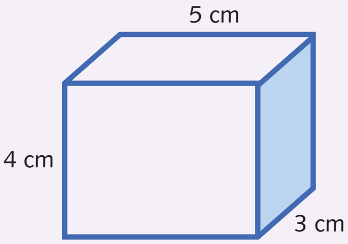

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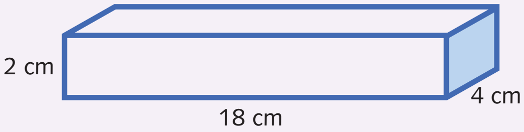

2 Calculate the volume of each rectangular prism.

	Length	Width	Height	Volume
a	5 cm	4 cm	3 cm	____ cm^3
b	2 cm	10 cm	4 cm	____ cm^3
c	12 cm	5 cm	2 cm	____ cm^3
d	6 cm	3 cm	10 cm	____ cm^3

3 Calculate the volume of a cube that has side length:

a 1 cm **b** 2 cm **c** 3 cm **d** 4 cm

e 5 cm **f** 6 cm **g** 7 cm **h** 8 cm

4 **a** Calculate the volume of a box with length 14 cm, width 13 cm and height 15 cm.

b What is the volume of rice in the box if it is filled to a height of 10 cm?

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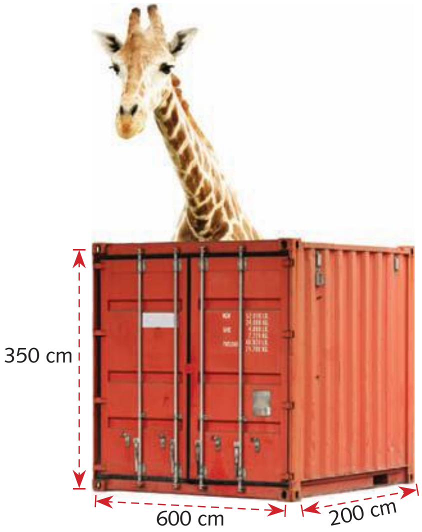
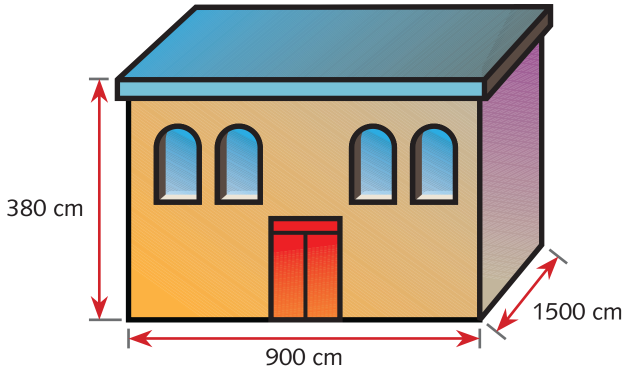
7C Cubic metres

It is not always practical to use a small measuring unit like a cubic centimetre for measuring volume. The object might be so large that you get huge numbers.



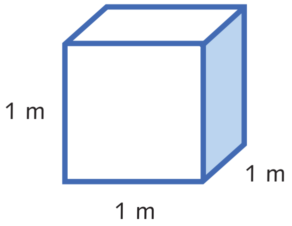
Volume = 42 000 000 cm^3



Volume = 513 000 000 cm^3

We use a larger unit of measurement for larger objects: we use the metre. The **cubic metre** is used when measurements are made in metres.

We use the metre to measure the length of large objects. The basic unit to measure their volume is a cube of 1 m × 1 m × 1 m. Its volume is called 'one cubic metre'.



Volume = 1 m^3

We then use the formula for calculating volume to calculate the volume in cubic metres.

Example 5

This shipping container measures 6 m × 2 m × 2 m. Calculate its volume.

Solution

$$\begin{aligned}\text{Volume} &= 6\text{ m} \times 2\text{ m} \times 2\text{ m}\\ &= 24\text{ m}^3\end{aligned}$$

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Example 6

Calculate the volume of a rectangular prism with dimensions length = 50 cm, width = 2 m and height = 3 m.

Solution

First convert 50 cm to metres so that all units are the same:
50 cm = 0.5 m

$$\begin{aligned} V &= l \times w \times h \\ &= 0.5 \times 2 \times 3 \\ &= 3\text{ m}^3 \end{aligned}$$

Remember

Cubic metres are used to measure the volume of large objects.

7C Whole class CONNECT, APPLY AND BUILD

1 Name three objects that have a volume of:

- **a** about 1 m^3
- **b** more than 1 m^3
- **c** less than 1 m^3

2 You are going to make a model of a cubic metre.

- **a** Predict whether you will be able to fit it through the door of the classroom or through a window.
- **b** Use rolled-up newspaper and tape to make a hollow structure with dimensions: L = 1 m, W = 1 m, H = 1 m. The rolled newspaper will become the edges of a box with a volume of 1 m^3.
- **c** How many people can comfortably fit inside your cubic metre?
- **d** How many cubic centimetres equal one cubic metre?

3 **a** Find at least four different groups of three numbers that give an answer of 36 when multiplied. For example, 1 × 1 × 36 = 36.

b Write the measurements of four different rectangular prisms that have a volume of 36 m^3.

4 **a** Make an estimate (or approximation) of the volume of your classroom by measuring its length, width and height to the nearest metre.

b Air has a mass of approximately 1.2 kilograms for every cubic metre at a temperature of 20°C. Calculate the approximate mass of the air in your classroom.

5 **Popcorn container**

You will need a small amount of popped corn, some un-popped corn, cooking facilities for popping corn, and paper, tape and scissors.

a Take one piece of popped corn. Calculate its approximate volume.

b Design and construct a closed container that could hold 100 pieces of popped corn.

c Pop 100 pieces of corn and see if your container is the right size.

d Discuss the issues involved in this activity.

7C Individual

1 Classify the objects below into these three groups:

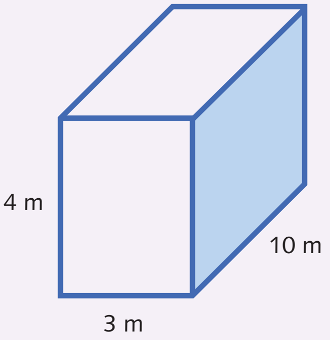
Volume is less than 1 m^3	Volume is more than 1 m^3 but less than 10 m^3	Volume is more than 10 m^3

a A telephone box **b** A swimming pool **c** A schoolbag

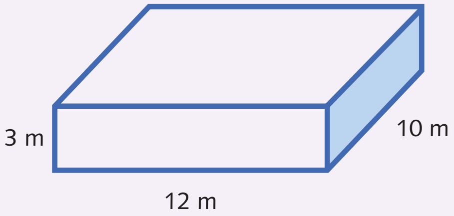
d Your classroom **e** Your bathroom at home **f** A shoe box

2 Calculate the volume of each rectangular prism. (They are not drawn to scale.)

a



b



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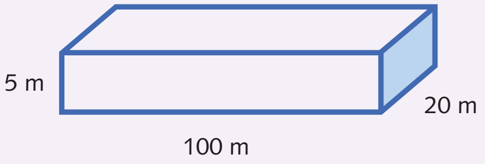
c



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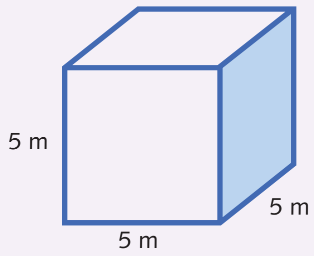


3 Calculate the volume of the rectangular prisms in this table.

	Length	Width	Height	Volume
a	5 m	4 m	3 m	____ m^3
b	2 m	10 m	4 m	____ m^3
c	12 m	5 m	2 m	____ m^3
d	6 m	3 m	10 m	____ m^3
e	7 m	10 m	4 m	____ m^3

4 Calculate the volume of a cube with side length:

a 3 m

b 7 m

c 10 m

5 Calculate the volume of these rectangular prisms. Give the volume in cubic metres.

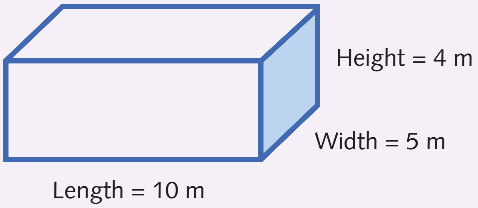
a L = 20 cm, W = 3 m, H = 2 m

b H = 4 m, W = 50 cm, L = 6 m

c H = 4 m 50 cm, L = 1 m, W = 0.05 m

d W = 0.02 m, L = 0.12 m, H = 10 m

6 This is a rectangular prism.



a Calculate the volume of the rectangular prism.

b What happens to the volume if you double only the length?

c What happens to the volume if you double the length *and* the width?

d What happens to the volume if you double all of the dimensions?

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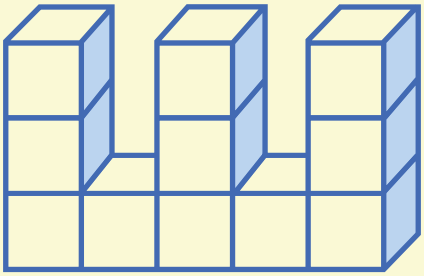
7D Finding the volume of solid objects

You can also find the volume of objects that are not rectangular prisms.

Example 7

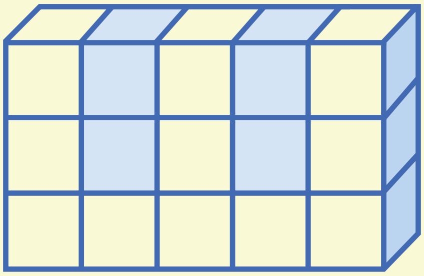
This object is made up of 1 cm × 1 cm × 1 cm cubes.



a Count the cubes to find the volume of the object.

b How many more cubes would you need to make a 5 cm × 1 cm × 3 cm rectangular prism?

Solution

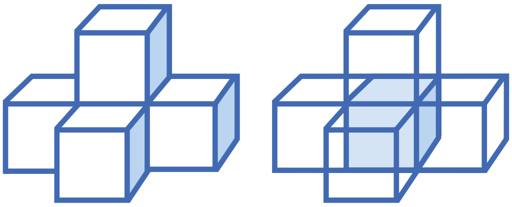


a Counting cubes gives a total volume of 11 cm^3.

b A 5 cm × 1 cm × 3 cm rectangular prism has a volume of 15 cm^3.

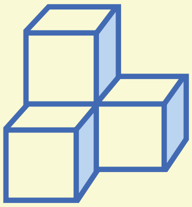
The object needs four more unit cubes to become a 5 cm × 1 cm × 3 cm rectangular prism.

Some objects have cubes that are hidden. You need to get used to picturing or 'seeing' the hidden cubes.



Example 8

This object is made from 2 cm^3 cubes.



a Count the cubes to find the volume of the object.

b How many more cubes are needed to make a 2 cm × 2 cm × 2 cm cube?

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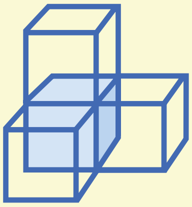
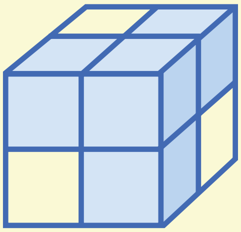
Solution

a Counting cubes, including the cube hidden in the corner, gives a total volume of 4 cm^3.

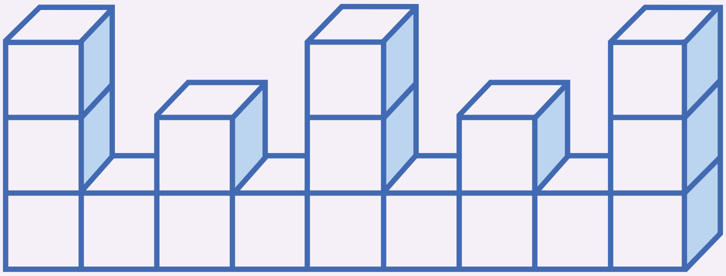


b A 2 cm × 2 cm × 2 cm cube has a volume of 8 cm^3. The object above needs four more 1 cm^3 cubes to become a 2 cm × 2 cm × 2 cm cube.



7D Individual

1 This object was made from 1 cm × 1 cm × 1 cm cubes.



a How many 1 cm × 1 cm × 1 cm cubes have been used to make it?

b How many more cubes are needed to make a 9 cm × 1 cm × 3 cm prism?

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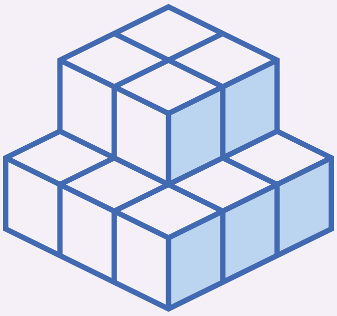
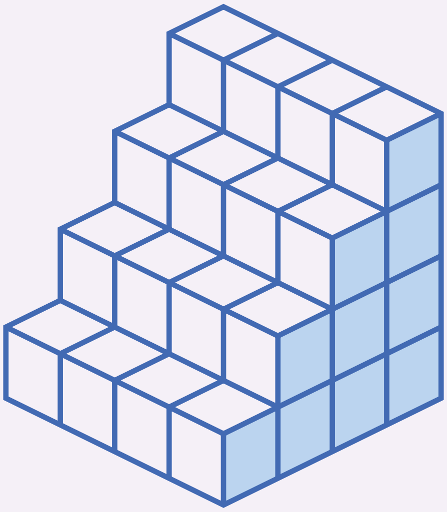
2 This object was built from 1 cm cubes.



a How many 1 cm × 1 cm × 1 cm cubes were used to build this object?

b How many more 1 cm^3 cubes would you need to make a 3 cm × 3 cm × 3 cm cube?

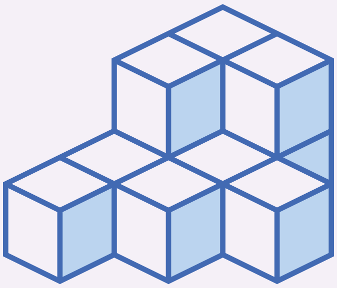
3 This staircase was built from 1 cm cubes.



a How many 1 cm × 1 cm × 1 cm cubes were used to build these stairs?

b How many more 1 cm × 1 cm × 1 cm cubes would you need to make a 4 cm × 4 cm × 4 cm cube?

4 This object was made from 1 cm × 1 cm × 1 cm cubes.



a How many 1 cm × 1 cm × 1 cm cubes were used?

b How many more 1 cm × 1 cm × 1 cm cubes would you need to make a 4 cm × 3 cm × 2 cm rectangular prism?

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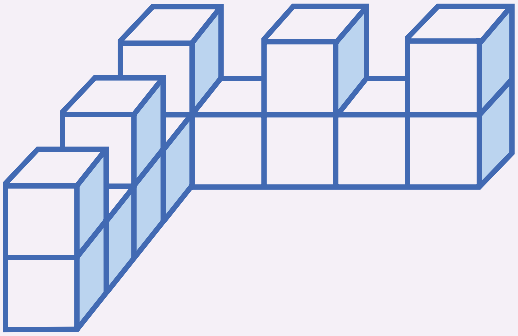
5 This object was made from 1 cm × 1 cm × 1 cm cubes.



a How many 1 cm × 1 cm × 1 cm cubes were used?

b How many more 1 cm × 1 cm × 1 cm cubes would you need to make a 5 cm × 5 cm × 2 cm prism?

c How many different ways can you work out the answer to part **b**? Show at least one other solution.

7E Liquid measure

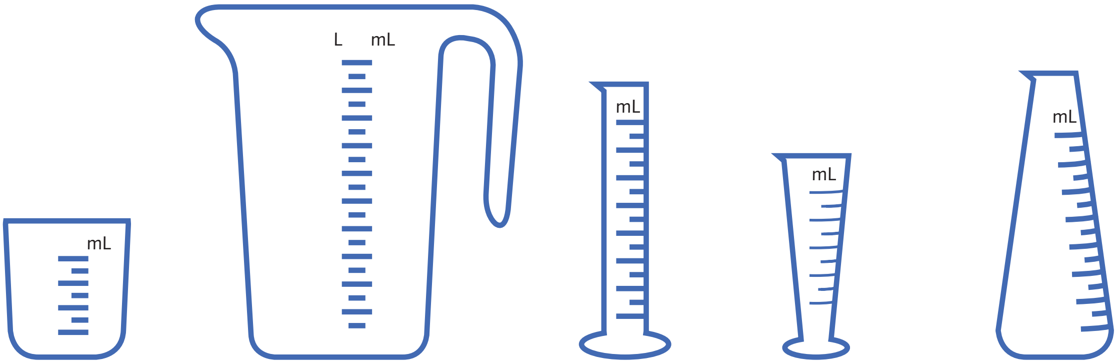
The volume of a container or prism can be measured in cubic centimetres or cubic metres. There is a special way of measuring volume when liquids or gases are involved. We use millilitres (mL) or litres (L).

1000 millilitres = 1 litre

We use a variety of different measuring containers to measure liquid volume.

The word **capacity** is used to describe how much liquid a container can hold. A jug that holds 1 litre has a reduced capacity of 1 litre, even if it does not actually have any liquid in it.

Measuring jugs and containers have scales on their sides that are marked with lines. These lines are called **calibrations** or **graduated scales**, and they enable you to measure liquids accurately.



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It is important that you have your eye level with the top of the liquid in the container when you are measuring. This enables you to read the scale accurately.

Did you know? 1 millilitre of water weighs 1 gram and has a volume of 1 cm^3.

Example 9

a Ali drank 1 litre 250 millilitres of soft drink. How many millilitres is that?
b Nadia drank 1340 millilitres of juice. What is that in litres and millilitres?

Solution

a 1 litre 250 millilitres = 1000 mL + 250 mL
= 1250 mL

b 1340 millilitres = 1000 mL + 340 mL
= 1 litre 340 mL

Remember

Litres (L) and millilitres (mL) are used to measure the volume of liquids and the capacity of containers.

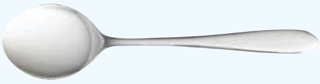
7E Whole class CONNECT, APPLY AND BUILD

1 Estimate, then measure, the capacity of these containers in millilitres.

a A mug

b The lid of a soft-drink bottle

c A dessert spoon



2 Find two containers that you estimate will hold less than 1 litre of water. Estimate how many millilitres each container holds. Check your estimates by pouring water into a measuring jug marked in millilitres.

3 Find two containers that you estimate will hold more than 1 litre of water. Estimate how many litres each container holds. Check your estimates by pouring water into a measuring jug marked in litres.

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7E Individual

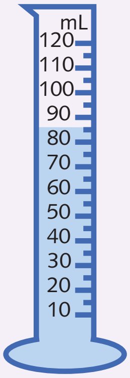
1 Would you use millilitres (mL) or litres (L) to measure the amount of liquid in:

a the petrol tank of a car?
b a teacup?
c a medicine bottle?
d a bucket of water?
e a soup bowl?
f a large fire extinguisher?

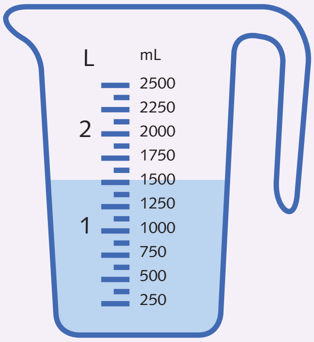
2 Read the scale for each measurement.

a

b



c



3 Convert these measurements to millilitres.

a 1 litre
b 2 litres
c 5 litres 200 millilitres
d 27 litres
e 7 litres 100 millilitres
f 13 litres 100 millilitres

4 Convert these measurements to litres, or litres and millilitres.

a 3000 mL
b 5000 mL
c 10 000 mL
d 1350 mL
e 4444 mL
f 10 505 mL

5 Annabella has a 2-litre, a 3-litre and a 1.5-litre container. She has a bucket with 4750 mL in it. How much more water will she need to fill the three containers?

6 A container full of oil is 15 cm long, 10 cm deep and 30 cm high. What volume of oil does it contain?

7 Which rectangular container holds more liquid?

a L = 10 cm H = 4 cm W = 5 cm
b L = 12 cm H = 3 cm W = 6 cm
c L = 9 cm H = 7 cm W = 3 cm

8 Victoria filled her 130 cm long rectangular bath with water. The bath is 60 cm wide and 40 cm deep. What volume of water is in the bath if she fills the bath to:

a 5 cm?
b 10 cm?
c 27 cm?
d 40 cm?

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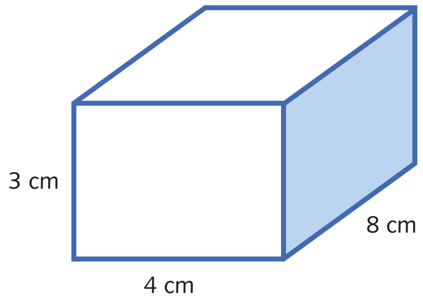
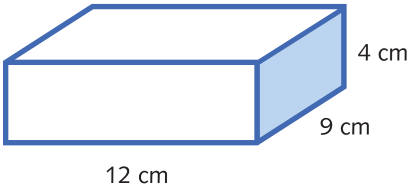
7F Review questions

1 Calculate the volume of each rectangular prism. (The prisms are not drawn to scale.)

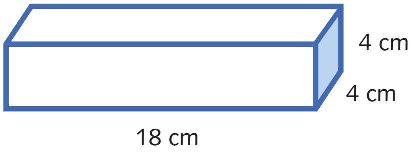
a



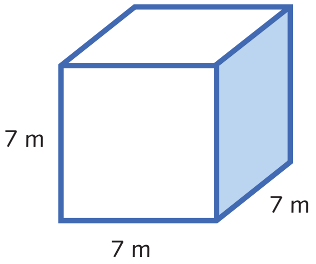
b



c



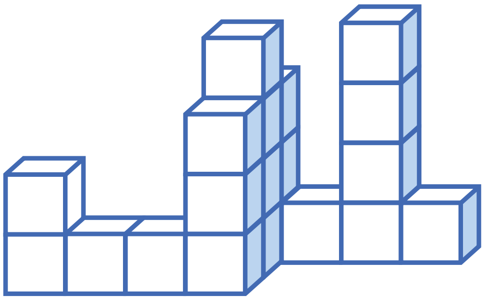
d



2 Calculate the volume of rectangular prisms with the following dimensions.

	Length	Width	Height	Volume
a	5 cm	8 cm	4 cm	_____ cm^3
b	7 m	3 m	5 m	_____ m^3
c	9 cm	3 cm	3 cm	_____ cm^3
d	3 m	2 cm	9 cm	_____ m^3

3 This figure was made from centicubes.



a What is its volume in cm^3?

b How many more unit cubes are needed to make a $7 \times 3 \times 4\ \text{cm}^3$ rectangular prism?

4 Calculate the volume of a cube with side length:

a 4 cm **b** 7 cm **c** 3 m **d** 22 mm

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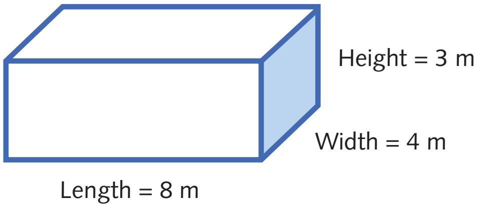
5 Look at the dimensions of this rectangular prism.



a Calculate the volume of the prism.

b What happens to the volume if you multiply the length by 3?

c What happens to the volume if you multiply the length *and* the width by 3?

d What happens if you multiply *all* of the dimensions by 3?

6 Classify the objects below into one of these three groups.

Volume less than 1 litre	Volume between 1 litre and 3 litres	Volume more than 3 litres

a A bowl of soup	**b** A swimming pool	**c** A cup of coffee
d A large bottle of soft drink	**e** A laundry sink	**f** A bucket

7 Calculate the volume of these rectangular prisms. Give the volume in cubic metres.

a L = 50 cm W = 7 m H = 8 m

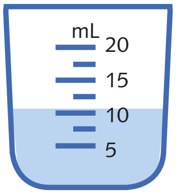
b W = 12 m L = 30 cm H = 20 cm

c H = 4 m W = 6 cm L = 12 m

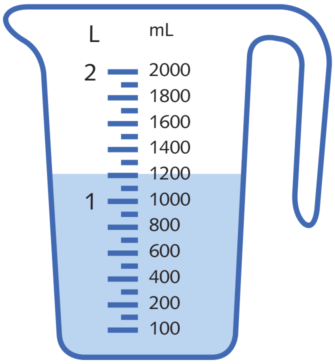
d H = 2 cm L = 3 cm W = 18 m

8 Read the scale for each measurement.

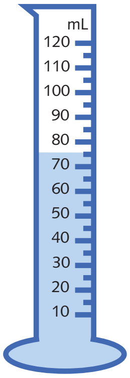
a



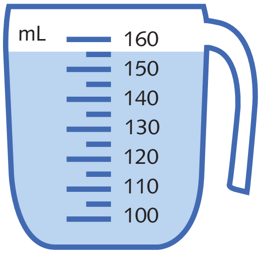
b



c



d



9 Pat poured 4800 mL into 4 containers, filling them to the top. Each container is 20 cm high and 12 cm wide. How deep is each container?

CHAPTER 8 Preparation

Useful skill for this chapter:

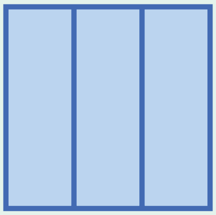
- an understanding of whole numbers and number lines
- experience in breaking simple geometric figures into equal parts.

KICK OFF

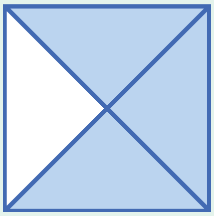
Match each diagram to one or more of the fractions.

$\frac{3}{4}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{2}$ $\frac{2}{3}$ $\frac{3}{3}$

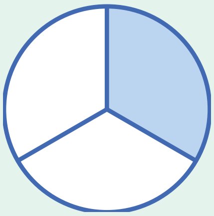
a



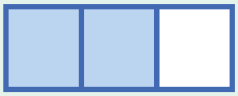
b



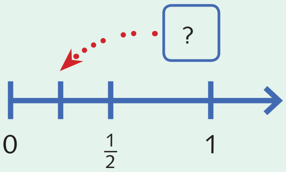
c



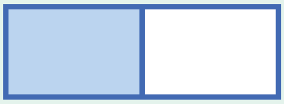
d



e



f



Show what you know

1 Read these fractions aloud to your teacher.

a $\frac{1}{2}$ **b** $\frac{3}{4}$ **c** $\frac{1}{5}$ **d** $\frac{3}{8}$ **e** $\frac{2}{5}$

2 Draw a rectangle. Now draw lines to cut the rectangle into 4 equal parts. Shade one of the parts. What fraction of the rectangle have you shaded?

3 Draw another rectangle. Draw lines to cut the rectangle into 4 equal parts. Shade 3 of the 4 equal parts of your rectangle. What fraction of the whole rectangle did you shade?

4 Take 7 blocks. Use the blocks to explain what $\frac{3}{7}$ means.

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CHAPTER

8

Number and Algebra

Fractions

Sometimes we can break a single thing into a number of smaller pieces.

For instance, we can have a whole cake, but it is too big for one person to eat.

Instead, we cut out a single slice to eat, which is a smaller piece of the cake.

The slice of cake is a **fraction** of the whole cake. A fraction is a smaller piece of a larger whole.

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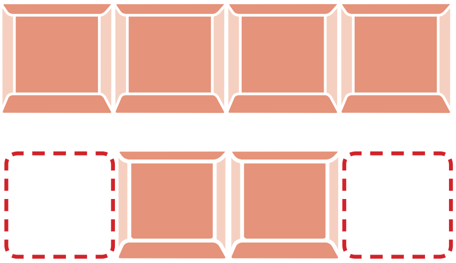
8A What is a fraction?

We can use fractions to explain a relationship between part of an object and the whole object.

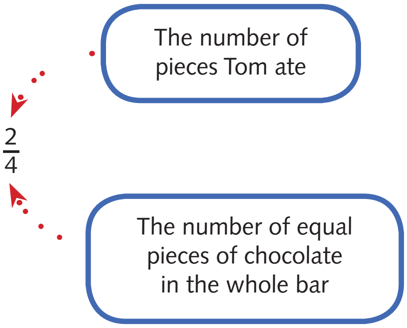


This chocolate bar is divided into 4 equal pieces.

Tom eats 1 piece of chocolate from each end.

This is the same chocolate bar with the place where the pieces that Tom ate shown as dotted outlines.

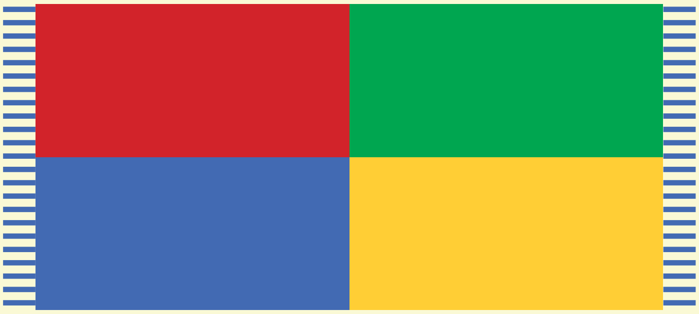
The chocolate bar had 4 equal parts, and 2 of them were eaten. The pieces Tom ate make up 2 out of the 4 pieces.



This fraction shows the part of the whole that Tom ate. Tom ate $\frac{2}{4}$ of the chocolate bar.

Example 1

Hudson's blanket is divided into 4 equal pieces. Each piece is a different colour.



What fraction of Hudson's blanket is yellow?

Solution

1 part out of 4 equal parts of the blanket is yellow. So, $\frac{1}{4}$ of Hudson's blanket is yellow.

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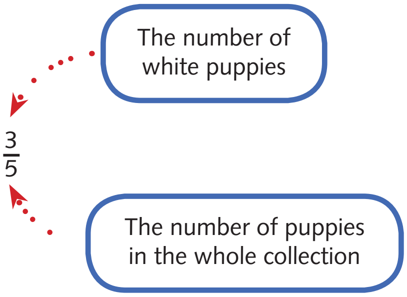
Fractions can also describe the relationship between a part of a collection and the whole number of objects in that collection.

Here are 5 puppies.

There are 3 white puppies in the whole collection, so 3 out of the 5 puppies are white. We write this as a fraction.



The 3 white puppies are $\frac{3}{5}$ of the whole collection.

Example 2

Sabina has a collection of 19 stamps. 7 of her stamps are from Malta.

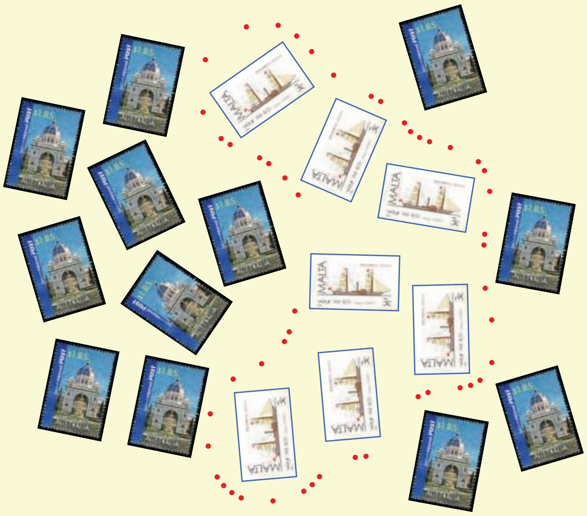
What fraction of her stamp collection is from Malta?

Solution

Draw a collection of 19 stamps. Circle 7 of the stamps and label this part of the collection 'Maltese'.

Write a fraction with 19 on the bottom to represent the total number of stamps in Sabina's collection, and 7 on the top to represent the number of stamps that are from Malta.

Write: '$\frac{7}{19}$ of Sabina's total collection of stamps are from Malta'.



Example 3

Then has a collection of 11 marbles. His collection contains 3 red marbles, 6 white marbles and 2 blue marbles.

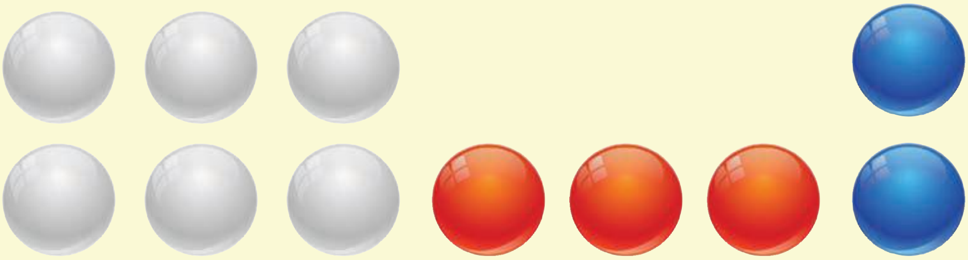
a What fraction of the marble collection is red?

b What fraction of the marble collection is white?

c What fraction of the marble collection is blue?

Solution

Draw the collection of marbles. Draw 3 red marbles, 6 white marbles and 2 blue marbles.



a We can see that 3 out of the collection of 11 marbles are red, so $\frac{3}{11}$ are red.

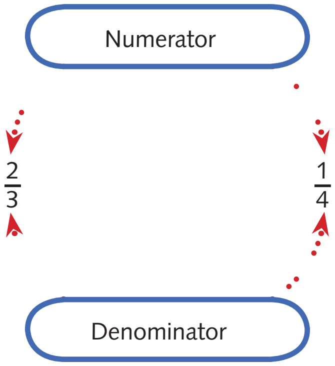
b We can see that 6 out of the collection of 11 marbles are white, so $\frac{6}{11}$ are white.

c We can see that 2 out of the collection of 11 marbles are blue, so $\frac{2}{11}$ are blue.

Some special names

A fraction has a number on top of the line and a number below the line. These numbers have special names.

The top number is called the **numerator**. The number below is called the **denominator**. The easy way to remember where it goes is to say 'D for denominator, D for down'.



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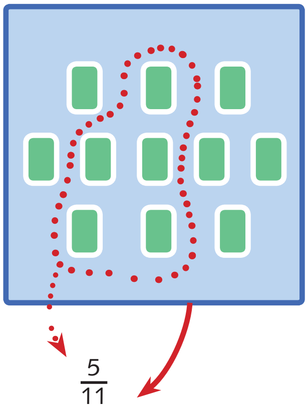
We can draw 11 blocks and show the fraction $\frac{5}{11}$. The numerator is the number of blocks circled. The denominator is the total number of blocks.

The circled blocks are $\frac{5}{11}$ of the total collection of blocks.

The line between the numerator and the denominator is called the **vinculum.**



8A Whole class CONNECT, APPLY AND BUILD

1 Use the people in your classroom to make these 'people fractions'.

- **a** Make a group where 4 out of 5 people in the group are children. Write the fraction.
- **b** Make a group where 2 out of 3 people in the group have short hair. Write the fraction.
- **c** Make a group where 3 out of 4 people in the group are wearing the same kind of top (for example, jumpers). Write the fraction.

2 Read these fractions aloud. For each number with a star (★), say 'numerator' or 'denominator'.

a $\frac{1}{6\,\bigstar}$ **b** $\frac{2\,\bigstar}{5}$ **c** $\frac{3\,\bigstar}{4}$ **d** $\frac{5}{7\,\bigstar}$ **e** $\frac{12}{5\,\bigstar}$

3 Work with a partner. You will need a handful of counters of two different colours. Player 1 reads each fraction aloud. Player 2 selects counters of two different colours to represent the fraction. Then swap roles.

SET 1 **a** $\frac{1}{3}$ **b** $\frac{3}{4}$ **c** $\frac{6}{8}$ **d** $\frac{11}{12}$

SET 2 **a** $\frac{1}{4}$ **b** $\frac{2}{3}$ **c** $\frac{5}{8}$ **d** $\frac{12}{13}$

4 Work with a partner. Read one set of fractions to your partner. Your partner writes the fractions as you read them. Your partner then draws a rectangle, divides it into an equal number of pieces and shades them to represent each fraction. Then swap roles.

SET 1 **a** $\frac{1}{2}$ **b** $\frac{2}{4}$ **c** $\frac{6}{7}$ **d** $\frac{4}{5}$

SET 2 **a** $\frac{1}{5}$ **b** $\frac{1}{4}$ **c** $\frac{3}{6}$ **d** $\frac{2}{8}$

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8A Individual

1 Write each fraction, then label the numerator and the denominator.

a $\frac{1}{5}$ **b** $\frac{2}{4}$ **c** $\frac{3}{4}$ **d** $\frac{3}{8}$ **e** $\frac{7}{8}$

2 What does the box represent in these fractions: numerator or denominator?

a $\frac{2}{\square}$ **b** $\frac{11}{\square}$ **c** $\frac{\square}{4}$ **d** $\frac{\square}{6}$ **e** $\frac{19}{\square}$

3 Copy these fractions. Write '2' in the numerator boxes and '7' in the denominator boxes.

a $\frac{4}{\square}$ **b** $\frac{\square}{5}$ **c** $\frac{\square}{3}$ **d** $\frac{1}{\square}$ **e** $\frac{\square}{191}$

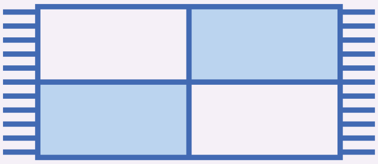
4 Write the fractions that match these descriptions.

a Numerator 2, denominator 5
b Numerator 1, denominator 4
c Numerator 12, denominator 13
d Numerator 4, denominator 8
e Numerator 50, denominator 100
f Numerator 99, denominator 100

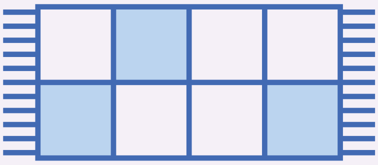
5 What fraction of each blanket is shaded? Write the fractions.

a

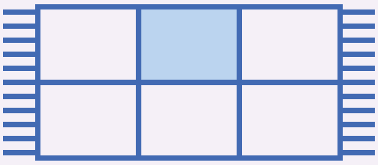
b



c

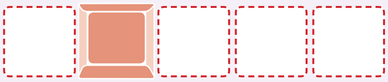


d

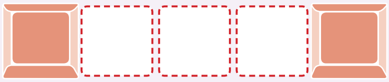


6 For each of these chocolate bars, the dotted outlines show which pieces have been eaten. The remaining chocolate is shown in brown. Write the fraction of each chocolate bar that remains.

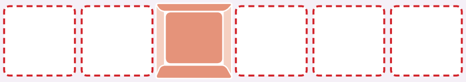
a



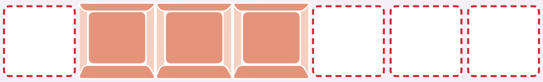
b



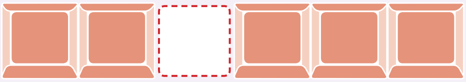
c



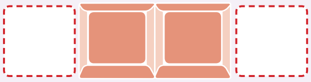
d



e



f



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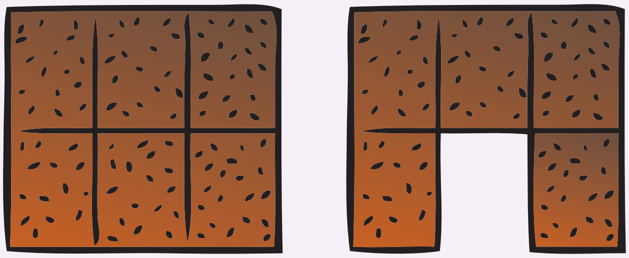
○ **7** Fran made this chocolate cake. She cut it into 6 equal pieces.

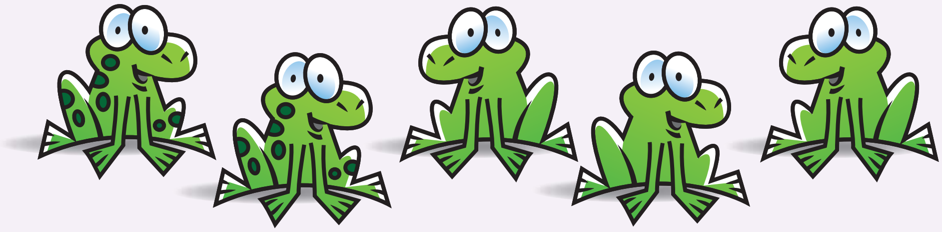
Her brother Darren came home and decided to have a snack. The second picture shows what the cake looked like after Darren's snack.



a What fraction of the cake did Darren eat? Write the fraction.

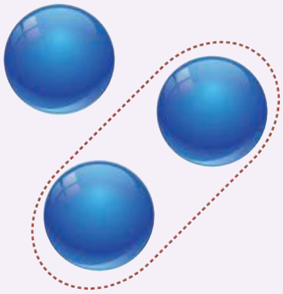
b What fraction of the cake was left after Darren's snack? Write the fraction.

○ **8** There are 5 frogs in a pond. Some of the frogs have spots. Write a fraction for the number of frogs that have spots as part of the whole group of frogs.

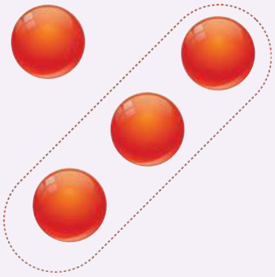


○ **9** For each of these, write a fraction to represent the circled marbles as a fraction of the whole collection.

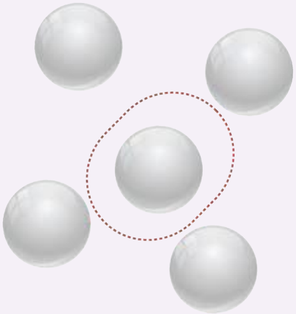
a



b

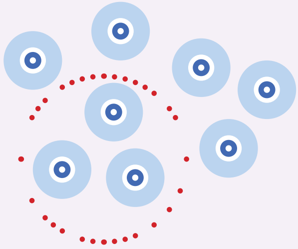


c

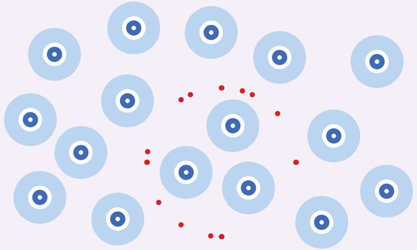


○ **10** Write a fraction to represent the circled discs as a fraction of the whole collection.

a



b



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11 a Draw a square with lines to show quarters. Shade $\frac{1}{4}$ of it.

b Draw a rectangle with lines to show thirds. Shade $\frac{2}{3}$ of it.

c Draw a circle with lines to show thirds. Shade $\frac{1}{3}$ of it.

d Draw a rectangle with lines to show sixths. Shade $\frac{5}{6}$ of it.

e Draw a circle with lines to show eighths. Shade $\frac{3}{8}$ of it.

12 Show $\frac{3}{4}$ using the following.

a A circle

b A rectangle

c Four squares

d A square using triangles

8B Fractions on the number line

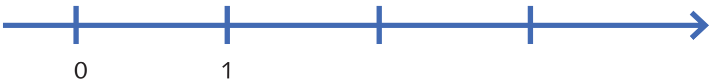
This number line has the first four whole numbers and zero marked. The whole numbers are equally spaced.

Fractions can be marked on a number line, too.

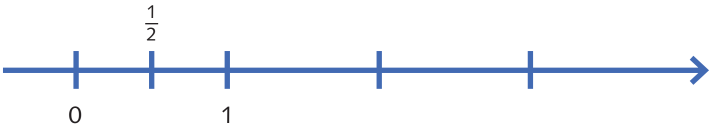
Halves

This is how to mark the fractions $\frac{1}{2}, \frac{2}{2}, \frac{3}{2}, \frac{4}{2}$ and $\frac{5}{2}$ on a number line.

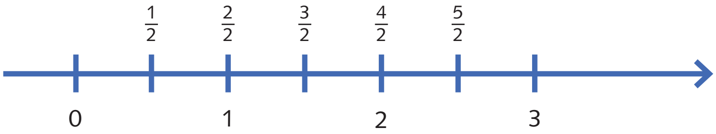
First mark in 0 and 1.



Now break the line between 0 and 1 into two equal pieces. Each piece is one-half.



Copy halves across the number line and label the markers $\frac{1}{2}, \frac{2}{2}, \frac{3}{2}, \frac{4}{2}, \frac{5}{2}$.



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We can see that:

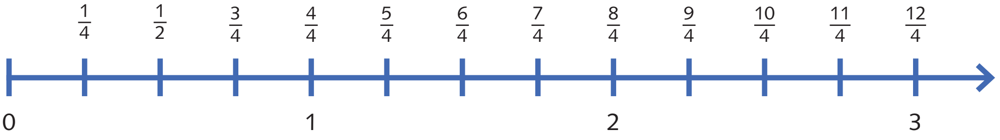
- $\frac{2}{2}$ is the same as 1
- $\frac{3}{2}$ is halfway between 1 and 2
- $\frac{4}{2}$ is the same as 2.

The numbers $\frac{1}{2}, \frac{2}{2}, \frac{3}{2}, \frac{4}{2}, \frac{5}{2}$, and so on, are called the **multiples** of $\frac{1}{2}$. We read these as 'one-half', 'two-halves', 'three-halves', 'four-halves', and so on.

Quarters

Draw a number line from 1 to 3. Divide the piece of the number line between 0 and 1 into 4 equal pieces. Each piece is one-quarter.

Copy quarters across the number line and label the points $\frac{1}{4}, \frac{2}{4}, \frac{3}{4}, \frac{4}{4}, \frac{5}{4}$, and so on.



We can see that:

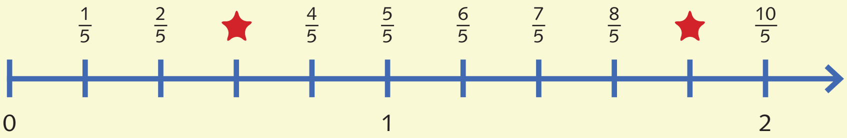
- $\frac{4}{4}$ is the same as 1
- $\frac{8}{4}$ is the same as 2
- $\frac{12}{4}$ is the same as 3.

The fractions $\frac{1}{4}, \frac{2}{4}, \frac{3}{4}, \frac{4}{4}, \frac{5}{4}$, are called the multiples of $\frac{1}{4}$.

We read these as 'one-quarter', 'two-quarters', 'three-quarters', and so on.

Example 4

What fractions are shown by the stars on the number line?



Solution

The first star is $\frac{3}{5}$.

The second star is $\frac{9}{5}$.

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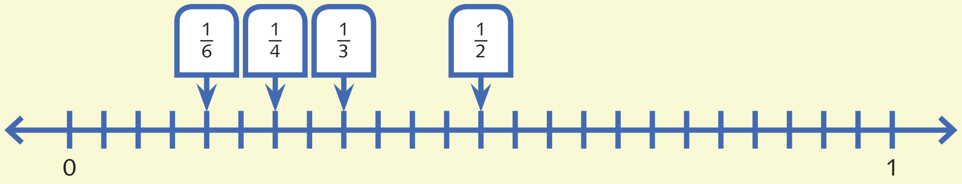
A **unit fraction** is a fraction where the numerator is 1 and the denominator is any whole number. So, the fractions $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{2000}$ and $\frac{1}{4\,819\,302}$ are unit fractions.

Example 5

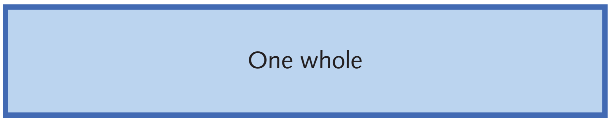
Show the unit fractions $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$ and $\frac{1}{6}$ on a number line.

Solution

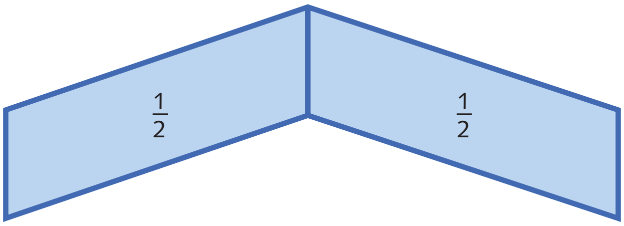


Fractions on paper strips

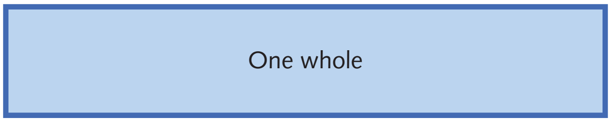
We can use paper strips such as streamers as a type of number line.



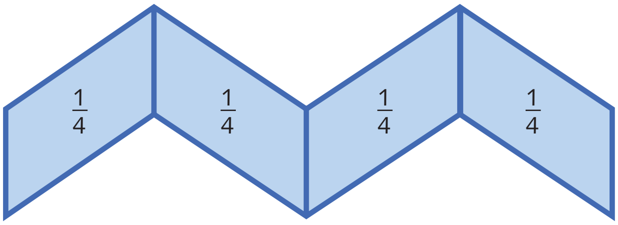
This paper strip has been folded in the middle to make 2 equal pieces. Each piece is one half of the strip. 2 halves make 1 whole.



We can also make a number line from a paper strip to show quarters.



We can fold the paper strip once in the middle, then once again to make 4 equal pieces. Each piece is one quarter of the paper strip. 4 quarters make 1 whole.



8B Whole class CONNECT, APPLY AND BUILD

1 Write these fractions in words.

a $\frac{2}{4}$ **b** $\frac{2}{5}$ **c** $\frac{9}{4}$ **d** $\frac{8}{2}$

2 Copy and complete these sentences. Draw a number line to help you.

a $\frac{5}{2}$ is halfway between _______ and _______.

b $\frac{6}{2}$ is the same as _______.

c $\frac{7}{2}$ is halfway between _______ and _______.

3 You will need paper streamers of different lengths for each student. Think of the streamer as a number line marked from 0 to 1.

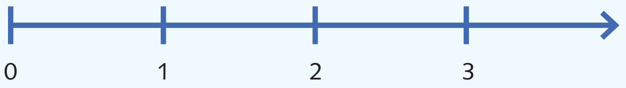
Fold your number line and draw lines to show $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$.

4 Take a new piece of streamer. Fold your streamer to make $\frac{1}{3}$, $\frac{2}{3}$ and $\frac{3}{3}$.

5 Work in pairs. Person 1 writes a multiple of $\frac{1}{2}$, then Person 2 writes that fraction in words. Take turns to write the next multiple as a fraction or in words. Then swap roles.

6 **Writing multiples of $\frac{1}{3}$ on a number line**

Start with a number line with the whole numbers marked on it.



Step 1

Divide the piece of line between 0 and 1 into 3 equal pieces. Mark the dividing points as $\frac{1}{3}$ and $\frac{2}{3}$.

Step 2

Continue to mark thirds across the number line.

Mark the points you come to as $\frac{3}{3}, \frac{4}{3}, \frac{5}{3}, \frac{6}{3}, \frac{7}{3}, \ldots$

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Copy these statements. Use your number line to help you fill in the blanks.

a The numbers $\frac{1}{3}, \frac{2}{3}, \frac{3}{3}, \frac{4}{3}, \ldots$ are called the ______________ of $\frac{1}{3}$.

b The number $\frac{3}{3}$ is the same as ______________.

c The number $\frac{\square}{3}$ is the same as 2.

d The number $\frac{9}{3}$ is the same as ________.

7 You will need sticks of chalk. Draw a number line on the playground surface and mark the whole numbers 0, 1, 2, 3 and 4 on it.

Then mark $\frac{2}{3}, \frac{3}{5}, \frac{3}{3}, \frac{5}{5}, \frac{4}{3}$ and $\frac{10}{5}$ on your number line.

8 **a** Fold a piece of paper streamer to show eighths.

b Label the pieces $\frac{1}{8}, \frac{2}{8}, \frac{3}{8}$, and so on.

8B Individual

1 Write these fractions in words.

a $\frac{1}{2}$ **b** $\frac{2}{4}$ **c** $\frac{2}{3}$ **d** $\frac{3}{2}$ **e** $\frac{7}{3}$

2 Write these as fractions.

a Three-quarters **b** One-third **c** Two-thirds

d Seven-quarters **e** Nine-halves **f** 72 thirds

3 Draw three number lines of different lengths.

Mark 0 and 1 different distances apart on each number line.

Then mark $\frac{1}{3}, \frac{2}{3}, \frac{3}{3}$ and $\frac{4}{3}$ on each of your number lines.

4 **a** Draw a number line from 0 to 1. Mark $\frac{1}{4}, \frac{1}{2}$ and $\frac{3}{4}$ on it.

b Draw a number line from 0 to 3. Mark $\frac{1}{3}, \frac{4}{3}, \frac{5}{3}$ and $\frac{6}{3}$ on it.

c Draw a number line from 0 to 5. Mark $\frac{3}{2}, \frac{3}{4}$ and $\frac{3}{3}$ on it.

d Draw a number line from 0 to 4. Mark $\frac{1}{5}, \frac{10}{5}, \frac{15}{5}$ and $\frac{9}{5}$ on it.

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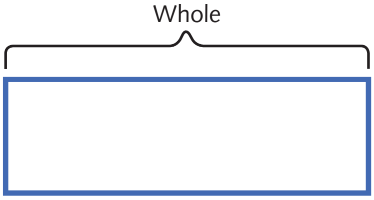
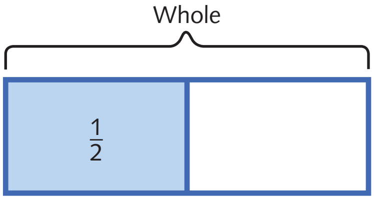
8C Using rectangles

We can use rectangles to make a fraction picture. Draw a rectangle. We think of this rectangle as the 'whole'. It has the value of 1.

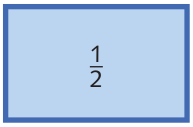


Divide the rectangle into 2 equal parts. Each part is $\frac{1}{2}$ of the whole.

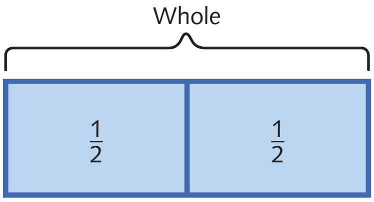
Now shade 1 part and make copies of it to represent the multiples of one-half.



$\frac{1}{2}$ one-half

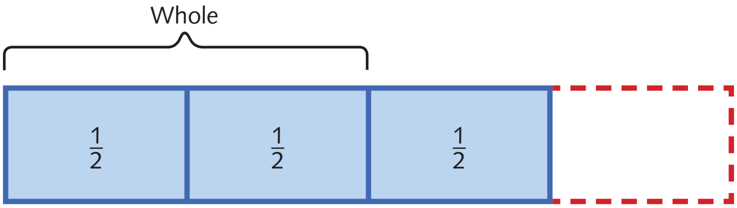


$\frac{2}{2}$ two-halves



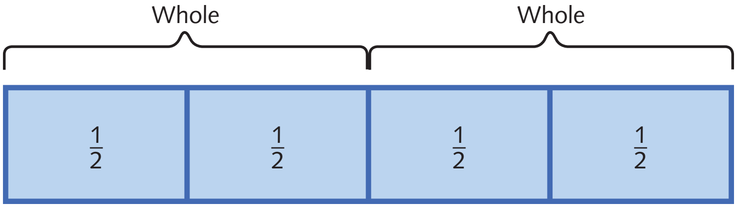
Extend your rectangle by adding on another part the same size.

$\frac{3}{2}$ three-halves



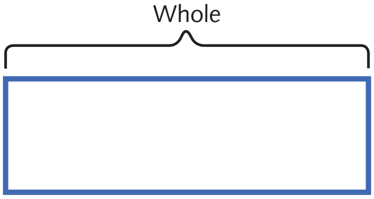
Keep going.

$\frac{4}{2}$ four-halves

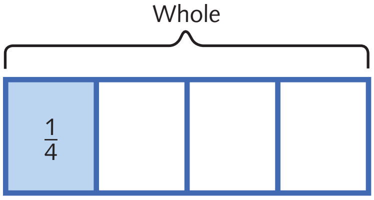


Multiples of $\frac{1}{4}$

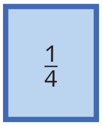
We can also use rectangles to show multiples of one-quarter.



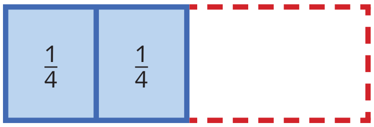
Divide the rectangle into 4 equal parts. Each part is $\frac{1}{4}$ of the whole.



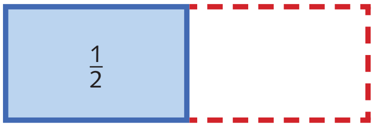
$\frac{1}{4}$ one-quarter



$\frac{2}{4}$ two-quarters

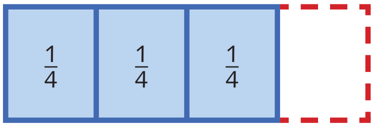


Compare $\frac{2}{4}$ and $\frac{1}{2}$. What do you notice? $\frac{2}{4}$ and $\frac{1}{2}$ are the same.

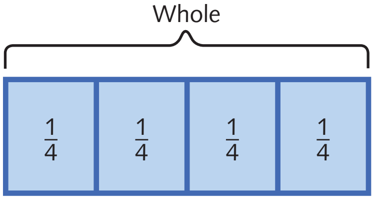


Keep going.

$\frac{3}{4}$ three-quarters

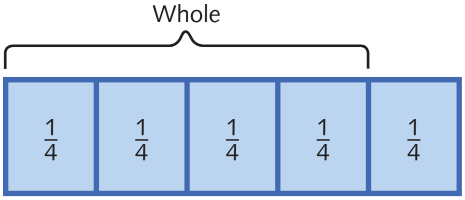


$\frac{4}{4}$ four-quarters



Compare $\frac{4}{4}$ and 1. You will notice they are the same. We can keep going and add another $\frac{1}{4}$. Remember that the whole equals 1.

$\frac{5}{4}$



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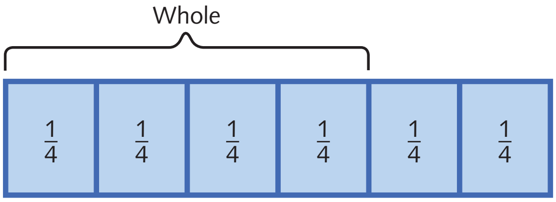
$\frac{6}{4}$

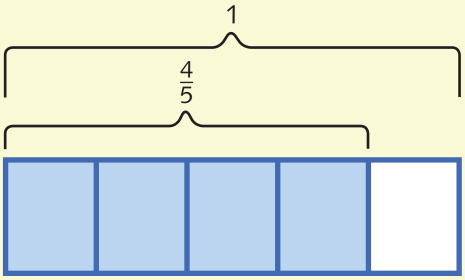


Compare $\frac{6}{4}$ and $\frac{3}{2}$. What do you notice? $\frac{6}{4}$ and $\frac{3}{2}$ are the same.

Example 6

Use shaded parts of a rectangle to show $\frac{4}{5}$.

Solution



8C Whole class CONNECT, APPLY AND BUILD

1 Thirds

a Draw a rectangle like this one. Call this the 'whole' and think of it as 1.

b Divide your rectangle into 3 equal parts. Shade 1 part.

Call it $\frac{1}{3}$ of the whole.

c Draw a new rectangle diagram for each of these fractions by putting together little rectangles of size $\frac{1}{3}$.

i $\frac{2}{3}$ **ii** $\frac{3}{3}$ **iii** $\frac{4}{3}$ **iv** $\frac{5}{3}$

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8C Individual

1 Draw a rectangle with parts shaded to show these fractions.

a $\frac{1}{5}$ **b** $\frac{2}{5}$ **c** $\frac{3}{5}$ **d** $\frac{4}{5}$ **e** $\enclose{circle}{\frac{5}{5}}$ **f** $\frac{6}{5}$

g Which whole number is the same as the circled fraction?

2 Draw rectangles with equal parts shaded to show these fractions.

a $\frac{1}{6}$ **b** $\enclose{circle}{\frac{2}{6}}$ **c** $\enclose{circle}{\frac{3}{6}}$ **d** $\enclose{circle}{\frac{4}{6}}$

e $\frac{5}{6}$ **f** $\enclose{circle}{\frac{6}{6}}$ **g** $\frac{7}{6}$ **h** $\frac{9}{6}$

i Write the circled fractions in another way. For example, $\frac{2}{6} = \frac{1}{3}$.

3 This diagram shows the front of a three-storey building. There are windows on each storey. The blinds are pulled down on some of the windows.

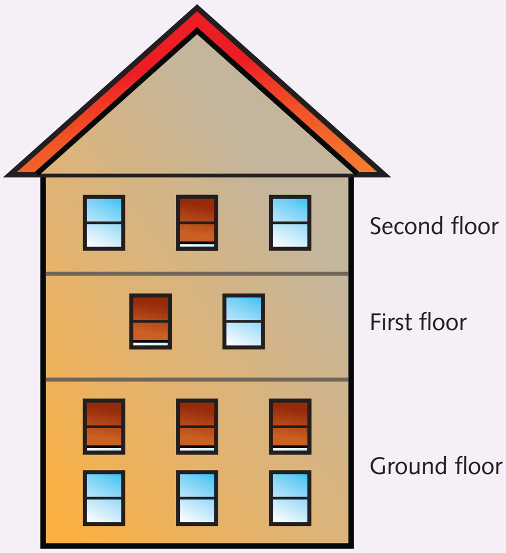
a What fraction of the windows on the second floor have blinds down?

b What fraction of the windows on the first floor have blinds down?

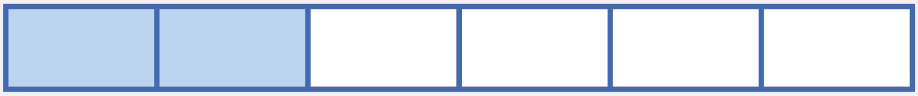
c What fraction of the windows on the ground floor have blinds down?

d What fraction of the windows on the front of the building have blinds down?

e What fraction of the windows on the top two floors have blinds down?



4 This rectangle has been divided into 6 equal parts.



a What fraction of the rectangle is shaded?

b Imagine that you shaded the next 2 parts as well. What fraction is shaded now?

c Copy and complete these sentences.

In part **a** I had the fraction $\frac{2}{\square}$.

I doubled it in part **b** and got the fraction $\frac{\square}{\square}$.

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8D Fractions and other figures

So far in this chapter we have divided part of a number line into equal parts and marked fractions on it. We have also divided rectangles into equal parts and used them to work out fractions. Here are some ways of breaking up other shapes to show fractions.

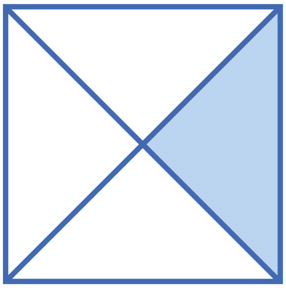
Squares

Draw a square. Now draw diagonal lines to join opposite corners. Shade one of the triangles.

What fraction of the square is shaded?

1 part out of a total of 4 equal parts is shaded.

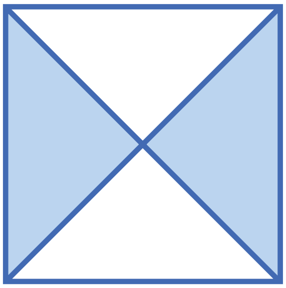
We write: '$\frac{1}{4}$ of the square is shaded'.



What fraction is shaded now?

2 parts out of a total of 4 equal parts is shaded.

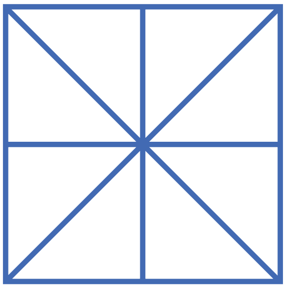
We write: '$\frac{2}{4}$ of the square is shaded'.



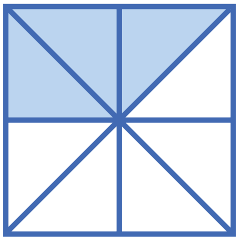
Draw a square with two diagonal lines, a vertical line through the centre and a horizontal line through the centre.

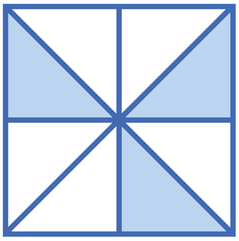
Each part of the square has the same area. If we cut out the parts of the square and put them on top of each other, they would all be the same size.

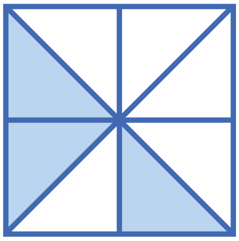
There are 8 equal parts.

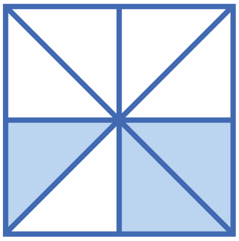


We can shade any 3 of the 8 equal parts to show the fraction $\frac{3}{8}$. Here are some different ways to do this.





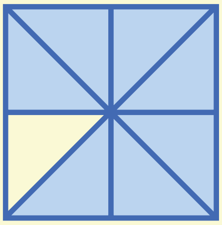




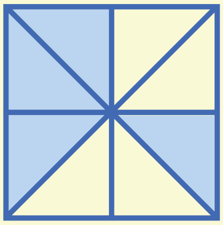
Example 7

What fraction of each square is shaded?

a



b



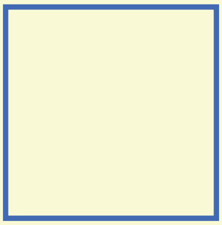
Solution

a 7 parts out of a total of 8 parts is shaded, so we write:
'$\frac{7}{8}$ of the square is shaded'.

b 4 parts out of a total of 8 parts is shaded, so we write:
'$\frac{4}{8}$ of the square is shaded'.

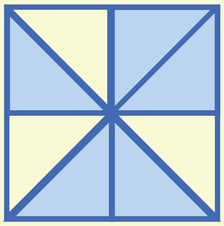
Example 8

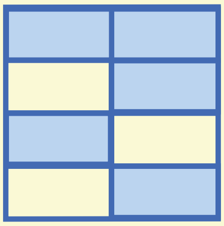
Shade $\frac{5}{8}$ of the area of this square.

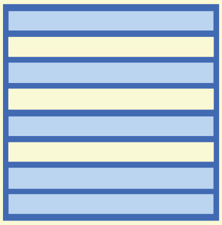


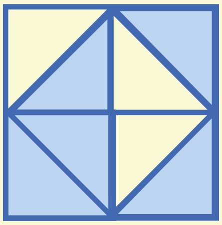
Solution

Divide the shape into 8 parts that are the same size and shape.
Shade any 5 of the 8 parts. Here are some different solutions.









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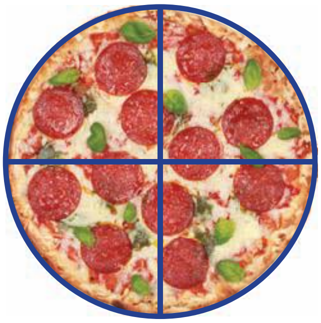
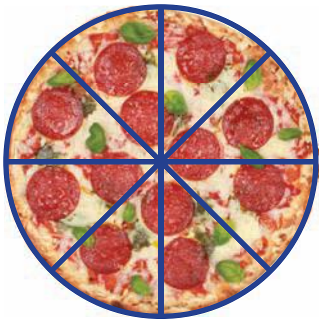
Circles

When we buy a pizza, it is usually in the shape of a circle, and can be cut into 4, 6 or 8 pieces.



If a pizza is cut into 4 equal pieces, each piece is $\frac{1}{4}$.

If a pizza is cut into 6 equal pieces, each piece is $\frac{1}{6}$.



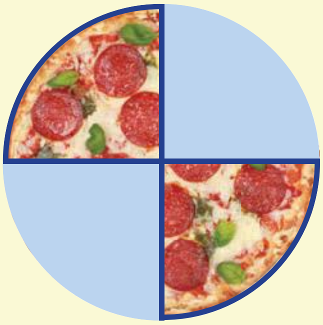
If a pizza is cut into 8 equal pieces, each piece is $\frac{1}{8}$.

Example 9

This pizza has been cut into 4 equal pieces.

2 of the 4 pieces have not been eaten.

Write two different fractions for the part of the pizza that remains.



Solution

2 parts out of a total of 4 pieces remain.
We can write:

'$\frac{2}{4}$ of the pizza has not been eaten'.

We can also see that 2 out of 4 pieces is the same as one half.

So we can also write '$\frac{1}{2}$ of the pizza has not been eaten'.

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8D Whole class CONNECT, APPLY AND BUILD

1 Discuss the best way to draw and shade a circle to represent thirds.

2 **a** Cut an equilateral triangle from a piece of paper.
b How could this triangle be cut or folded so that it represents quarters?
c How could you check that each piece is the same size as the others?
d Show $\frac{3}{4}$ using your equilateral triangle.

8D Individual

1 Draw four squares. Divide them into sixths and use shading to represent each of these fractions.

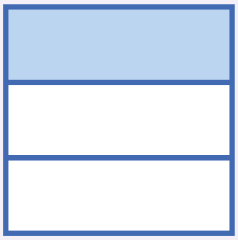
a $\frac{5}{6}$ **b** $\frac{3}{6}$ **c** $\frac{1}{6}$ **d** $\frac{6}{6}$

2 Draw four circles. Divide them into eighths and use shading to represent each of these fractions.

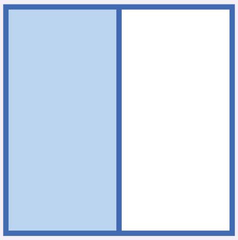
a $\frac{1}{8}$ **b** $\frac{8}{8}$ **c** $\frac{4}{8}$ **d** $\frac{5}{8}$

3 Write the fraction that describes how much of each square is shaded.

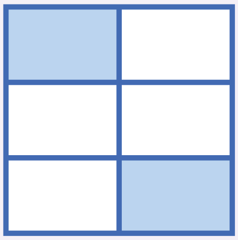
a



b

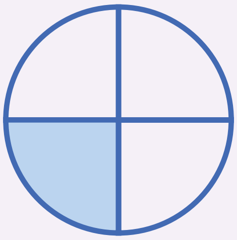


c



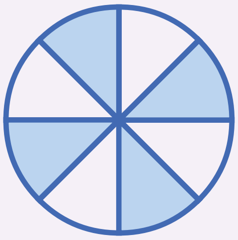
4 Write the fraction that describes how much of each circle is shaded.

a



b

c



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8E Equivalent fractions

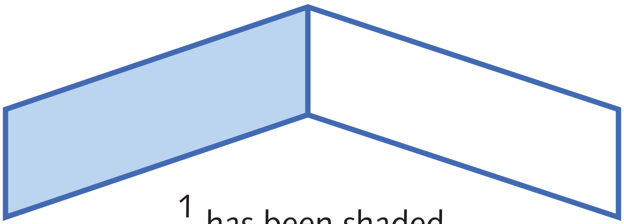
Catherine has these coins in her pocket.

Matthew has these coins.

Although they have different coins, the value is the same. We say these amounts are **equivalent**. In this section, we look at **equivalent fractions**: fractions that have the same value.

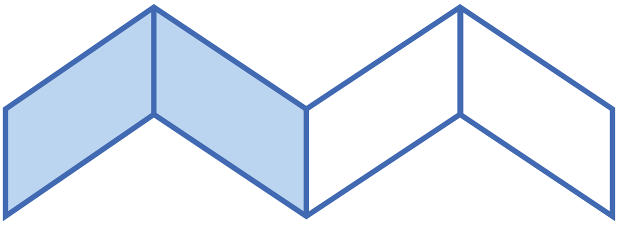
Halves, quarters, eighths

Take a length of streamer. Fold it over to make 2 equal pieces, then shade 1 piece.



$\frac{1}{2}$ has been shaded.

Leave your streamer closed on the half fold. Fold it again to make 4 equal parts. Unfold your streamer. It should look something like this:



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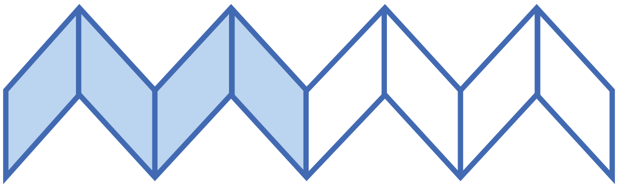
You can see that $\frac{2}{4}$ is shaded. This means that $\frac{2}{4}$ is equal to $\frac{1}{2}$.

Fold your streamer shut on the quarter fold and fold it again.

Unfold your streamer. It should now look like this:



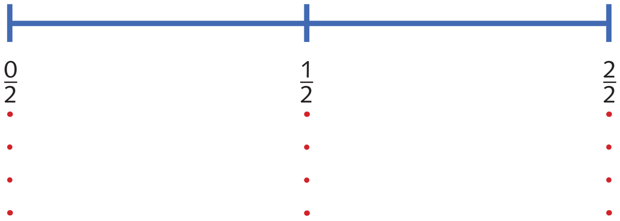
You can see that $\frac{4}{8}$ is shaded. This means that $\frac{4}{8}$ is equal to $\frac{2}{4}$ and to $\frac{1}{2}$.

The fractions $\frac{1}{2}$, $\frac{2}{4}$ and $\frac{4}{8}$ are equal. We call them equivalent fractions.

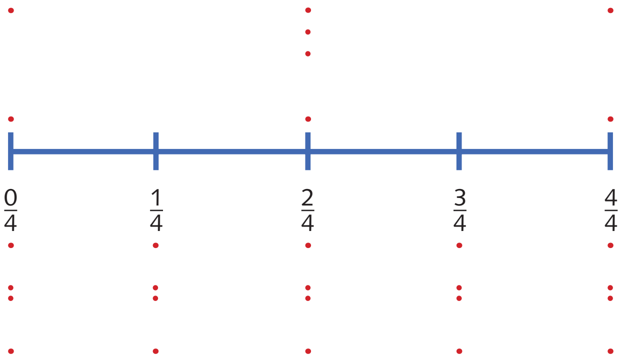
We can show equivalent fractions on the number line.

Start with a number line with 0 and 1 marked on it.

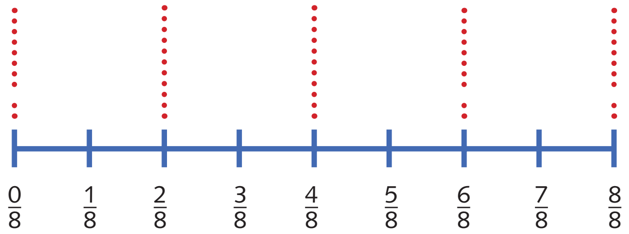
Divide the distance between 0 and 1 into 2 equal pieces. Each piece is $\frac{1}{2}$.



Divide each of those pieces into 2 equal pieces. Each piece is $\frac{1}{4}$.



Now divide each of those pieces into 2 equal pieces. Each piece is $\frac{1}{8}$.



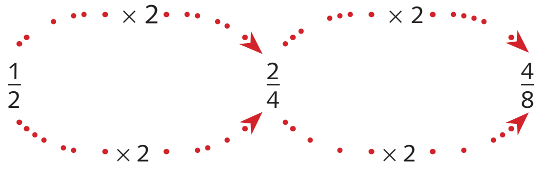
From this we can see that:

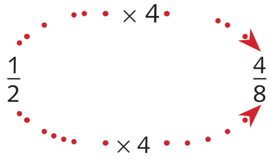
$$\frac{1}{2} = \frac{2}{4} = \frac{4}{8}$$

$$\frac{1}{4} = \frac{2}{8}$$

$$\frac{3}{4} = \frac{6}{8}$$

Going from $\frac{1}{2}$ to $\frac{2}{4}$ to $\frac{4}{8}$:

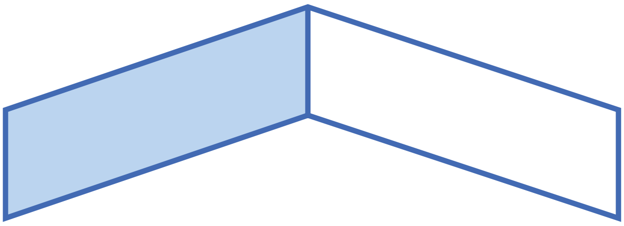




We get an equivalent fraction if we multiply the numerator and the denominator by the same whole number.

Halves, sixths and twelfths

Take a long piece of paper streamer. Fold it in half to make 2 equal parts.



Open the streamer and shade one part. $\frac{1}{2}$ is shaded.

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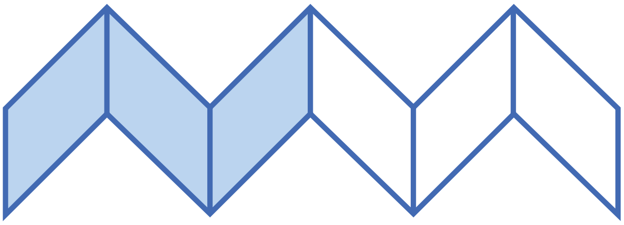
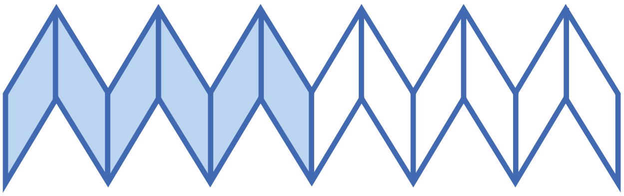
Close your streamer on the half fold again, then fold it into 3 equal parts. Open it up. It should look something like this.



$\frac{3}{6}$ of the streamer is shaded.

Close your streamer on the sixth fold again, then fold the paper into 2 equal pieces. Open it up. It should look something like this.



$\frac{6}{12}$ of your streamer is now shaded.

The fractions $\frac{1}{2}$, $\frac{3}{6}$ and $\frac{6}{12}$ are equal. They are equivalent fractions.

Going from $\frac{1}{2}$ to $\frac{3}{6}$ to $\frac{6}{12}$:

$$\begin{tikzcd} \frac{1}{2} \arrow[r, bend left, "\times 3"] \arrow[r, bend right, "\times 3"'] & \frac{3}{6} \end{tikzcd}$$

Multiply the numerator and denominator of $\frac{1}{2}$ by 3 to get $\frac{3}{6}$.
$\frac{3}{6}$ is equivalent to $\frac{1}{2}$.

$$\begin{tikzcd} \frac{3}{6} \arrow[r, bend left, "\times 2"] \arrow[r, bend right, "\times 2"'] & \frac{6}{12} \end{tikzcd}$$

Multiply the numerator and denominator of $\frac{3}{6}$ by 2 to get $\frac{6}{12}$.
$\frac{6}{12}$ is equivalent to $\frac{3}{6}$.

$$\begin{tikzcd} \frac{6}{12} \arrow[r, bend left, "\div 6"] \arrow[r, bend right, "\div 6"'] & \frac{1}{2} \end{tikzcd}$$

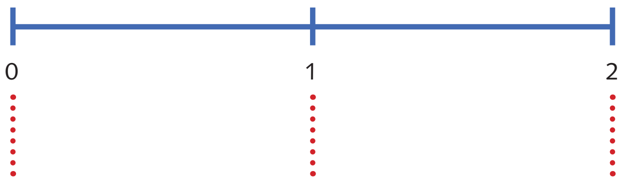
Divide the numerator and denominator of $\frac{6}{12}$ by 6 to get $\frac{1}{2}$.
$\frac{1}{2}$ is equivalent to $\frac{6}{12}$.

We get an equivalent fraction if we divide the numerator and the denominator by the same whole number.

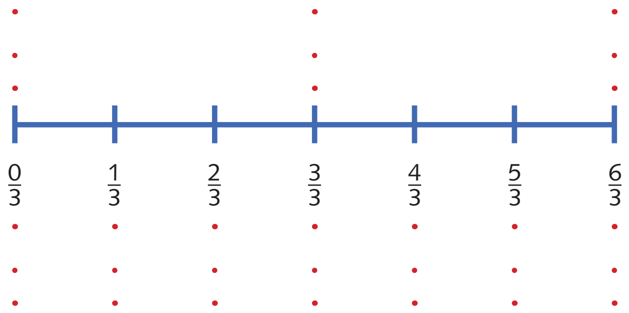
Thirds and sixths

We can show thirds and sixths on the number line.

Start with a number line marked 0, 1 and 2.

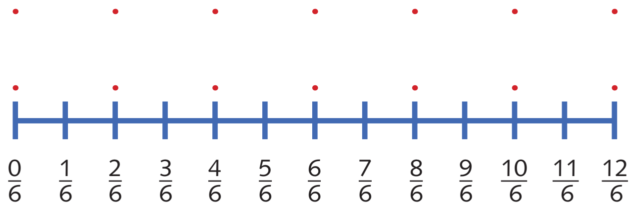


Divide the distance between 0 and 1 into 3 equal pieces, and then divide the distance between 1 and 2 into 3 equal pieces.



Your number line is now marked in thirds.

Divide each third into 2 equal pieces. Each piece is $\frac{1}{6}$.



Looking at the number line, we can see that:

$$1 = \frac{3}{3} = \frac{6}{6}$$

$$2 = \frac{6}{3} = \frac{12}{6}$$

$$\frac{1}{3} = \frac{2}{6} \qquad \frac{2}{3} = \frac{4}{6} \qquad \frac{4}{3} = \frac{8}{6} \qquad \frac{5}{3} = \frac{10}{6}$$

What happens if we cut $\frac{1}{6}$ into two equal pieces? We get twelfths.

$$\frac{1}{6} = \frac{2}{12}$$

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Example 10

Find two different equivalent fractions for:

a $\frac{1}{2}$ **b** $\frac{15}{20}$

Solution

a

$$\begin{tikzcd}\frac{1}{2} \arrow[r, bend left, "\times 2"] \arrow[r, bend right, "\times 2"'] & \frac{2}{4}\end{tikzcd} \qquad \begin{tikzcd}\frac{1}{2} \arrow[r, bend left, "\times 5"] \arrow[r, bend right, "\times 5"'] & \frac{5}{10}\end{tikzcd}$$

$\frac{2}{4}$ and $\frac{5}{10}$ are equivalent fractions for $\frac{1}{2}$.

b

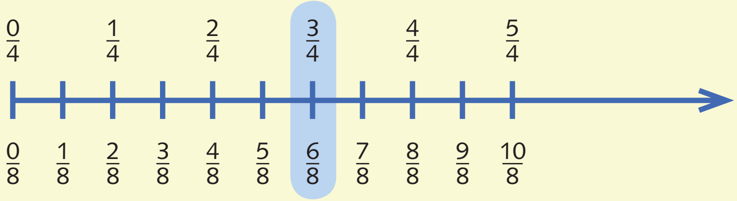
$$\begin{tikzcd}\frac{15}{20} \arrow[r, bend left, "\div 5"] \arrow[r, bend right, "\div 5"'] & \frac{3}{4}\end{tikzcd} \qquad \begin{tikzcd}\frac{15}{20} \arrow[r, bend left, "\times 2"] \arrow[r, bend right, "\times 2"'] & \frac{30}{40}\end{tikzcd}$$

$\frac{3}{4}$ and $\frac{30}{40}$ are equivalent fractions for $\frac{15}{20}$.

Example 11

Show that $\frac{3}{4}$ and $\frac{6}{8}$ are equivalent by drawing them on a number line.

Solution



Simplest form

Here are two equivalent fractions:

$\frac{6}{15}$ and $\frac{2}{5}$

Check mentally that they are equivalent. What did you divide the numerator and denominator by? Do you think that $\frac{2}{5}$ is a nicer fraction than $\frac{6}{15}$? Most people think so, because the numbers 2 and 5 are smaller than 6 and 15.

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We divide the numerator and denominator by 3.

$$\frac{6}{15} = \frac{6 \div 3}{15 \div 3} = \frac{2}{5}$$

We cannot get a fraction equivalent to $\frac{2}{5}$ with an even smaller numerator and denominator, because we cannot find a whole number that divides both 2 and 5 (except for 1, of course).

So we say $\frac{2}{5}$ is the **simplest form** of the fraction $\frac{6}{15}$.

Example 12

Write the fraction $\frac{8}{20}$ in simplest form.

Solution

The largest whole number we can divide 8 and 20 by is 4.

$$\frac{8}{20} = \frac{8 \div 4}{20 \div 4} = \frac{2}{5}$$

So $\frac{2}{5}$ is the simplest form of the fraction $\frac{8}{20}$.

8E Whole class CONNECT, APPLY AND BUILD

1 Halves, fifths and tenths

a Take a long piece of paper streamer. Fold it in half to make 2 equal pieces. Shade 1 piece so that you have now shaded $\frac{1}{2}$.

b Close your streamer on the half fold, then fold the streamer into 5 equal pieces. What fraction of your streamer is shaded now?

c Copy and complete these statements.

- $\frac{1}{2}$ is the same as $\frac{5}{\square}$.
- $\frac{1}{5}$ is the same as $\frac{\square}{10}$.

2 Practise drawing circles divided into halves, thirds, quarters, sixths and eighths. Then draw circles divided up to represent these equivalent fractions.

a $\frac{2}{3}$ and $\frac{4}{6}$

b $\frac{1}{2}$ and $\frac{4}{8}$

c $\frac{3}{4}$ and $\frac{6}{8}$

3 Draw three paper bags in your book and label them as shown. Sort each fraction into the correct paper bag.

$\frac{1}{8}$ $\frac{3}{4}$ $\frac{1}{4}$ $\frac{5}{8}$ $\frac{2}{3}$ $\frac{1}{3}$ $\frac{4}{8}$ $\frac{2}{9}$ $\frac{5}{10}$ $\frac{1}{10}$ $\frac{1}{2}$

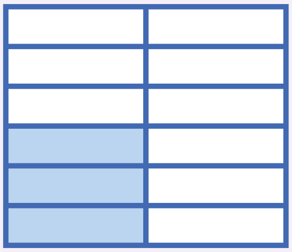
4 **a** Fold a square into 3 equal sections. Open it out. Now fold it in half in the other direction. Use colour and dots to show that $\frac{1}{2} = \frac{3}{6}$.

b Is it possible to show that $\frac{2}{6} = \frac{4}{12}$?

8E Individual

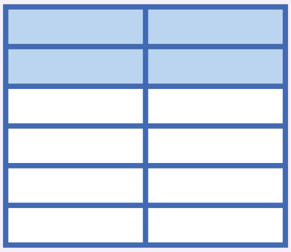
1 Complete the missing denominators to make equivalent fractions.

a



$\frac{3}{12} = \frac{1}{\square}$

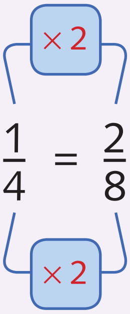
b



$\frac{4}{12} = \frac{1}{\square}$

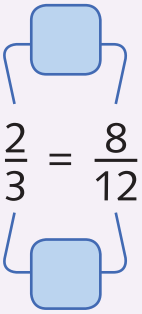
2 Write the number the numerator and denominator were multiplied by to arrive at each equivalent fraction. The first one has been done for you.

a



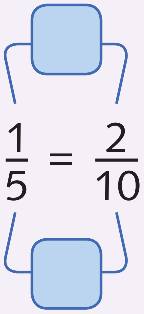
$\frac{1}{4} = \frac{2}{8}$

b



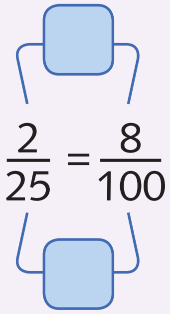
$\frac{2}{3} = \frac{8}{12}$

c



$\frac{1}{5} = \frac{2}{10}$

d



$\frac{2}{25} = \frac{8}{100}$

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3 Draw three paper bags in your book. Label the bags as shown, then sort each fraction into the correct bag.

$\frac{1}{2}$ $\frac{3}{12}$ $\frac{1}{8}$ $\frac{5}{8}$ $\frac{2}{3}$ $\frac{1}{3}$ $\frac{2}{8}$ $\frac{2}{9}$ $\frac{5}{10}$ $\frac{1}{4}$ $\frac{3}{10}$ $\frac{3}{4}$

4 Match each fraction in row 1 with an equivalent fraction in row 2.

Row 1: $\frac{1}{2}$ $\frac{1}{10}$ $\frac{10}{12}$ $\frac{6}{8}$ $\frac{16}{24}$

Row 2: $\frac{5}{6}$ $\frac{5}{10}$ $\frac{2}{3}$ $\frac{2}{20}$ $\frac{3}{4}$

5 Work out the simplest form of these fractions.

a $\frac{12}{16}$ **b** $\frac{9}{36}$ **c** $\frac{18}{45}$ **d** $\frac{25}{100}$

e $\frac{10}{25}$ **f** $\frac{28}{49}$ **g** $\frac{24}{64}$ **h** $\frac{24}{60}$

Homework

1 Make a poster about one of these fractions.

$\frac{2}{3}$ $\frac{5}{8}$ $\frac{7}{12}$ $\frac{3}{4}$

Your poster must include:

- a picture of a square, with your fraction of the square shaded
- a picture of a pizza, with your fraction of the pizza eaten
- a long rectangle cut into equal parts, with your fraction shaded
- a collection of 24 blocks, with your fraction of the blocks circled
- a block of chocolate, with your fraction of the block remaining
- three equivalent fractions for your fraction
- a number line marked 0, $\frac{1}{2}$ and 1, with your fraction marked with a star.

2 What do you need to add to your fraction to make 1?

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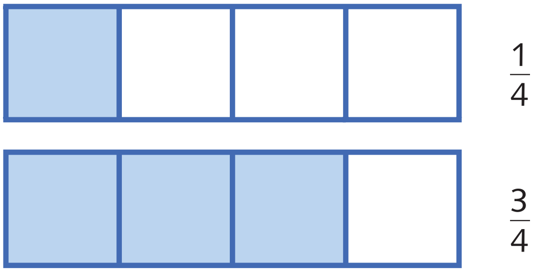
8F Comparing fractions

In Chapter 1, we looked at how to decide which of two whole numbers is larger. Comparing two fractions is easy when their denominators are the same. But it is a bit trickier when the denominators are different.

Comparing fractions with the same denominator

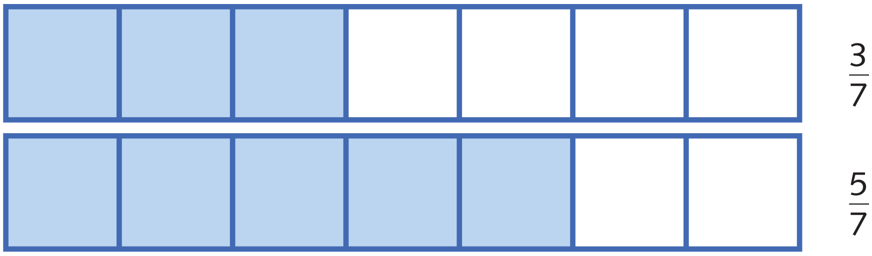
It's easy to compare fractions that have the same denominator. This rectangle has been divided into quarters to compare $\frac{1}{4}$ and $\frac{3}{4}$.



$\frac{1}{4}$ is less than $\frac{3}{4}$.

> If two fractions have the same denominator, the one with the larger numerator is the larger fraction.

These rectangles have been divided into sevenths to compare $\frac{3}{7}$ and $\frac{5}{7}$.



$\frac{5}{7}$ is greater than $\frac{3}{7}$.

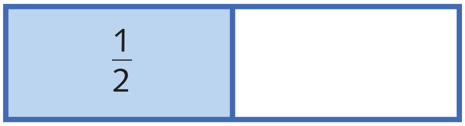
Comparing unit fractions

Fractions that have 1 as the numerator are called **unit fractions**. For example, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{837}$, $\frac{1}{1\,000\,000}$, and so on.

> A unit fraction has a numerator of 1.

Let's compare two unit fractions.

2 equal pieces make 1 whole.



3 equal pieces make 1 whole.

$\frac{1}{3}$ is smaller than $\frac{1}{2}$ because it takes 3 lots of $\frac{1}{3}$ to make a whole.

It only takes 2 lots of $\frac{1}{2}$ to make a whole.

When we have two unit fractions, the one with the larger denominator is the smaller fraction.

Using the number line to compare fractions

To compare two or more fractions, mark them on the number line. The fraction to the right on the number line is the larger fraction.

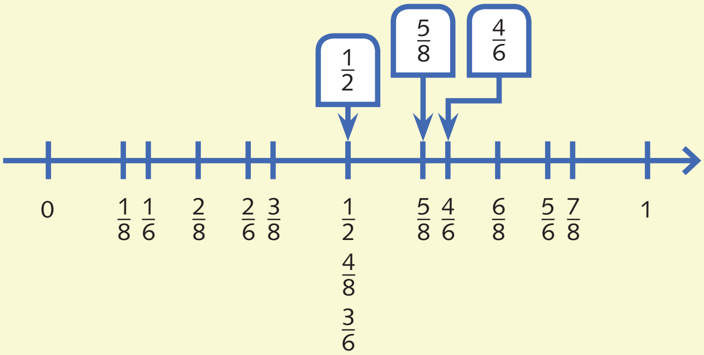
Example 13

Order these fractions from smallest to largest.

$\frac{5}{8}, \frac{1}{2}, \frac{4}{6}$

Solution

Draw a number line marked with halves, sixths and eighths.



The order, from smallest to largest, is $\frac{1}{2}, \frac{5}{8}, \frac{4}{6}$.

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Using equivalent fractions to compare fractions

The best way to compare fractions is to find an equivalent fraction with the same denominator for each fraction.

Example 14

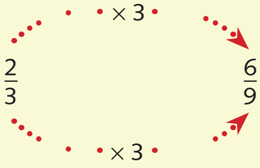
Is $\frac{2}{3}$ larger or smaller than $\frac{5}{9}$?

Solution

Convert $\frac{2}{3}$ into $\frac{\square}{9}$.

$$\frac{2}{3} = \frac{2 \times 3}{3 \times 3} = \frac{6}{9}$$

$\frac{6}{9}$ is larger than $\frac{5}{9}$, so $\frac{2}{3}$ is larger than $\frac{5}{9}$.



Remember

If two fractions have the same denominator, the one with the larger numerator is the larger fraction.

When we have two unit fractions, the fraction with the larger denominator is smaller.

A number line can be used to compare fractions.

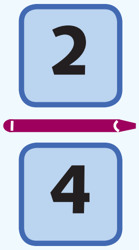
8F Whole class CONNECT, APPLY AND BUILD

1 Write each of these numbers on a different 10 cm × 10 cm card:
1, 2, 3, 4, 6, 8 and 12.
Make these fractions with the cards, using a pencil for the vinculum.

a A fraction equivalent to $\frac{1}{2}$

b A fraction larger than $\frac{2}{4}$ but smaller than 1

c A fraction equivalent to $\frac{2}{3}$



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2 Use a piece of string as a number line. Write these fractions on cards.

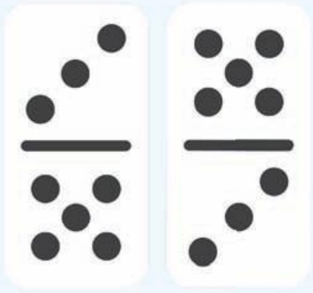
$\frac{3}{4}$ $\frac{6}{7}$ $\frac{9}{10}$ $\frac{6}{8}$ $\frac{6}{12}$ $\frac{27}{30}$ $\frac{5}{10}$ $\frac{2}{4}$ $\frac{12}{14}$

Peg fractions on the number line in order.

Discuss the placement of the fraction cards.

3 You will need a class set of dominoes (after removing the dominoes with blank spaces).

Work in small groups. Take a handful of dominoes and order the 'domino fractions' from smallest to largest. The fractions will vary depending on the position of the dominoes. For example, this domino reads $\frac{3}{5}$ or $\frac{5}{3}$:



8F Individual

1 Which is larger?

a $\frac{3}{5}$ or $\frac{2}{5}$?

b $\frac{6}{7}$ or $\frac{8}{7}$?

c $\frac{5}{12}$ or $\frac{7}{12}$?

2 Write these fractions in order, smallest to largest.

a $\frac{3}{8}, \frac{1}{8}, \frac{6}{8}, \frac{5}{8}, \frac{8}{8}$

b $\frac{5}{10}, \frac{2}{10}, \frac{10}{10}, \frac{3}{10}, \frac{9}{10}$

3 For each set of fractions, write equivalent fractions that have the same denominator.

a $\frac{3}{8}$ $\frac{1}{4}$ $\frac{2}{2}$

b $\frac{5}{6}$ $\frac{1}{2}$ $\frac{2}{3}$

c $\frac{1}{10}$ $\frac{2}{5}$ $\frac{1}{4}$

4 Which fraction in each pair is larger?

a $\frac{3}{4}$ or $\frac{1}{4}$?

b $\frac{2}{3}$ or $\frac{1}{4}$?

c $\frac{1}{8}$ or $\frac{1}{3}$?

d $\frac{1}{2}$ or $\frac{2}{3}$?

5 Which fraction in each pair is smaller?

a $\frac{7}{9}$ or $\frac{8}{9}$?

b $\frac{5}{6}$ or $\frac{2}{3}$?

c $\frac{7}{10}$ or $\frac{4}{5}$?

6 Which fraction is larger: $\frac{1}{2}$ or $\frac{48}{100}$? Explain your answer.

7 Mrs Tee's class and Mr Cher's class both have the same number of students in them. $\frac{5}{6}$ of the students are present in Mrs Tee's class. $\frac{2}{3}$ of the students are present in Mr Cher's class. Which class has more students at school?

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8G Improper fractions and mixed numbers

Proper and improper fractions

If the numerator of a fraction is less than the denominator, we call it a **proper fraction**. For example, $\frac{1}{3}$ and $\frac{4}{5}$ are proper fractions.

If the numerator is greater than or equal to the denominator, the fraction is called an **improper fraction**. For example, $\frac{4}{3}$ and $\frac{3}{3}$ are improper fractions.

Example 15

Label each fraction as proper or improper.

a $\frac{1}{4}$ **b** $\frac{6}{5}$ **c** $\frac{2}{2}$ **d** $\frac{89}{99}$

Solution

a $\frac{1}{4}$ is a proper fraction.

b $\frac{6}{5}$ is an improper fraction.

c $\frac{2}{2}$ is an improper fraction.

d $\frac{89}{99}$ is a proper fraction.

Whole numbers as fractions

All whole numbers can be written as fractions. For example, $1 = \frac{2}{2}$ and $2 = \frac{4}{2}$.

If the numerator and the denominator are the same number, we get a fraction that is equivalent to 1. For example, $\frac{3}{3} = 1$ and $\frac{10}{10} = 1$.

If the numerator is a multiple of the denominator, we get a whole number.

For example, $\frac{6}{3} = 2$ and $\frac{9}{3} = 3$.

Example 16

Write the whole number equivalent of each fraction.

a $\frac{4}{2}$ **b** $\frac{15}{5}$ **c** $\frac{20}{10}$ **d** $\frac{36}{9}$

Solution

a $\frac{4}{2} = 2$ **b** $\frac{15}{5} = 3$ **c** $\frac{20}{10} = 2$ **d** $\frac{36}{9} = 4$

Mixed numbers

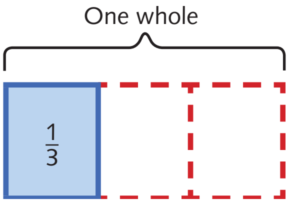
A mixed number is a whole number plus a fraction smaller than 1.

$1\frac{1}{2}$ is a mixed number. It means 1 plus $\frac{1}{2}$ more.

Let's build up thirds to see what happens when we get more than one whole.

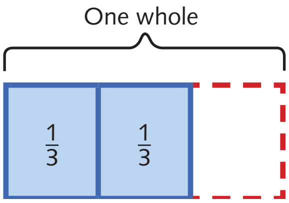
If we divide a rectangle into three equal pieces, each piece is $\frac{1}{3}$ of the whole.

$\frac{1}{3}$ One-third

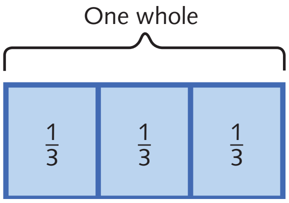


Now we extend the drawing by adding on pieces of size $\frac{1}{3}$.

$\frac{2}{3}$ Two-thirds

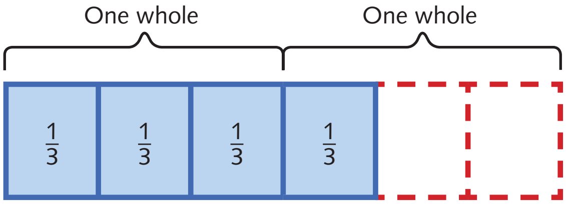


$\frac{3}{3}$ Three-thirds



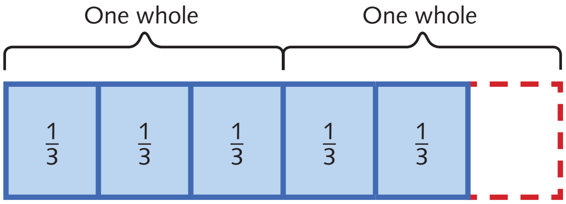
Notice that $\frac{3}{3}$ is the same as 1.

$\frac{4}{3}$ Four-thirds



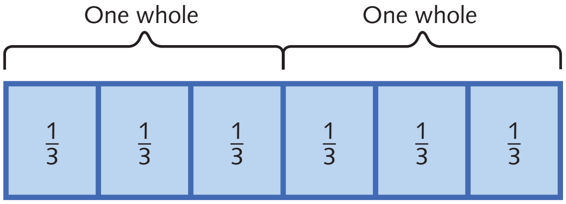
Four-thirds is the same as $1 + \frac{1}{3} = 1\frac{1}{3}$

$\frac{5}{3}$ Five-thirds



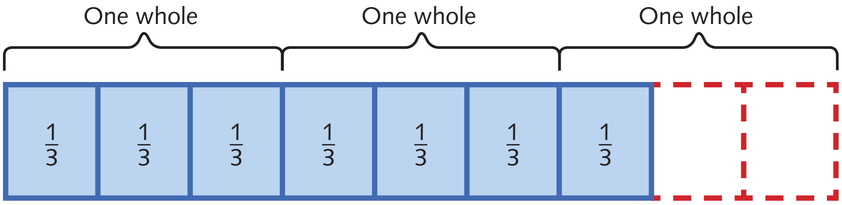
Five-thirds is the same as $1 + \frac{2}{3} = 1\frac{2}{3}$

$\frac{6}{3}$ Six-thirds



Six-thirds is the same as 2.

$\frac{7}{3}$ Seven-thirds



Seven-thirds is the same as $2\frac{1}{3}$.

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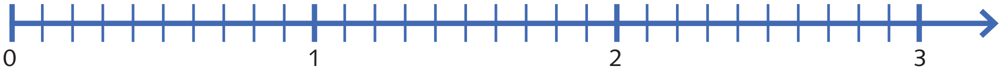
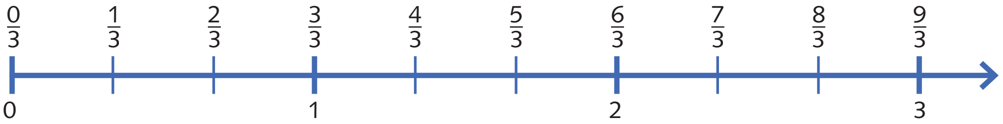
We can also show this on the number line.

Here is a number line marked 0, 1, 2, and 3.

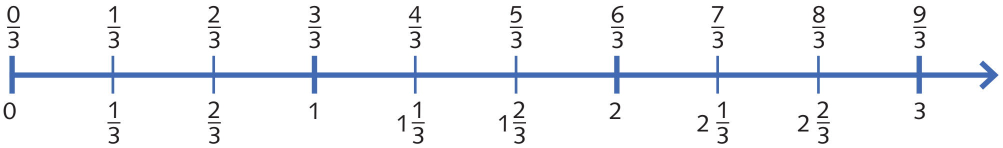


If we mark the number line in thirds and label across the number line



we see that $\frac{3}{3} = 1$, $\frac{6}{3} = 2$, and $\frac{9}{3} = 3$.

We can re-label the number line using whole numbers and mixed numbers.



Now we can see that $\frac{4}{3} = 1\frac{1}{3}$, $\frac{5}{3} = 1\frac{2}{3}$ and $\frac{7}{3} = 2\frac{1}{3}$.

Example 17

Write these improper fractions as mixed numbers.

a $\frac{7}{4}$

b $\frac{14}{12}$

Solution

a
$$\begin{aligned}\frac{7}{4} &= \frac{4}{4} + \frac{3}{4}\\ &= 1 + \frac{3}{4}\\ &= 1\frac{3}{4}\end{aligned}$$

b
$$\begin{aligned}\frac{14}{12} &= \frac{12}{12} + \frac{2}{12}\\ &= 1 + \frac{2}{12}\\ &= 1\frac{1}{6}\end{aligned}$$

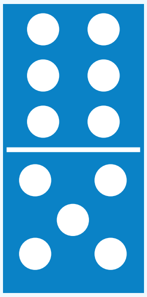
8G Whole class CONNECT, APPLY AND BUILD

1 Sort these fractions into one of three bags.

$\frac{3}{4}$	$\frac{2}{3}$	$\frac{4}{2}$	$10\frac{9}{8}$	$\frac{999}{1000}$	$2\frac{1}{2}$
$\frac{3}{2}$	$18\frac{2}{3}$	$\frac{999}{998}$	$10\frac{1}{1000}$	$\frac{5}{5}$	$\frac{77}{77}$

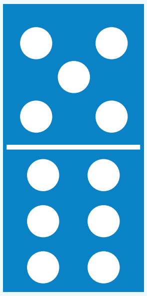
2 We can turn dominoes on their side to get a fraction. This domino can be read as either

$\frac{6}{5}$



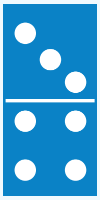
or

$\frac{5}{6}$

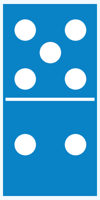


Write the fraction for each domino below. Are they proper or improper fractions?

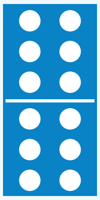
a



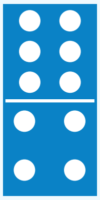
b



c



d



3 You will need a class set of dominoes.

a Take 2 dominoes from the class set and stand them on their ends. Write the fractions down. Convert each to a mixed number if you can. Which is the larger fraction?

b Take 5 dominoes from the class set and stand them on their ends. Sort them from smallest fraction to largest.

c Take 10 dominoes from the class set and use them to make fractions. Sort them into 2 groups: 'larger than $\frac{1}{2}$' or 'smaller than $\frac{1}{2}$'. Turn the domino upside down if you get a fraction equivalent to $\frac{1}{2}$.

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8G Individual

1 Write these fractions as whole numbers.

a $\frac{4}{2}$ **b** $\frac{5}{5}$ **c** $\frac{9}{3}$ **d** $\frac{16}{4}$ **e** $\frac{18}{3}$

f $\frac{100}{10}$ **g** $\frac{42}{6}$ **h** $\frac{100}{50}$ **i** $\frac{43}{43}$ **j** $\frac{34}{17}$

2 Draw a picture using shaded parts of rectangles to show each mixed number.

a $1\frac{1}{8}$ **b** $2\frac{3}{4}$ **c** $3\frac{3}{5}$

3 Convert these mixed numbers to improper fractions.

a $4\frac{1}{4}$ **b** $3\frac{2}{5}$ **c** $8\frac{3}{10}$ **d** $9\frac{26}{100}$ **e** $13\frac{1}{2}$

f $2\frac{1}{8}$ **g** $4\frac{11}{12}$ **h** $3\frac{49}{50}$ **i** $6\frac{111}{1000}$ **j** $4\frac{18}{30}$

4 Convert these improper fractions to mixed numbers.

a $\frac{4}{3}$ **b** $\frac{12}{5}$ **c** $\frac{8}{3}$ **d** $\frac{104}{50}$ **e** $\frac{34}{3}$

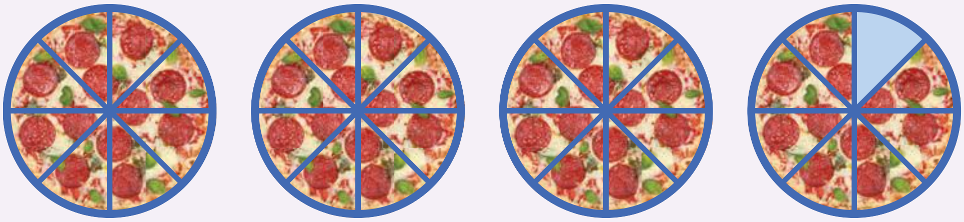
f $\frac{40}{6}$ **g** $\frac{40}{37}$ **h** $\frac{100}{12}$ **i** $\frac{76}{25}$ **j** $\frac{51}{2}$

5 Giuseppe's school had a Pizza Day. Each class had some leftover pizza. Write the fraction for the amount remaining in each class as a fraction and as a mixed number.

a

b

c



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8H Adding fractions with the same denominator

Addition of fractions with the same denominator is like other additions.

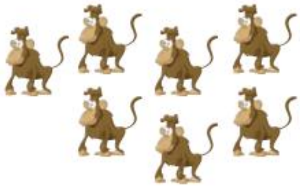
3 balloons + 4 balloons = 7 balloons


+

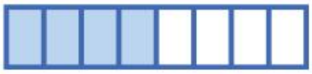
=


3 baboons + 4 baboons = 7 baboons


+

=


3 eighths + 4 eighths = 7 eighths


Example 18

Calculate $\frac{2}{4}+\frac{1}{4}$.

Solution

We can draw a square and shade two quarters and then one quarter.

2 quarters plus 1 quarter is 3 quarters.

$$\frac{2}{4}+\frac{1}{4}=\frac{3}{4}$$

When we add fractions with the same denominator we add the numerators.

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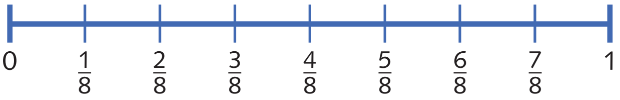
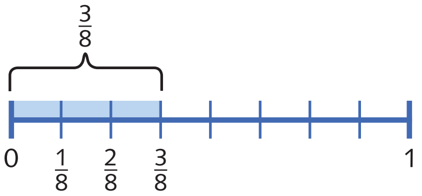
This is how we show the addition of two fractions on the number line.

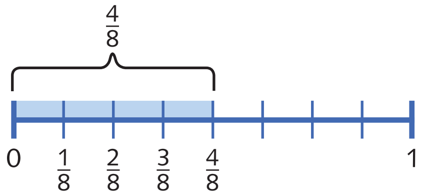
To work out $\frac{3}{8} + \frac{1}{8}$

- we divide the number line into eighths

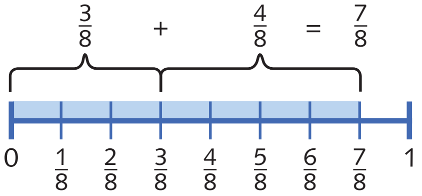


- then we show the two fractions as segments on the number line





- to add the fractions, we move the second segment next to the first one.



We get $\frac{3}{8} + \frac{4}{8} = \frac{7}{8}$.

Example 19

Calculate $\frac{3}{10} + \frac{8}{10} + \frac{4}{10}$.

Solution

$$\begin{aligned}\frac{3}{10} + \frac{8}{10} + \frac{4}{10} &= \frac{15}{10} \\ &= \frac{10}{10} + \frac{5}{10} \\ &= 1\frac{5}{10} \\ &= 1\frac{1}{2}\end{aligned}$$

Remember

When adding fractions with the same denominators, add the numerators.

8H Whole class CONNECT, APPLY AND BUILD

1 Draw rectangle pictures to show each addition.

a $\frac{1}{5}+\frac{3}{5}$ **b** $\frac{2}{8}+\frac{4}{8}$ **c** $\frac{2}{3}+\frac{1}{3}$ **d** $\frac{3}{4}+\frac{5}{4}$

2 Draw number lines to show these additions. Write the answer for each.

a $\frac{3}{6}+\frac{2}{6}$ **b** $\frac{2}{3}+\frac{4}{3}$ **c** $\frac{5}{8}+\frac{7}{8}$ **d** $\frac{4}{7}+\frac{6}{7}$

8H Individual

1 Draw a number line to calculate each addition.

a $\frac{1}{4}+\frac{3}{4}$ **b** $\frac{1}{5}+\frac{3}{5}$ **c** $\frac{3}{6}+\frac{2}{6}$ **d** $\frac{4}{10}+\frac{7}{10}$

2 Calculate:

a $\frac{2}{4}+\frac{3}{4}$ **b** $\frac{3}{9}+\frac{1}{9}$ **c** $\frac{4}{6}+\frac{1}{6}$

d $\frac{1}{20}+\frac{12}{20}$ **e** $\frac{4}{11}+\frac{7}{11}$ **f** $\frac{1}{5}+\frac{1}{5}+\frac{1}{5}+\frac{1}{5}$

g $\frac{1}{8}+\frac{2}{8}+\frac{1}{8}+\frac{3}{8}$ **h** $\frac{1}{20}+\frac{12}{20}+\frac{1}{20}+\frac{12}{20}+\frac{1}{20}+\frac{12}{20}$

3 Arky has 3 water tanks of the same size. He checked the water tanks each day during a very rainy week and wrote down how much water was collected each day as a fraction of one whole tank.

	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Fraction of a water tank collected	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{3}{6}$	$\frac{5}{6}$	$\frac{0}{6}$	$\frac{7}{6}$	$\frac{1}{6}$

a On which day(s) was more than one tank of water collected?

b How much water was collected on the weekend?

c How much water was collected on Monday and Tuesday?

d How much water was collected in total for the week?

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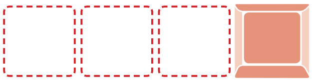
8I Review questions

1 Each chocolate bar has been broken into a number of equal pieces. Write the fraction shown by the shaded part of each bar.

a



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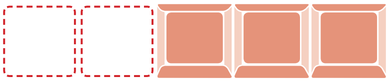

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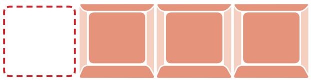
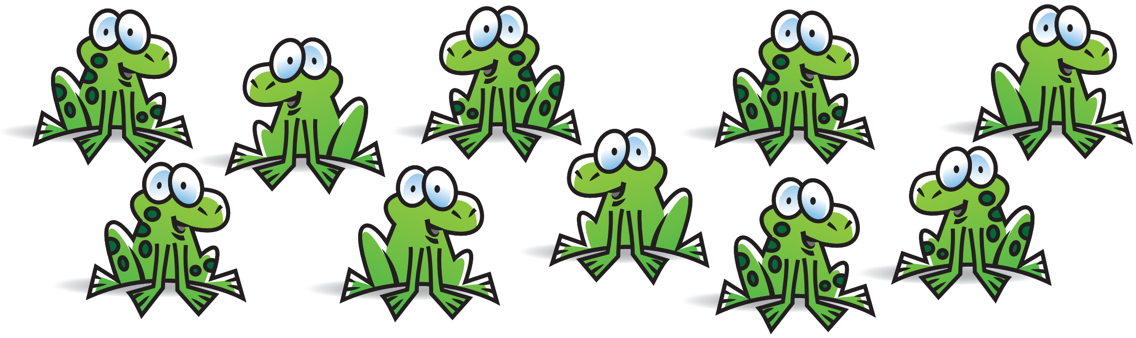


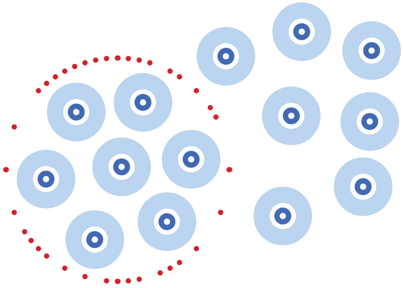
d

2 Here are 10 frogs. Some of the frogs have spots. Write a fraction for the number of frogs that have spots as part of the whole group of frogs.



3 Write a fraction to represent the circled collection of discs as part of the total number of discs.

a



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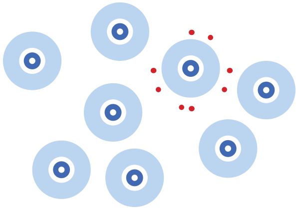

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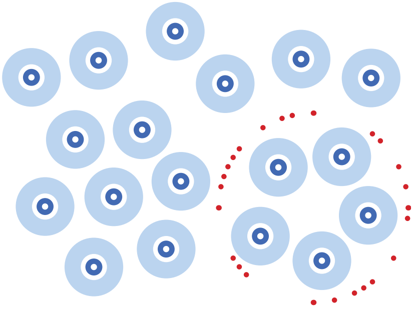

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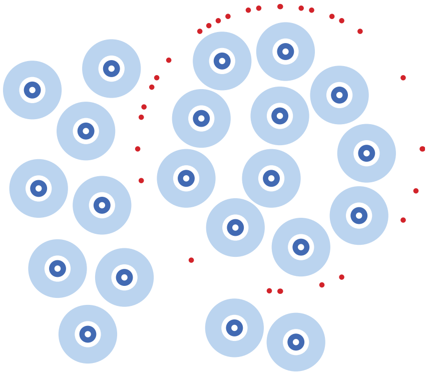

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4 **a** Draw a square, then draw lines to show quarters. Shade $\frac{3}{4}$. Do this in three different ways.

b Draw a circle, then draw lines to show thirds. Shade $\frac{2}{3}$.

c Draw a square, then draw lines to show sixths. Shade $\frac{1}{6}$. Do this in two different ways.

d Draw a circle, then draw lines to show eighths. Shade $\frac{5}{8}$. Do this in two different ways.

5 Write the fractions for these.

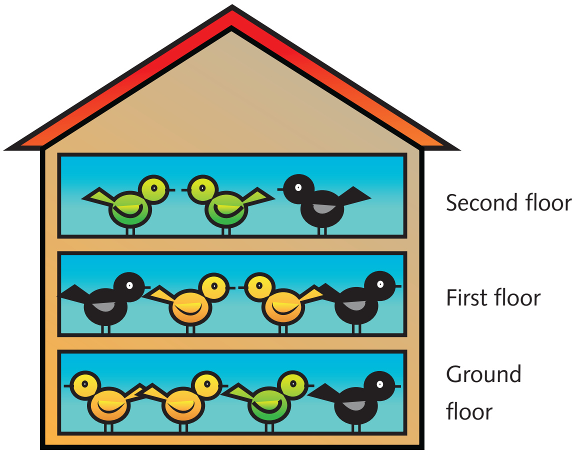
a seven-eighths **b** two-fifths **c** eight-tenths

6 **a** Draw a number line from 0 to 1. Mark $\frac{3}{4}$, $\frac{1}{2}$ and $\frac{1}{6}$ on it.

b Draw a number line from 0 to 2. Mark $\frac{2}{3}$, $\frac{4}{3}$, $\frac{1}{2}$ and $\frac{5}{6}$ on it.

7 This bird house has three floors.

There are three kinds of birds: green, black and yellow.



a What fraction of the birds on the second floor are black?

b What fraction of the birds on the first floor are yellow?

c What fraction of the birds on the first floor are black?

d What fraction of the birds on the ground floor are *not* green?

e What fraction of the birds in the entire bird house are yellow?

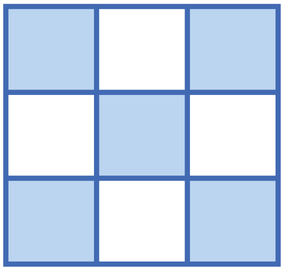
f What fraction of the birds in the entire bird house are green?

g What fraction of the birds in the entire bird house are black?

8 Write the fraction that describes how much of each square is shaded.

a

b



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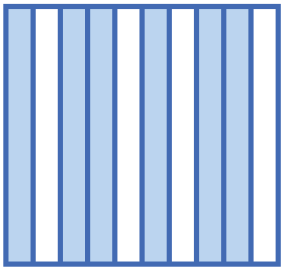

9 Fill in the numerator and denominator to make equivalent fractions.

a $\frac{1}{\square} = \frac{\square}{6} = \frac{12}{24}$ **b** $\frac{2}{\square} = \frac{10}{30} = \frac{5}{\square}$ **c** $\frac{6}{\square} = \frac{\square}{4} = \frac{12}{16}$

10 Draw three paper bags in your book and label them as shown. Sort each fraction into the correct paper bag.

$\frac{1}{2}$ $\frac{3}{12}$ $\frac{1}{8}$ $\frac{3}{4}$ $\frac{4}{6}$ $\frac{3}{3}$ $\frac{1}{3}$ $\frac{2}{8}$ $\frac{2}{9}$ $\frac{5}{10}$ $\frac{6}{4}$ $\frac{1}{4}$ $\frac{3}{10}$ $\frac{10}{15}$

11 Write these fractions in order, smallest to largest.

$\frac{1}{8}, \frac{1}{4}, \frac{1}{3}, \frac{1}{6}, \frac{1}{10}$

12 Which fraction in each pair is larger?

a $\frac{1}{2}$ or $\frac{6}{8}$? **b** $\frac{1}{3}$ or $\frac{3}{12}$? **c** $\frac{1}{4}$ or $\frac{3}{16}$?

d $\frac{7}{8}$ or $\frac{3}{4}$? **e** $\frac{4}{5}$ or $\frac{9}{10}$? **f** $\frac{2}{3}$ or $\frac{5}{9}$?

13 Bill ate $\frac{4}{6}$ of his chocolate bar. Stefan ate $\frac{10}{12}$ of his. Who ate more of his chocolate bar?

14 a $\frac{1}{3} + \frac{1}{3}$ **b** $\frac{1}{5} + \frac{2}{5}$ **c** $\frac{2}{7} + \frac{4}{7}$

d $\frac{4}{9} + \frac{2}{9}$ **e** $\frac{1}{6} + \frac{4}{6}$ **f** $\frac{5}{12} + \frac{6}{12}$

CHAPTER 9 Preparation

Useful skills for this topic:

- understanding the base-10 system (hundreds, tens and ones)
- understanding that fractions are part of a whole
- being able to use number lines to represent numbers, including fractions.

KICK OFF

Beachball

Write these numbers on stickers and place them randomly on a large beachball.

29	12	68	121	23
445	900	80	76	1000

Pass the beachball around the classroom. Whoever catches the ball looks at the number nearest to their right thumb and says the number that is:

a 1 more than that number

b 1 less than that number

c 10 more than that number

d 10 less than that number

Show what you know

1 Draw three bags in your book and label them as shown. Sort each number into the correct bag. Some numbers can go into more than one bag.

120	950	870	853	521	150	945
784	500	680	400	190	480	

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CHAPTER

9

Number and Algebra

Decimals

In this chapter we see how decimal numbers are built up from whole numbers and fractions, such as $\frac{1}{10}, \frac{1}{100}, \frac{1}{1000}$, and so on.

The number 391 is written on a place-value chart like this:

Hundreds	Tens	Ones
3	9	1

The number 391 has 3 hundreds, 9 tens and 1 one.

When we use decimal numbers, we extend the place-value work we have done to include tenths, hundredths and thousandths.

The word ‘decimal’ comes from the Latin word *decem*, meaning ten.

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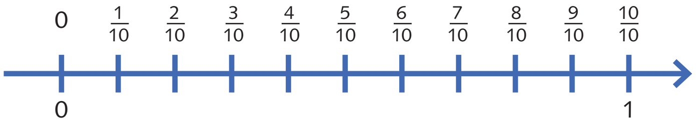
9A Tenths between 0 and 1

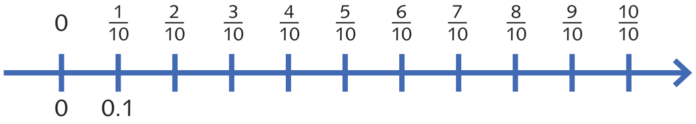
This number line shows 0 and 1.

If we cut the length between 0 and 1 into 10 equal pieces, each piece has a length of $\frac{1}{10}$.

We label the first point $\frac{1}{10}$, then continue to label across the number line.



We write $\frac{1}{10}$ as 0.1 when we use the decimal way of writing numbers.
When the number line is cut into tenths, we label the first marker to the right of the zero as 0.1. We read this as ‘zero point one’.

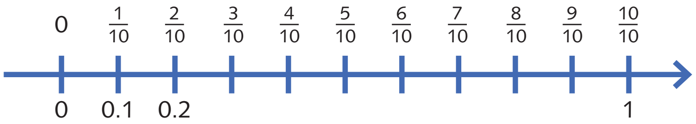


0.1 is the same as $\frac{1}{10}$.

The decimal point sits to the right of the ones place and tells us that the places after it are parts of the whole. The first place to the right of the decimal point is for tenths. We write 0.1 in a place-value chart like this:

Ones	tenths
0 ●	1

On the number line, we label the second point to the right of the zero as 0.2.
We read this as ‘zero point two’.



0.2 is the same as $\frac{2}{10}$.

We write 0.2 in a place-value chart like this:

Ones	tenths
0 ●	2

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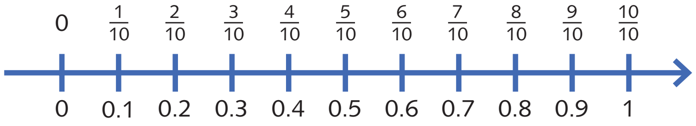
We continue to label across the number line in tenths. This number line stops at 1, but we could keep going beyond 1 forever marking in tenths.



1 is the same as $\frac{10}{10}$.

In the decimal system, 1 is the same as 1.0.

Tenths are part of our base-10 number system, so they follow the same rules as whole numbers:

10 hundreds make 1 thousand

10 tens make 1 hundred

10 ones make 1 ten

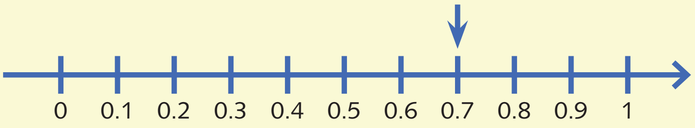
10 tenths make 1 one

Example 1

Mark 0.7 on a number line.

Solution

Draw a number line marked with 0 and 1. Cut the length between 0 and 1 into 10 equal pieces. The length of each piece is one-tenth. Label the number line between 0 and 1 in tenths, going from left to right. The seventh marker after 0 is 0.7 or seven-tenths.



9A Whole class CONNECT, APPLY AND BUILD

1  **Beachball**

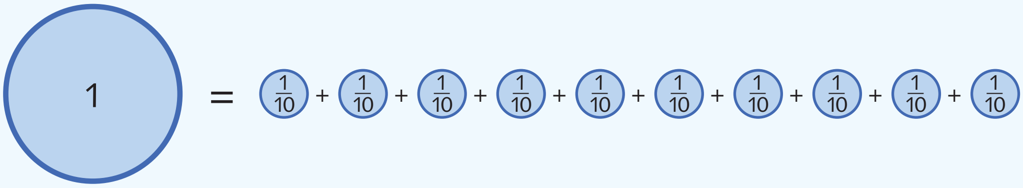
Write these fractions on stickers placed randomly on a large beachball:

$\frac{1}{10}, \frac{2}{10}, \frac{3}{10}, \frac{4}{10}, \frac{5}{10}, \frac{6}{10}, \frac{7}{10}, \frac{8}{10}, \frac{9}{10}, \frac{10}{10}$. Pass the beachball around the classroom. Whoever catches the ball reads the fraction nearest to their right thumb, then says that fraction as a decimal number.

2 You will need a half-metre piece of streamer. Fold your streamer into 10 equal pieces and label the fold marks in tenths using decimal notation.

3 **Playdough**

Start with a large ball (basketball size) of playdough. Cut the ball of playdough into 10 equal pieces, each one about the size of a fist.



Complete these sentences.

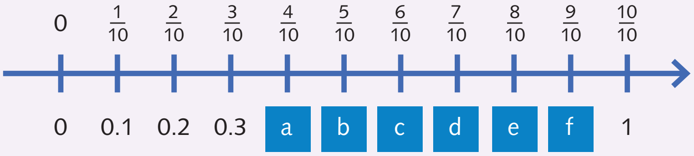
a Each of the 10 pieces is $\frac{1}{\square}$ or $0.\square$

b 3 pieces is equal to $\frac{3}{\square}$ or $0.\square$

c 7 pieces is equal to the fraction ________ and the decimal ________.

9A Individual

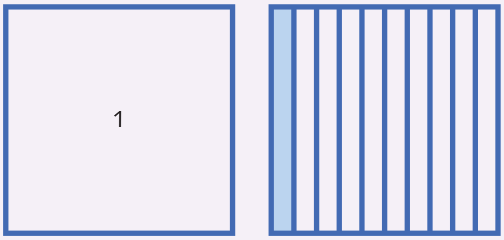
1 Copy this number line and write the decimal number for each letter.



2 Draw a number line marked in tenths from 0 to 1, then show these decimals.

a 0.2 **b** 0.4 **c** 0.6

3 One-tenth can be represented by taking a square and thinking of it as 1. Then divide the square into 10 equal parts, as shown. The shaded part represents $\frac{1}{10}$ or 0.1 of the square.



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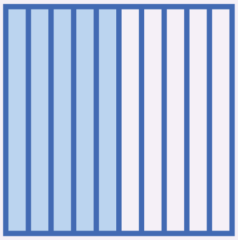
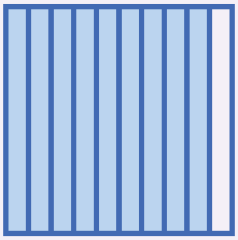
Write a decimal for the shaded part of each square.

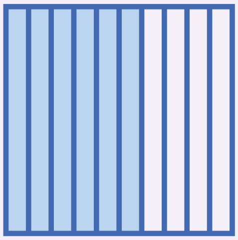
a



b



c



4 Write these fractions as decimals.

a $\frac{1}{10}$ **b** $\frac{4}{10}$ **c** $\frac{9}{10}$

5 Write these decimals as fractions.

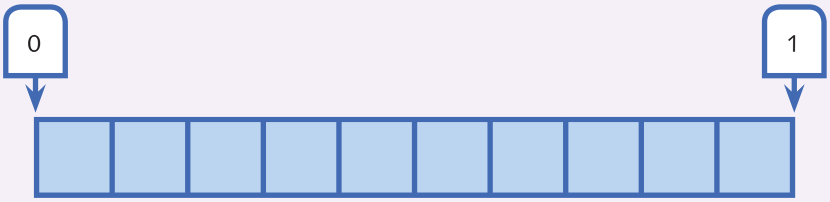
a 0.2 **b** 0.3 **c** 0.5

6 Order these decimals from smallest to largest.

a 0.4, 0.3, 0.8, 0.5

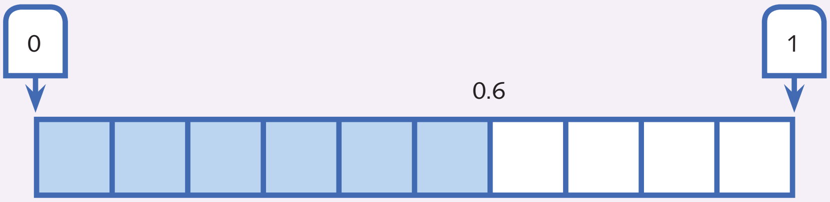
b 0.1, 1.0, 0.9, 0.7

7 The gauge on Arnie's petrol tank shows 1 when it is full.



Write the decimal number that describes how much petrol is left in Arnie's petrol tank. The first one has been done for you.

a



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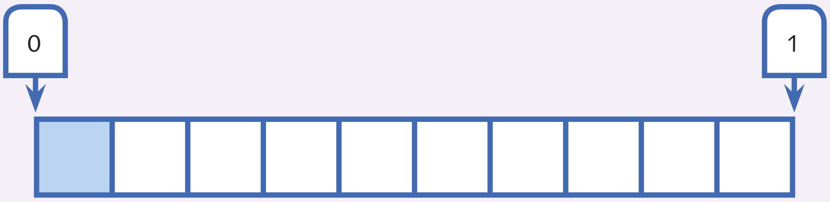

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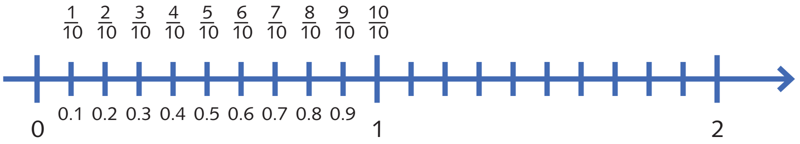
9B Numbers larger than 1

Now we are going to see what happens when we go past the number 1 on the number line.

This number line is marked with the whole numbers 0, 1 and 2 and the tenths between 0 and 1.



If we start at 0 and step by tenths, we say:

$\frac{1}{10}$ $\frac{2}{10}$ $\frac{3}{10}$ $\frac{4}{10}$ $\frac{5}{10}$ $\frac{6}{10}$ $\frac{7}{10}$ $\frac{8}{10}$ $\frac{9}{10}$ $\frac{10}{10}$

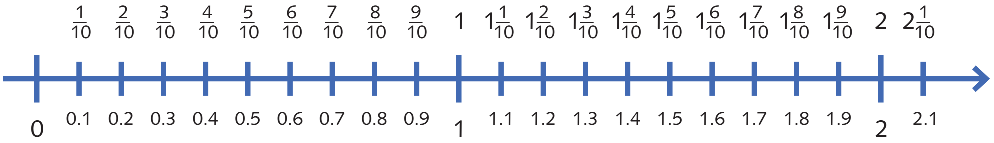
When we write this in decimals, it becomes:

0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

Notice that $\frac{10}{10}$ is the same as 1.

If we keep taking steps of one-tenth on the number line, what do you think will come after 1?

We cut the length between 1 and 2 into 10 equal pieces so that each piece has a length of one-tenth. We label across the number line.



If we take one step of one-tenth from $\frac{10}{10}$, we arrive at $\frac{11}{10}$, which is the same as $1 + \frac{1}{10}$ or $1\frac{1}{10}$.

The decimal way of writing $1\frac{1}{10}$ is 1.1.

The numbers that follow 1 will be:

$1\frac{1}{10}$	1 and 1 tenth	1.1	one point one
$1\frac{2}{10}$	1 and 2 tenths	1.2	one point two
$1\frac{3}{10}$	1 and 3 tenths	1.3	one point three
$1\frac{4}{10}$	1 and 4 tenths	1.4	one point four
$1\frac{5}{10}$	1 and 5 tenths	1.5	one point five
$1\frac{6}{10}$	1 and 6 tenths	1.6	one point six

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$1\frac{7}{10}$	1 and 7 tenths	1.7	one point seven
$1\frac{8}{10}$	1 and 8 tenths	1.8	one point eight
$1\frac{9}{10}$	1 and 9 tenths	1.9	one point nine
2	2 and 0 tenths	2.0	two point zero

On a place-value chart, we write 1 as 1.0 to show that there are zero tenths.

Ones	tenths
1 ●	0

If we take a step of one-tenth to the right of 1 on the number line, the number of tenths has increased by 1.

Ones	tenths
1 ●	1

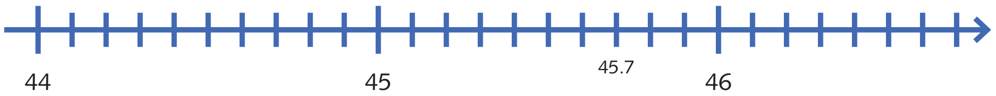
We read the number 45.7 as 'forty-five point seven'.

Tens	Ones	tenths
4	5 ●	7

The number 45 to the left of the decimal point tells us that we have 4 tens and 5 ones. The 7 to the right tells us that we have 7 tenths more.

45.7 is the same as $45\frac{7}{10}$.

This number line shows that 45.7 is between 45 and 46.



Example 2

Write these decimal numbers in words.

a 1.4 **b** 4.3 **c** 40.7

Solution

a One point four **b** Four point three **c** Forty point seven

Remember

The digits to the left of the decimal point tell us the whole number part.

The digit in the first place to the right of the decimal point tells us the number of tenths.

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Example 3

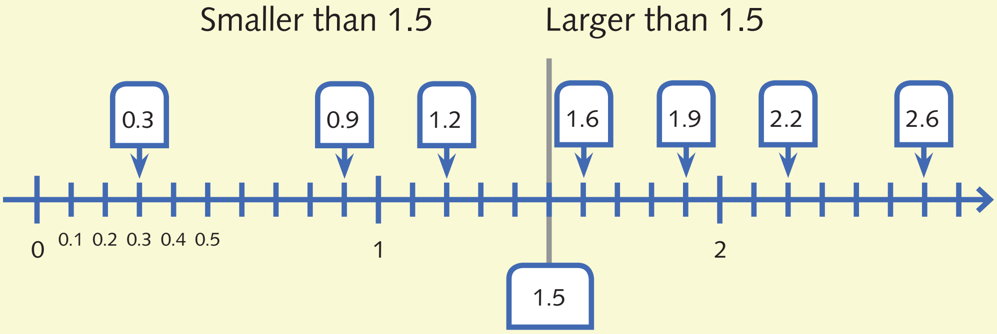
Sort these numbers into two groups:

- numbers smaller than 1.5
- numbers larger than 1.5

1.2 0.9 0.3 1.6 2.6 1.9 2.2

Solution

We place each number on the number line, then divide them into two groups.



Example 4

Write $3\frac{2}{10}$ as a decimal.

Solution

$3\frac{2}{10}$ has a whole number part, which is 3, and a fraction part, which is $\frac{2}{10}$.

The 3 does not change. In decimal notation, $\frac{2}{10}$ is written as a 2 in the tenths place.

So $3\frac{2}{10} = 3.2$.

9B Whole class CONNECT, APPLY AND BUILD

1 **Beachball**

Write these decimal numbers on stickers placed randomly on a large beachball: 12.4, 20.6, 10.5, 99.9, 38.2, 10.0, 5.9, 63.6, 41.8. Pass the beachball around the classroom. Whoever catches the ball reads the number nearest to their right thumb.

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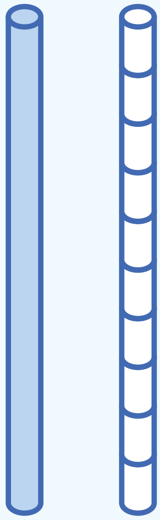
2 Decimal sticks

Draw a vertical stick about 50 centimetres long on the board. Call its length ‘1’.

a Ask students how long they think one-tenth might be.

b Draw another stick just like the first one and mark tenths on it.

Ask students to write and complete this statement:
____-tenths is the same as 1.

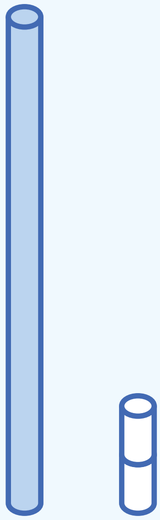


c We can use decimal-stick pictures to model decimal numbers. This is what 1.2 looks like using a decimal-stick picture:

1.2 is the same as 1 one and 2 tenths.

Use decimal-stick pictures to model these numbers:

1.4 3.2 4.5 9.1



9B Individual

1 Copy and complete this place-value chart.

		Hundreds	Tens	Ones	tenths
	45.7		**4**	**5** ●	**7**
a	45.6				
b	8.2				
c	60.8				
d	2.3				
e	32				
f	500.4				

2 Write these decimals as fractions.

a 2.1 **b** 3.5 **c** 0.8 **d** 2.6

e 4.4 **f** 10.2 **g** 1.7 **h** 27.3

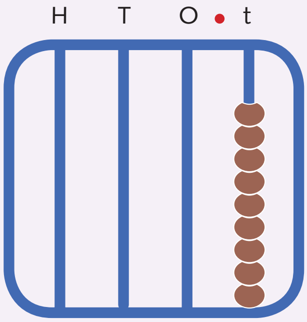
3 Write these fractions as decimals.

a $1\frac{1}{10}$ **b** $2\frac{7}{10}$ **c** $8\frac{4}{10}$ **d** $3\frac{3}{10}$

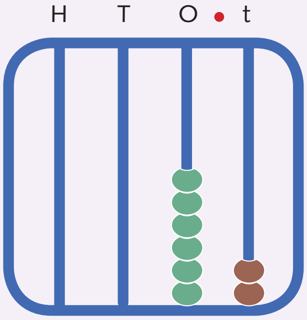
e $12\frac{2}{10}$ **f** $91\frac{8}{10}$ **g** $143\frac{6}{10}$ **h** $\frac{11}{10}$

4 Write the number shown on each abacus as a decimal, then in words.

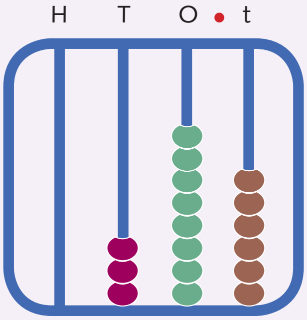
a



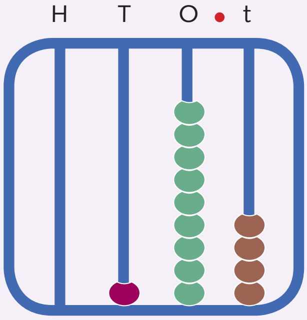
b



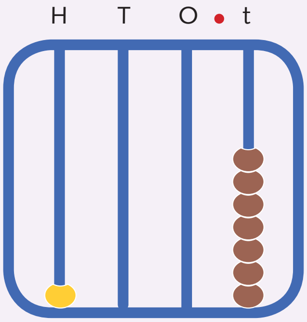
c



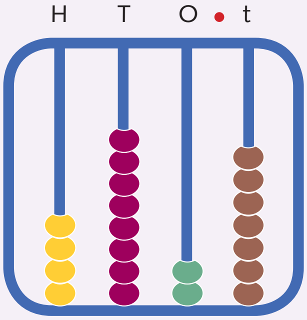
d



e



f



5 Draw a decimal-stick picture for each decimal number.

a 7.8 **b** 4.1 **c** 8.2 **d** 5.5

6 Write each number as a decimal. The first one has been done for you.

a 5 ones and 8 tenths Answer: 5.8

b 3 tens, 2 ones and 1 tenth

c 7 hundreds, 6 ones and 7 tenths

d 4 tens, 9 ones and $\frac{6}{10}$

e 2 tens, 5 ones and 7 tenths

f $14\frac{3}{10}$

7 Write each fraction and mixed number as a decimal.

a $\frac{1}{2}$ **b** $\frac{1}{5}$ **c** $1\frac{1}{2}$ **d** $\frac{1}{4}$ **e** $\frac{3}{4}$ **f** $4\frac{1}{4}$ **g** $6\frac{1}{2}$

h $2\frac{3}{4}$ **i** $1\frac{1}{5}$ **j** $\frac{1}{20}$ **k** $3\frac{2}{5}$ **l** $\frac{4}{5}$ **m** $\frac{3}{20}$ **n** $\frac{72}{10}$

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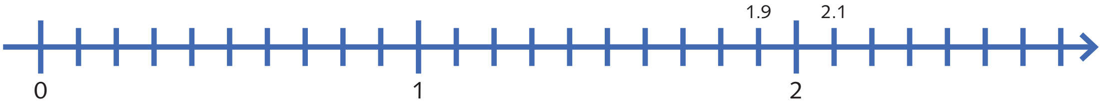
9C Comparing decimals

Which number is larger: 2.1 or 1.9?

We can see this on a number line.



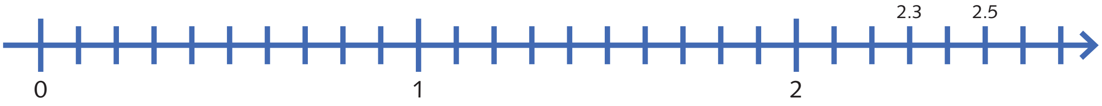
We know that numbers increase in size as we go to the right on a number line. So 2.1 is larger than 1.9.

There is often a shortcut to comparing decimal numbers.

The whole number part of 1.9 is 1. The whole number part of 2.1 is 2. The number with the larger whole number part is the larger number, so 2 is larger.

What happens if the whole number parts of two numbers being compared are the same?

This number line shows 2.3 and 2.5.



We can see that 2.5 is larger than 2.3 because it lies to the right of 2.3 on the number line.

Or, we can work it out this way:

2.3 is the same as $2\frac{3}{10}$

2.5 is the same $2\frac{5}{10}$.

The whole number parts are the same, but:

2.5 is 5 tenths more than 2 and 2.3 is only 3 tenths more than 2.

So 2.5 is larger than 2.3.

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Example 5

Put these numbers in order, smallest to largest:

2.8, 3.7, 1.5, 2.6

Solution

Line up the numbers under each other.

2.8
3.7
1.5
2.6

Order the numbers by comparing the highest value digits, in this case that means starting with the ones.

1.5	2.8	3.7
	2.6	

There are two numbers with the digit 2 in the ones place, so we need to compare the tenths. Since 8 tenths is larger than 6 tenths, 2.8 is larger than 2.6.

Our ordering is now done: 1.5, 2.6, 2.8, 3.7.

9C Whole class CONNECT, APPLY AND BUILD

1 Draw a decimal-stick picture for each pair of numbers, then decide which number in each pair is larger.

a 1.2 or 3.4 **b** 3.1 or 2.9 **c** 1.3 or 1.8 **d** 0.5 or 0.4

2 Draw decimal-stick pictures for each set of numbers, then order them from smallest to largest.

a 3.2, 4.5, 2.9 **b** 1.3, 1.8, 1.4 **c** 2.9, 1.6, 2, 1.7, 1.9

3 Draw two bags on the board and label them as shown.

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a As a class, discuss how to sort these numbers into the bags.

1.9 0.8 2.4 0.5 1.1 2.1 2.8 2.9 1.6 1.3

b Sort the numbers into the bags in order from smallest to largest.

4 Make the largest number

Ones •	tenths

Work in pairs.

Draw a place-value grid as shown on the right.

You will need a 10-sided die (marked 0–9). Roll the die, then write the number rolled in one of the boxes on your grid. Once you have written the number you cannot change its place.

Then roll the die again and write the number rolled in the remaining box.

The student who makes the largest number is the winner. Repeat several times.

9C Individual

1 Draw decimal-stick pictures for these pairs of decimal numbers, then decide which one of each pair is larger.

a 1.2 or 0.8 **b** 4.9 or 5.1 **c** 4.6 or 4.2 **d** 3 or 3.2

2 Write each group of numbers in order, smallest to largest.

a 1.1, 1.8, 1.7, 1.5, 1.3, 1.9, 1.4, 1.2

b 1.2, 2.1, 0.2, 0.1, 0.0, 12.1, 0.7, 7.0

c 12, 4.3, 4, 1.8, 9.1, 5.0, 4.7, 12.1

3 Five friends measured their heights. These are the results:

Hui 1.5 m, Ben 1.6 m, Sally 1.6 m, Lin 1.4 m, Jack 1.7 m

a Who is the tallest?

b Who is the shortest?

c Who is closest to being 2 metres tall?

4 Order these decimals from smallest to largest.

a 3.4, 3.3, 3.1, 3.6 **b** 1.4, 0.6, 7.1, 8.2

c 2.6, 3.2, 6.2, 0.6 **d** 10.2, 1.2, 1.0, 2.1

5 Which of these decimals is closest to 1?

a 0.6 0.3 1.1 0.7 **b** 4.2 2.3 0.8 1.7

c 1.9 1.7 0.9 0.7 **d** 8.7 3.5 6.2 9.9

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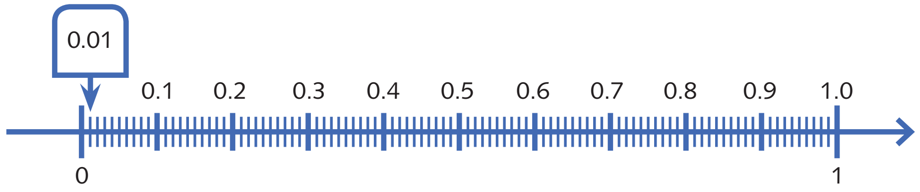
9D Hundred*ths*

Just as we cut 1 into ten equal pieces to get tenths, we can cut one tenth into ten equal pieces to get hundred*ths*. When we cut each ten*th* into ten equal pieces, it makes 100 pieces between 0 and 1. Each piece is equal to $\frac{1}{100}$.

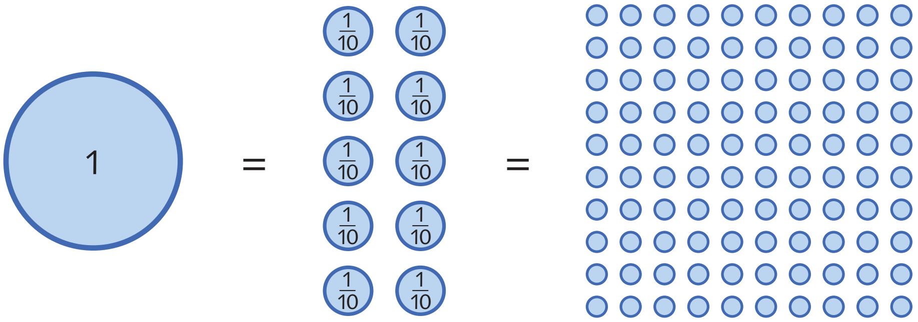
We write $\frac{1}{100}$ as 0.01 when using the decimal way of writing numbers.

This gives new markers on the number line. The first one is $\frac{1}{100}$ or 0.01, as shown below.



0.01 is the same as $\frac{1}{100}$.

Here is a picture of hundredths using the playdough ball.



$1 \quad = \quad 10 \times \frac{1}{10} \quad = \quad 100 \times \frac{1}{100}$

or $\quad$ or

$10 \times 0.1 \quad 100 \times 0.01$

On a place-value chart, the second place to the right of the decimal point has the value of hundredths.

0.01 is written like this.

Ones	tenths	hundredths
0 •	0	1

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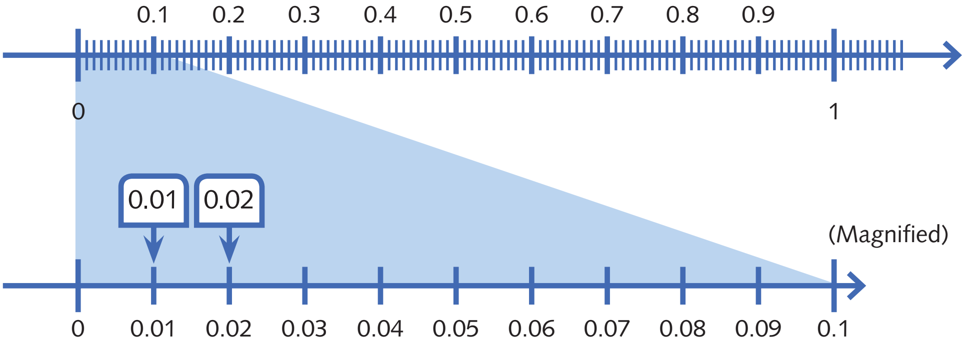
We can count in hundredths on the number line. We label the first point on the number line to the right of zero as 0.01 and keep going. We need to 'zoom' in on the number line to see hundredths between 0 and 0.1.



When we get to 10 hundredths, this is the same marker as one-tenth or 0.1. We can also write 0.1 as 0.10.

If we keep going up by one-hundredth, we get:

0.11, which is the same as $\frac{1}{10} + \frac{1}{100}$

0.12, which is the same as $\frac{1}{10} + \frac{2}{100}$

0.13, which is the same as $\frac{1}{10} + \frac{3}{100}$

0.14, which is the same as $\frac{1}{10} + \frac{4}{100}$

0.15, which is the same as $\frac{1}{10} + \frac{5}{100}$

0.16, which is the same as $\frac{1}{10} + \frac{6}{100}$

0.17, which is the same as $\frac{1}{10} + \frac{7}{100}$

0.18, which is the same as $\frac{1}{10} + \frac{8}{100}$

0.19, which is the same as $\frac{1}{10} + \frac{9}{100}$

0.2, which is the same as $\frac{2}{10}$.

We can keep labelling in hundredths across the number line until we get to 100 hundredths, which is the same as 1.

1 is the same as $\frac{100}{100}$.

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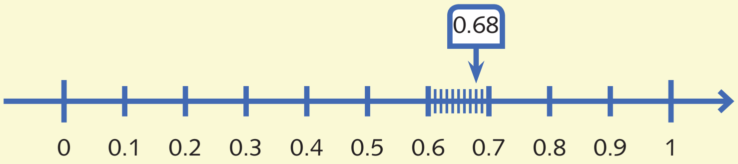
Example 6

Mark 0.68 on a number line.

Solution

Draw a number line marked with 0 and 1. Cut the length between 0 and 1 into 10 equal pieces. Each piece is one-tenth. Label the number line in tenths, from left to right. The sixth marker after 0 is 0.6. Now cut the length between 0.6 and 0.7 into 10 equal pieces. Each piece is one-hundredth. The eighth marker is 0.68.



Example 7

Convert $\frac{7}{100}$ to a decimal.

Solution

We have 0 ones, 0 tenths and 7 hundredths, so we write a 7 in the hundredths place.

$$\frac{7}{100} = 0.07$$

Ones	tenths	hundredths
0 •	0	7

Example 8

Convert $\frac{87}{100}$ to a decimal.

Solution

$$\begin{aligned}\frac{87}{100} &= \frac{80}{100} + \frac{7}{100}\\ &= \frac{8}{10} + \frac{7}{100}\end{aligned}$$

$\left(\text{We can simplify } \frac{20}{100} \text{ to get } \frac{2}{10}.\right)$

We have 0 ones, 8 tenths and 7 hundredths, so we write an 8 in the tenths place and a 7 in the hundredths place.

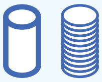
$$\frac{87}{100} = 0.87$$

9D Whole class CONNECT, APPLY AND BUILD

1 To make a decimal-stick picture for decimal numbers that have hundredths in them, you will need a picture for hundredths.

If this is 1  and this is one tenth , then one-hundredth will look like this: .

We know that 10 tenths is the same as 1. We can see that 10 hundredths is the same as one-tenth.



$\frac{10}{100} = \frac{1}{10}$ or 10 lots of 0.01 = 0.1

Draw decimal-stick pictures for these numbers. You might need a whole page of your book.

a 2.31 **b** 3.65 **c** 2.99 **d** 3.08

Choose some decimal numbers of your own and draw decimal-stick pictures for them.

2 **Playdough**

Use a playdough ball to model hundredths. Cut the ball of playdough into 10 equal pieces. Each piece is $\frac{1}{10}$ or 0.1. Then cut one of the tenths into 10 equal pieces about the size of your thumb. Each smaller piece is $\frac{1}{100}$ or 0.01.

Use the playdough pieces to model these decimal numbers.

a 0.23 **b** 0.03 **c** 0.2 **d** 0.3 **e** 0.32 **f** 0.02

9D Individual

1 Copy and complete this place-value chart.

		Hundreds	Tens	Ones	tenths	hundredths
	1.05			1 •	0	5
a	2.33					
b	10.82					
c	153.18					
d	49.02					

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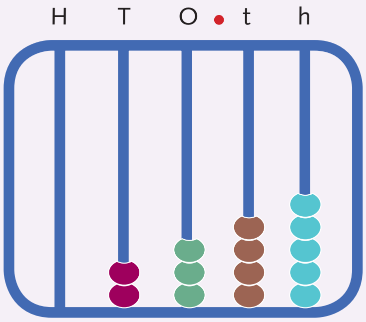
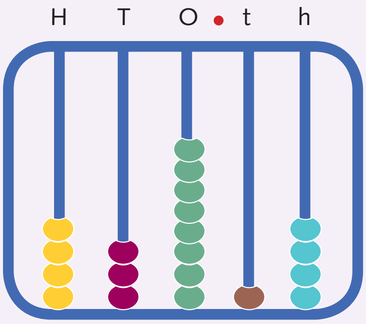
2 Write the number shown on each abacus in numbers, then in words.

a



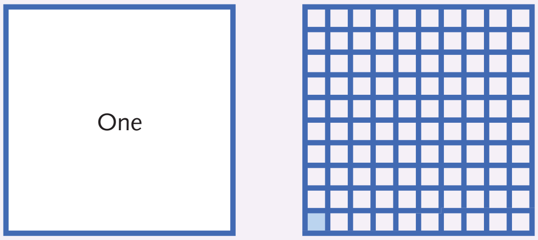
b



3 Draw a decimal-stick picture for each of these.

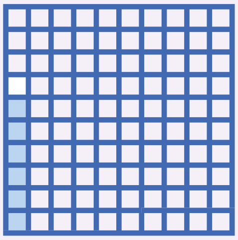
a 7.8 **b** 4.1 **c** 8.2 **d** 5.5

4 One hundredth can be represented by taking a square and thinking of it as 1. Then divide the square into 100 equal parts, as shown. The shaded part represents $\frac{1}{100}$ or 0.01 of the square.

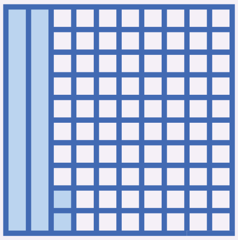


What decimal part of each square is shaded?

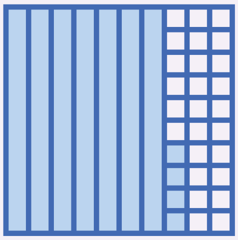
a



b



c



5 Write these fractions as decimals.

a $\frac{1}{100}$ **b** $\frac{2}{100}$ **c** $\frac{3}{100}$ **d** $\frac{7}{100}$ **e** $\frac{9}{100}$ **f** $\frac{12}{100}$ **g** $\frac{37}{100}$

6 Write these decimals as fractions.

a 0.01 **b** 0.08 **c** 0.02 **d** 0.23 **e** 0.66 **f** 0.99

7 Write these numbers as decimals. The first one has been done for you.

a 3 tens, 4 ones, 0 tenths and 5 hundredths Answer: 34.05

b 8 tens, 2 ones, 6 tenths and 3 hundredths

c 9 hundreds, 8 tens, 4 ones, 1 tenth and 7 hundredths

d 5 tens, 2 ones, 2 tenths and 5 hundredths

e 1 hundred, 7 tens, 7 tenths and 6 hundredths

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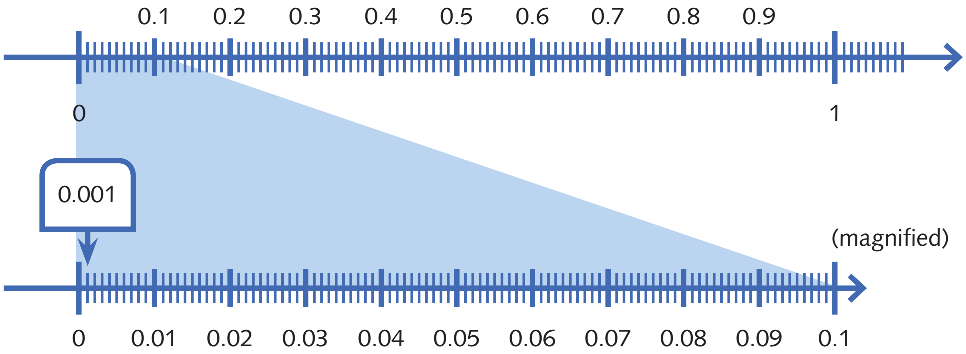
9E Thousand*ths*

We can cut hundredths into ten equal pieces to get thousandths.

To show thousandths on the number line, imagine that you are looking through a magnifying glass.



When we cut each hundredth into ten pieces, there are 1000 pieces between 0 and 1, so each piece is called $\frac{1}{1000}$.

We write $\frac{1}{1000}$ as 0.001 when we are using decimals.

0.001 is the same as $\frac{1}{1000}$.

On a place-value chart, the third place to the right of the decimal point has the value of thousandths. One-thousandth is written on a place-value chart like this:

Ones	tenths	hundredths	thousandths
0 •	0	0	1

We can count in thousandths on the number line. We label the first marker on the number line to the right of zero as 0.001 and then keep going:

0.002 0.003 0.004 0.005 0.006 0.007 0.008 0.009

When we get to 10 thousandths we see that this is the same marker as one hundredth or 0.01.

0.01 is the same as $\frac{10}{1000}$ and 0.010.

If we keep going up by one-thousandths, we get:

0.011, which is the same as $\frac{1}{100} + \frac{1}{1000}$

0.012, which is the same as $\frac{1}{100} + \frac{2}{1000}$

0.013, which is the same as $\frac{1}{100} + \frac{3}{1000}$

0.014, which is the same as $\frac{1}{100} + \frac{4}{1000}$

0.015, which is the same as $\frac{1}{100} + \frac{5}{1000}$

0.016, which is the same as $\frac{1}{100} + \frac{6}{1000}$

0.017, which is the same as $\frac{1}{100} + \frac{7}{1000}$

0.018, which is the same as $\frac{1}{100} + \frac{8}{1000}$

0.019, which is the same as $\frac{1}{100} + \frac{9}{1000}$

0.02, which is the same as $\frac{2}{100}$.

We can keep labelling in thousandths across the number line until we get to 100 thousandths, which is the same as 0.1.

0.1 is the same as $\frac{100}{1000}$.

We can continue labelling in thousandths across the number line until we get to 1000 thousandths, which is the same as 1.

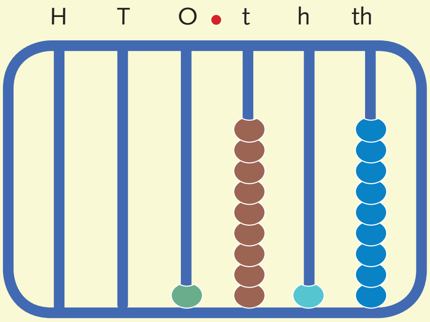
1 is the same as $\frac{1000}{1000}$.

The place-value system keeps going forever. You might have also seen ten-thousand*ths*, hundred-thousand*ths* and million*ths*.

Example 9

Draw an abacus with the decimal 1.919 on it.

Solution



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How to read decimals

We read the digits after a decimal point by saying the digits in order. For example, 3.215 is 'three point two one five'.

Example 10

Convert $\frac{23}{1000}$ to a decimal.

Solution

$$\begin{aligned}\frac{23}{1000} &= \frac{20}{1000} + \frac{3}{1000} \\ &= \frac{2}{100} + \frac{3}{1000}\end{aligned}$$

$\left(\frac{20}{1000}\right.$ cancels down to $\left.\frac{2}{100}.\right)$

We have 0 ones, 0 tenths, 2 hundredths and 3 thousandths, so we write a 0 in the tenths place, a 2 in the hundredths place and a 3 in the thousandths place.

$$\frac{23}{1000} = 0.023$$

Example 11

a Convert 0.002 to a fraction.

b Convert 0.104 to a fraction.

Solution

a We have 0 ones, 0 tenths, 0 hundredths and 2 thousandths.
So we write:

$$\begin{aligned}0.002 &= \frac{2}{1000} \\ &= \frac{1}{500} \qquad \text{(in simplest form)}\end{aligned}$$

b $0.104 = 1$ tenth $+ 0$ hundredths $+ 4$ thousandths

$$\begin{aligned}&= \frac{1}{10} + \frac{0}{100} + \frac{4}{1000} \\ &= \frac{100}{1000} + \frac{4}{1000} \\ &= \frac{104}{1000} \\ &= \frac{13}{125} \qquad \text{(in simplest form)}\end{aligned}$$

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9E Whole class CONNECT, APPLY AND BUILD

1 **Is there a number in between? (Activity)**

To the teacher: Think of two whole numbers. Write them at opposite ends of the board, with the larger number on the right. Ask for a number in between these two. Write the new number between the two numbers already written on the board. Rub out one of the first numbers and ask for a number between the two now on the board. Eventually you will get to two consecutive whole numbers. Students will then have to use a decimal number for the number they make up between the two on the board. Keep going until the numbers on the board are only one-thousandth apart. Repeat several times until students realise that there is always a number in between. You could go beyond thousandths and keep going on forever.

2 To make a decimal-stick picture for numbers that have thousandths, you will need a picture for thousandths.

If this is 1 , this is one-tenth  and this is one-hundredth , then one-thousandth will look like this .

1000 thousandths is the same as 1. $\frac{1000}{1000} = 1$

Draw decimal-stick pictures for these numbers.

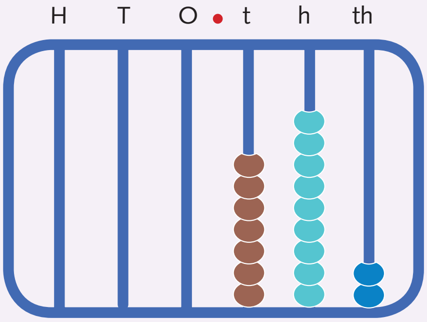
a 2.813 **b** 3.999 **c** 2.302 **d** 3.917

e Try making pictures for five numbers of your own. Get someone to check them.

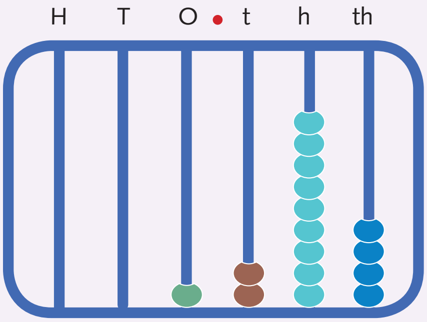
9E Individual

1 Write the number shown on each abacus as a decimal number, and then in words.

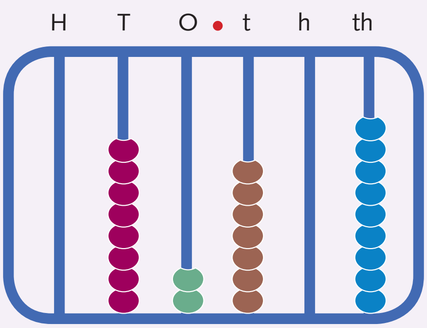
a



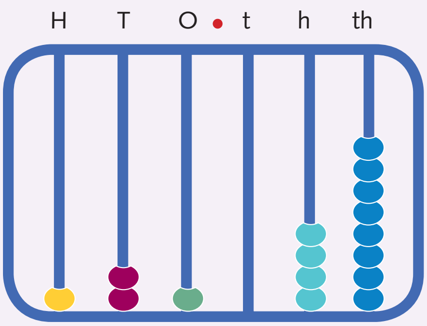
b



c



d



2 Copy and complete this place-value chart.

		Hundreds	Tens	Ones	tenths	hundredths	thousandths
	3.908			**3**	**9**	**0**	**8**
a	0.236						
b	1.732						
c	456.007						
d	121.893						
e	909.674						

3 Write these fractions as decimals.

a $\frac{1}{1000}$ **b** $\frac{4}{1000}$ **c** $\frac{6}{1000}$ **d** $\frac{333}{1000}$ **e** $\frac{424}{1000}$

f $\frac{999}{1000}$ **g** $\frac{48}{1000}$ **h** $\frac{68}{1000}$ **i** $\frac{12}{1000}$ **j** $\frac{99}{1000}$

4 Write these decimals as fractions.

a 0.001 **b** 0.002 **c** 0.004 **d** 0.6893

e 0.6161 **f** 0.9999 **g** 0.21 **h** 0.11

i 0.38 **j** 0.166 **k** 0.499 **l** 0.500

Homework

1 How far apart are these numbers on the number line?

a 0.3 and 0.4 **b** 11.2 and 11.3

c 0.1 and 0.3 **d** 2 and 2.1

e 10.1 and 10.4 **f** 1.9 and 2.1

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9F More comparing decimals

We saw earlier that it is best to compare decimal numbers starting from the left. We can compare any two decimal numbers in this way. Line up the numbers so that their place-value components are one under the other. Make sure the decimal points are aligned.

Start with the whole number parts.

If the whole number parts are the same, compare the tenths.
If the tenths are the same, compare the hundredths.
If the hundredths are the same, compare the thousandths, and so on.

The first time you find that one digit is larger than another in the same place, then the number with the larger digit is the larger of the two numbers. If you need convincing that one number is larger than another, draw decimal-stick figures or a number line and see for yourself.

Example 12

Which is larger: 1.37 or 1.214?

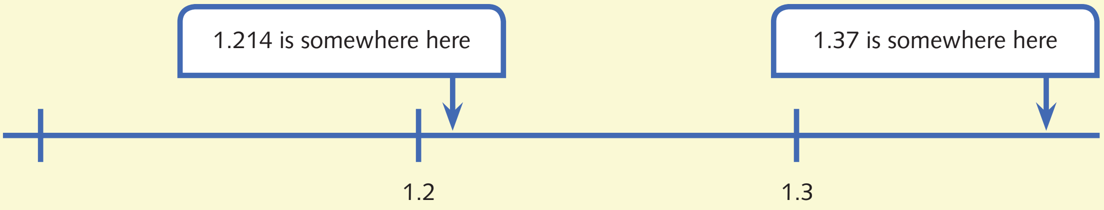
Solution

This can be done in a number of ways.

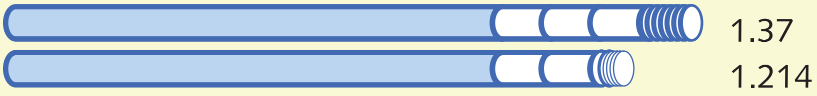
1. 3 7
1. 2 1 4

1 Align the digits.
Compare the ones: these are the same.
Compare the tenths: 3 tenths is larger than 2 tenths, so 1.37 is larger than 1.214

2 On a number line we can see that 1.214 is less than 1.3 and 1.37 is greater than 1.3



3 Make a stick picture.
You can see that 1.37 is larger than 1.214



9F Whole class CONNECT, APPLY AND BUILD

1 **String number line**

Everybody writes a decimal number on a card; they then take turns to peg their decimal number on a string number line. Discuss the correct placement of numbers.

2 Use playdough cut into tenths, hundredths, thousandths and so on to help you decide which of these pairs of numbers is larger.

a 1.1 or 1.03 **b** 2.7 or 2.77 **c** 0.91 or 0.19 **d** 0.123 or 0.3

3 What is the largest number you can make by placing the digits 2519 and a decimal point in any order? What is the smallest number you can make?

4 Draw a place-value chart like this one.

Ones	tenths	hundredths	thousandths
		•	

Roll a 10-sided die (marked 0–9) and call out the number. Write the number in one of the boxes on your place-value chart. Once you have written the number, you cannot change its place.

Repeat this step three more times, then compare the numbers you have made. The student with the largest number is the winner.

9F Individual

1 Draw a number line for each question and mark the approximate position of the number.

a 1.2 3.6 0.08 1.9 **b** 0.15 0.79 0.002 1.009

2 Which decimal in each pair is larger?

a 0.8 or 0.088 **b** 3.409 or 4.92

c 4.7777 or 4.8 **d** 0.3 or 0.22

e 8.3 or 8.983 **f** 4.0009 or 4.8

g 38.3 or 3.2 **h** 2.1231 or 2.03

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3 Write these numbers in order, from largest to smallest.

a	0.001	0.6161	0.9	0.21
b	1.402	1.499	1.4	1.424
c	0.004	0.11	0.166	0.01
d	0.6893	0.38	0.3	0.099

4 Show each pair of numbers on the number line. Then say which one is smaller.

a 0.5 and $\frac{3}{4}$ **b** $\frac{1}{8}$ and 0.13 **c** 4.3 and $3\frac{999}{1000}$

5 Which is larger?

a $\frac{1}{2}$ or 0.7 **b** 0.3 or $\frac{1}{4}$ **c** 0.999 or $\frac{99}{100}$

6 Put these fractions and decimals in order, from smallest to largest.

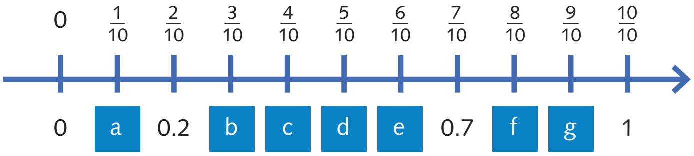
a 1.2, 2.18, $2\frac{1}{10}$, $\frac{11}{10}$, 2.11 **b** $\frac{21}{10}$, $\frac{11}{10}$, $\frac{2}{10}$, 2.4, 2.7, 1.6

9G Review questions

1 Copy and complete this place-value chart.

		Hundreds	Tens	Ones	tenths	hundredths	thousandths
a	**101.001**	1	0	1	0	0	1
b	23.803						
c	999.876						
d	20.07						
e	402.024						

2 Write the decimal number for each letter.



3 Draw a number line from 0 to 1. Mark it in tenths, then show these decimals.

a	0.6	0.2	0.4	0.7
b	0.22	0.03	0.1	0.3
c	0.8	0.789	0.72	0.279

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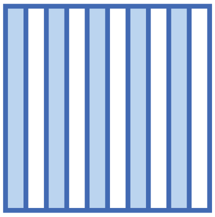
4 What decimal part of each square is shaded?

a



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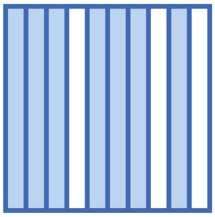

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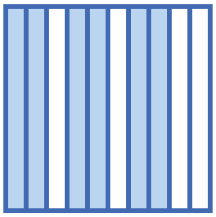

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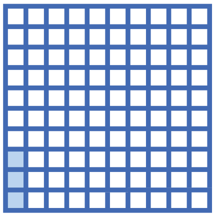
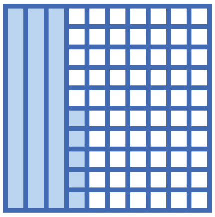


e



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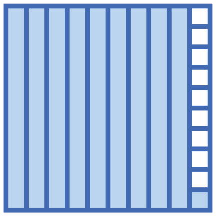
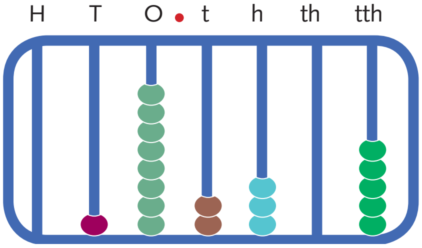


5 Write the number shown on each abacus in numbers, then in words.

a



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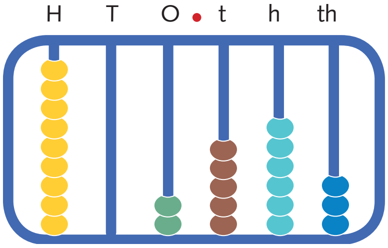


6 Draw a decimal-stick picture for each of these decimal numbers.

a 1.2 **b** 2.34 **c** 4.082

7 Write these fractions as decimals.

a $\frac{8}{10}$ **b** $\frac{4}{100}$ **c** $\frac{7}{1000}$ **d** $\frac{23}{100}$ **e** $\frac{3}{1000}$ **f** $\frac{72}{1000}$

8 Write these decimals as fractions.

a 0.003 **b** 0.08 **c** 0.104 **d** 0.43 **e** 0.108 **f** 0.0909

9 Joanne, Martha and Ingrid measured their heights as 1.24 m, 1.99 m and 1.362 m respectively. Who is the tallest and who is the shortest?

10 Claude and Rebecca were doing some cooking. Claude weighed two lots of flour, each one 0.3 kg. Rebecca weighed out 0.58 kg of flour. Who had more flour?

11 Which is larger?

a 6.7 or 7.6? **b** 4.009 or 4.9? **c** 1.4 or 1.392? **d** 1.5 or 1.932?

12 Write each group of numbers in order, from largest to smallest.

a 1.2 3.4 0.8 5.6
b 0.02 0.008 0.802 0.228
c 0.347 0.593 0.009 0.051
d 100.2 100.02 100.222 100.022

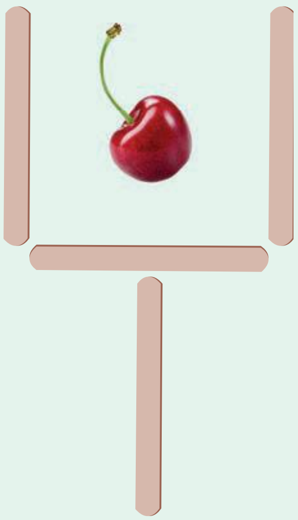
CHAPTER 10 Preparation

Useful skills for this chapter:

- previous experience drawing and describing lines and shapes.

KICK OFF

This is a glass with a cherry inside. Make this glass with four craft sticks and a counter. Move only two craft sticks to make another glass with the cherry outside it.



Show what you know

1 Look around your classroom. How many right angles can you find? See if you can find 10 different right angles and write down their locations.

2 How many angles smaller than a right angle can you find? Find at least 3 and write down the location of each.

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CHAPTER

10

Measurement and Geometry

Lines and angles

Lines and **angles** and are everywhere.

The doors, desks and windows in your classroom all have lines and angles.

When two lines meet, they make an angle. When a door is ajar or a window opens in or out, an angle is formed.

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10A Looking at lines

In mathematics the word **line** always means a straight line. It does not include curves such as circles and squiggles.

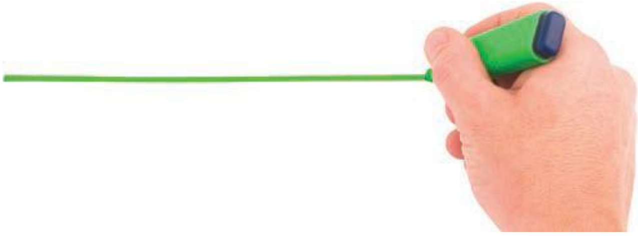
Lines go on forever. We cannot draw something that goes forever in both directions, so we draw part of a line called a **line segment** and imagine it going on forever.

There are different types of lines.

Horizontal lines

Look at this gymnast's balance beam. The beam is **horizontal**. When you go to the beach and look out at the sea, you can see the horizon. That's where the word 'horizontal' comes from.

We can think of the top and bottom edges of a piece of paper as representing horizontal lines.



A builder uses a spirit level to make sure something like the top of a door frame is horizontal. When the air bubble is in the centre of the gauge, the timber is horizontal.

Vertical lines

A builder uses a plumb line to make sure a wall is vertical. The plumb line is a **vertical** line.

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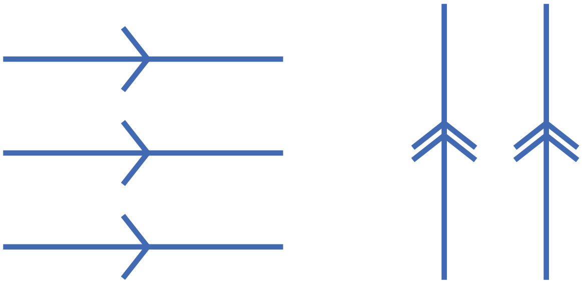
A vertical line, like a plumb line, goes from top to bottom. If the top and bottom edges of a piece of paper are horizontal, then we can think of the side edges as vertical.

Parallel lines

Two or more lines that are always the same distance apart but never meet are known as **parallel** lines.

We think of the lines going on forever in both directions.

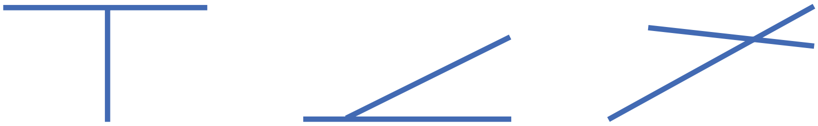


We draw a small arrow on each line to show the lines that are parallel. If there are two groups of parallel lines, we draw two arrows on one set.

Intersections

When two lines cross or meet at a point we say they **intersect**. The point where the lines meet is called an **intersection**. For example, two roads meet or cross at an intersection.

The word intersect comes from 'inter', meaning 'between', and 'sect', meaning 'cut'. There are many ways lines can intersect.



Remember

Two lines that are the same distance apart but never meet, no matter how far you keep drawing them or how far they go on, are parallel lines.

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10A Whole class CONNECT, APPLY AND BUILD

1 Think of your arms, legs and bodies as lines. In groups of 4, use this idea to make different kinds of lines. For example, 2 people standing 30 cm apart can represent parallel lines. Take turns to model the different types of lines you have learnt about in this chapter. Have other group members guess the kind of line.

2 Draw pictures to help you remember the different kinds of lines. For example, if you lie on the floor, you make a horizontal line.

a Vertical line **b** Horizontal line **c** Parallel lines

3 Work with a partner to copy and complete this chart with 2 examples of where these lines can be seen from outside the classroom.

Vertical line	Horizontal line	Parallel lines

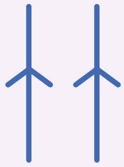
4 Work with a partner. Each person draws a shape using the kinds of lines you have learnt about so far. Then swap pictures and label the other person's drawing with the names of the lines used.

10A Individual

1 Copy the diagrams and label them with words from the list. You may use more than one label.

Vertical line Horizontal line Parallel lines

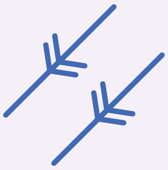
a



b

c

d



2 Find and draw 2 objects in the classroom that contain the following:

a a horizontal line **b** a vertical line **c** a pair of parallel lines

3 Draw 1 shape that contains at least one of each of the following:

- a set of parallel lines
- a horizontal line
- a vertical line

4 Draw a straight line to represent the horizon. Now draw two ships, one a sailing ship and the other a cargo ship on the horizon, using the kinds of lines you have learnt about. Label the lines you have used in your picture.

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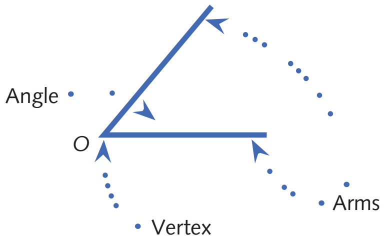
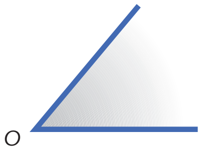
5 **Make a model.** Use matchsticks and plasticine to design and build a bridge that can support a toy car. Use at least one of each of the kinds of lines mentioned in this section. Identify the lines on the parts of the construction. Label the lines.

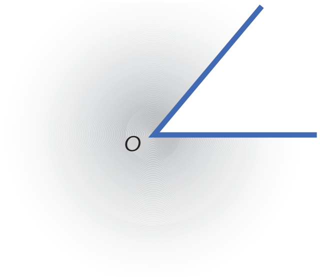
10B Angles

Here are two lines meeting at a point named *O*. We call the two lines that make the angle the **arms** of the angle. The point where the arms of the angle meet is known as the **vertex**.

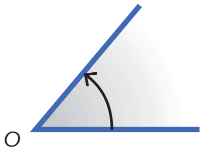


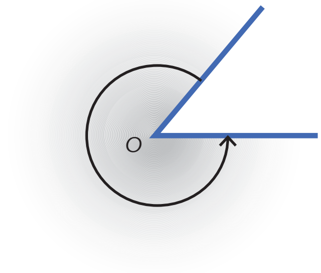
The lines make two angles. We can shade the angle *between* the lines or the angle *outside* the lines.



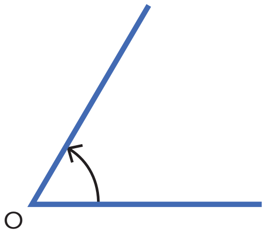


To measure an angle we see how much we have to turn one of the lines through the shaded area to get to the other line. We mark the angle we are measuring with a curved arrow.

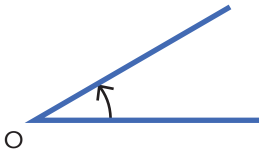




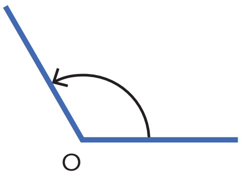
We measure angles in degrees.



Angle = 60°



Angle = 30°



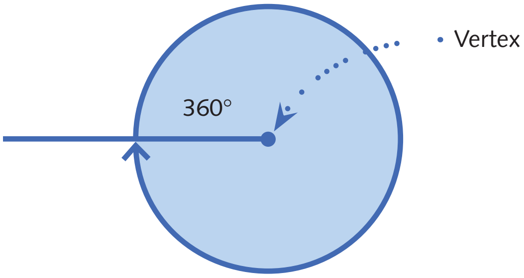
Angle = 120°

There are many types of angles.

Revolution

Turning through a complete circle is a turn with an angle of 360 degrees. We write this as 360°. A 360° turn is also called a **revolution**.

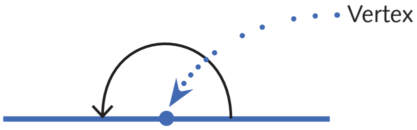
You can see in the diagram that when we turn through 360° the arms finish up resting on top of each other.



If you want to know why there are 360° in a revolution, investigate the history of Babylonian astronomy.

Straight angles

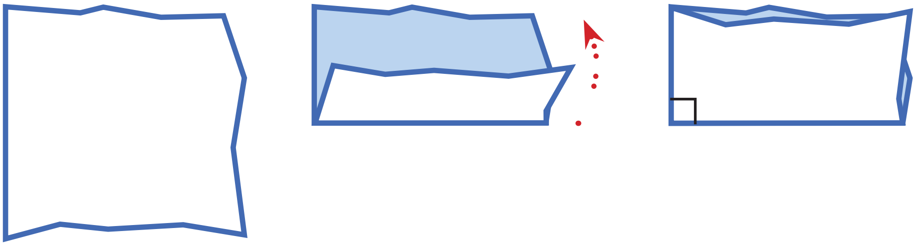
Half a full turn is called a **straight angle** because the two arms of the angle make a straight line. A straight angle is equal to half of 360°, which is 180°.



Straight angle (180°)

Right angles

Take a piece of paper with one straight edge and fold it along that edge. By folding a straight angle in half, you make two angles equal to 90°. A 90° angle is known as a **right angle** and is one-quarter of a full turn.



The piece of paper with the right angle in the corner can be used to find right angles around your classroom. Hold your right angle in each corner to see if the angle you have found is a right angle.

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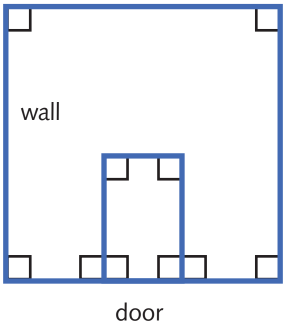
Here are some right angles you can probably find. Look at cupboards, doors, desks, books … you may even lose count, because there are so many!

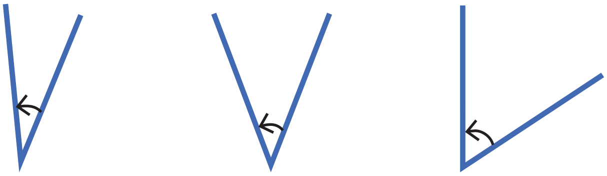


We mark right angles with a small square in the corner to show that the arms of the angle are at 90° to each other like this:

When the angle between two lines is a right angle, we say the lines are **perpendicular** to each other.

Acute angles

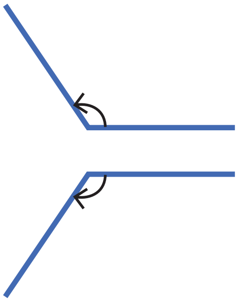
An angle is acute if it is less than 90°.



If you were feeling very sick with pains in the stomach you might say, ‘I have an acute pain in the stomach’. Acute means ‘sharp’. An angle is acute if it looks ‘sharp’.

Obtuse angles

An obtuse angle is one that is between 90° and 180°.



The word ‘obtuse’ means ‘blunt’ – it is the opposite of ‘sharp’.

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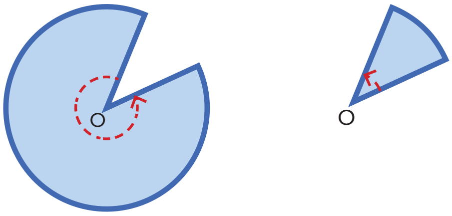
Reflex angles

An angle larger than 180° is called a **reflex angle**. The word ‘reflex’ means ‘turned back’ or ‘bent back’.

Chrissie bought a round chocolate cake for Jemma’s birthday. Jemma cut a slice, cutting from the centre outwards, like this:



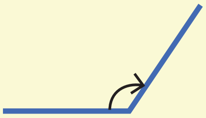
This gave two pieces of cake and two angles. The larger piece has an angle larger than 180°. It is a reflex angle.

The smaller piece has an angle less than 90° and is an acute angle.

Example 1

Label these angles.

a



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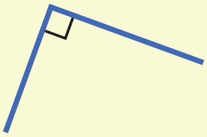

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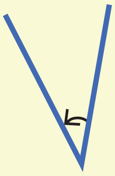

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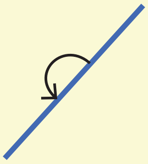

Solution

a Obtuse angle **b** Right angle **c** Acute angle **d** Straight angle

Remember

A full turn is 360° and is called a revolution.

A straight angle is half a full turn and is equal to 180°.

A right angle is $\frac{1}{4}$ of a turn and is equal to 90°.

A right angle is half a straight angle.

Angles less than 90° are acute angles.

Angles more than 90° but less than 180° are obtuse angles.

Angles more than 180° but less than 360° are reflex angles.

Two lines are perpendicular if the angle between them is a right angle.

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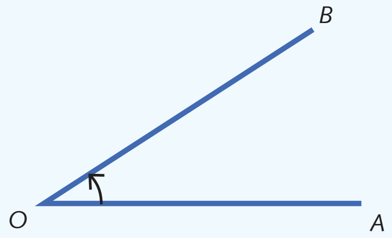
10B Whole class CONNECT, APPLY AND BUILD

1 Mark 2 lines on the floor or the playground surface and label them as shown.



One person stands on the point where the 2 lines meet (the vertex) holding one end of a skipping rope or piece of string.

Another person stands at *A* holding the other end of the rope and stretching the rope taut along the line *OA*.

Now the person standing at *A* walks through the angle between the lines until they are standing on the point *B*. Keep the string taut all the time. How much did the string turn? What kind of angle did you make?

Do this for several different angles and discuss which angles you drew were smaller and which were larger. Can you name the kinds of angles you made?

2 **Taking turns to make turns.** Act this out in class.

Two students come out and face the front wall.

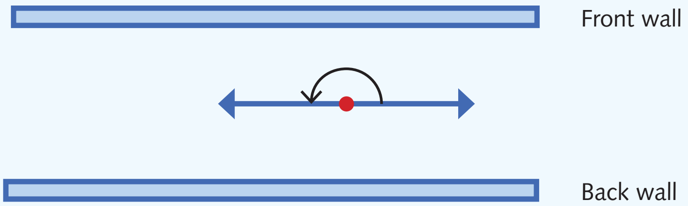
They both hold their right arms straight out sideways, pointing to the right-hand wall.

Draw a diagram to indicate this. The 'dot' represents a person.

The line with the arrow means a right arm.

a Both students make a full turn. Through which angle have their right arms turned?

b One student turns anticlockwise and stops turning when facing the wall behind the class.



What fraction of a complete revolution is this?

How many degrees did the student turn? What is another name for the angle that the student's right arm turned?

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c The second student turns and stops when facing the wall on the left. Draw a diagram and mark the angle this student's right arm has turned. What is the angle this student has turned through? How many degrees is that?

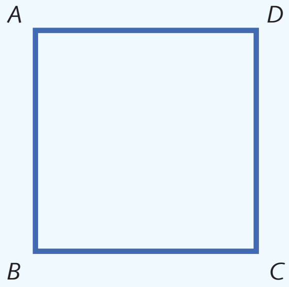
d What did we discover in this activity? Copy and complete. Half a full turn is ______°.

One-quarter of a full turn is ______°. This is also called a ______ angle.

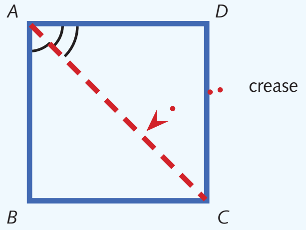
3 Work in a group of 3. Use a 2-metre piece of string. One student holds the string in the centre, and the other 2 students each take an end of the string. Pull the string taut. Make a right angle with the string. Find angles in the room that look like it, for example the corner of the room. The walls of the room meeting at a corner might be perpendicular to each other.

4 Start with a display clock with the hands pointing to 12:00. Move the hands so they are perpendicular (for example, 3:00). Can you find other times when the hands of the clock are perpendicular to each other? How many can you make?

5 Take a square piece of coloured paper. A small kindergarten square will do. We have labelled the four corners *A*, *B*, *C* and *D* in the diagram to the right so that we have a name for each.

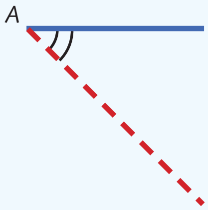


Fold the square over so the top side *AD* falls exactly on *AB*. Make a neat crease and then unfold the paper. It should look like this:



a Are the 2 marked angles the same or different? Discuss your answer and give your reasons to your classmates.

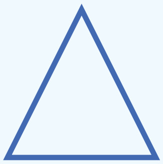
b What fraction of a right angle is this angle at *A*?

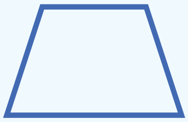


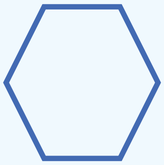
If a right angle is 90°, how many degrees is this angle?

6 Here are some shapes. Copy the shapes and label:

a reflex angles **b** acute angles **c** obtuse angles







10B Individual

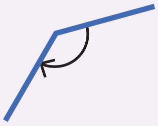
1 Copy and complete these sentences.

- **a** An acute angle is less than ________°.
- **b** A straight angle is ________°.
- **c** A right angle is ________ of a complete turn.
- **d** An obtuse angle is between ________° and ________°.
- **e** A ________ angle is more than 180° but less than 360°.

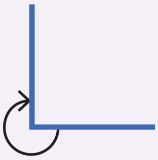
2 What type of angle are these marked angles?

a

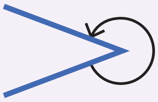
b



c



d



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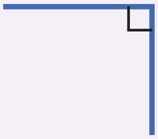

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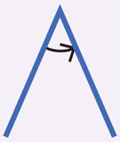

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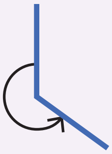
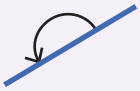


i



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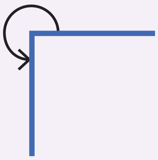
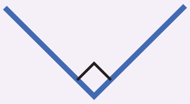
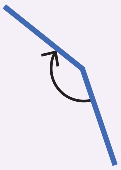


k

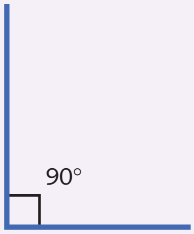


l



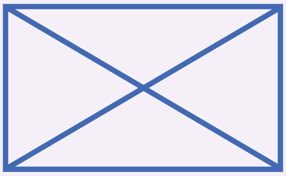
3 Use your pencil and ruler to draw these angles. Mark the number of degrees on each one. The first one is done for you.

a A quarter-turn



- **b** Three quarter-turns one after the other
- **c** A half-turn
- **d** Three-quarters of a complete revolution
- **e** A complete revolution

4 Find (at least) 6 angles in this diagram. Copy the diagram and label the angles you find.



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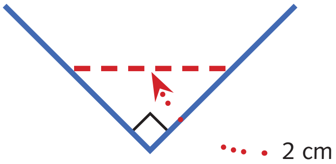
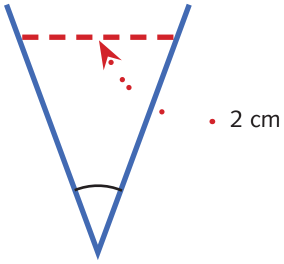
10C Measuring angles using a protractor

How do we measure the angle made when two lines intersect?





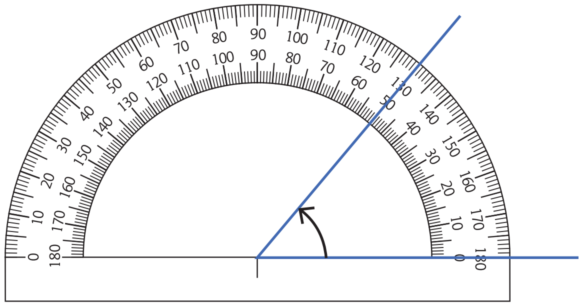
If we use a ruler to measure the distance between the arms, the measurement could be the same, but we know that one angle is 90° and the other is an acute angle, which is less than 90°.

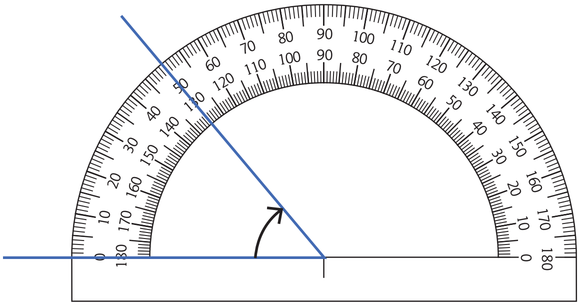
Also, if you move the ruler up or down the angle, the length changes.

We cannot use a ruler to measure the angle made when two lines intersect. A **protractor** is used to measure angles.

A protractor has two sets of numbers. One set of numbers is for measuring angles from the right. The other set of numbers is for measuring angles from the left.

Here are two angles.

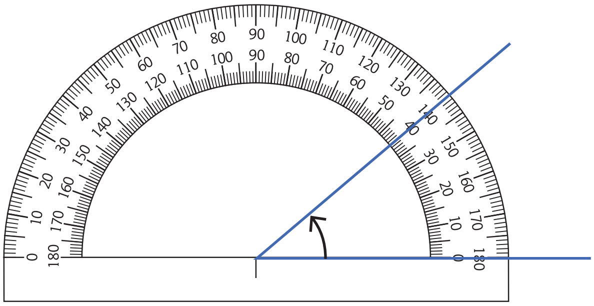




To measure them we put the centre point of the 0° line of the protractor on the vertex of the angle and read along the scale. The two marked angles are both 50°.

Measuring acute angles

To measure an acute angle we place the centre point of the 0° line on the vertex and read the scale where the other arm lies. This angle is 40°.



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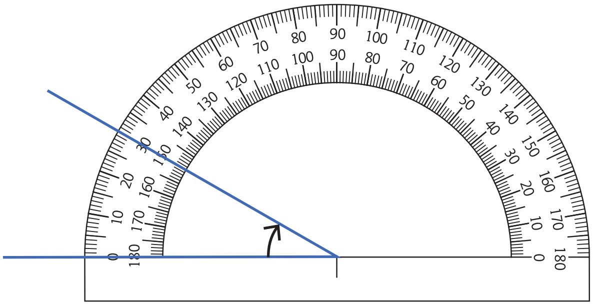
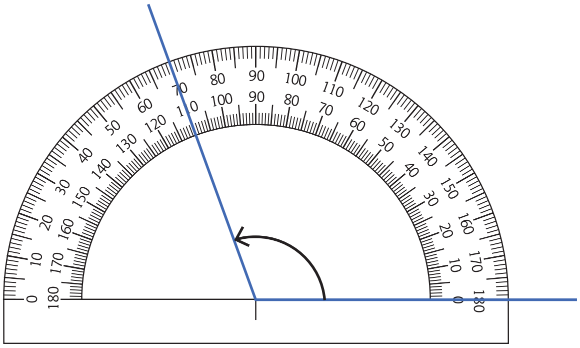
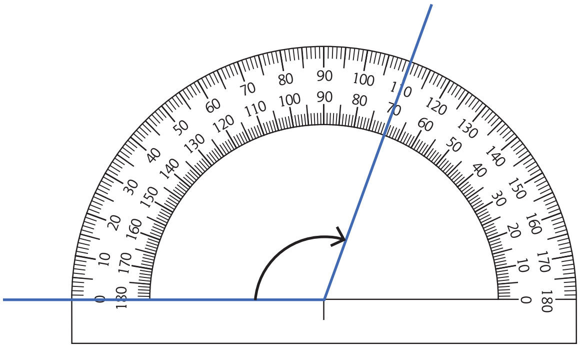


This angle is 30°.

Measuring obtuse angles

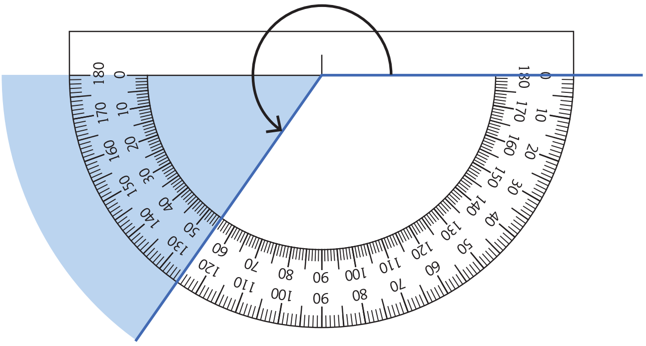




Both of these angles are greater than a right angle. This means that their angles are greater than 90°. They are both 110°.

Measuring reflex angles

To measure a reflex angle, you first need to rotate the protractor.



This gives you the shaded part of the angle (55°). To find the full size of the angle, you now need to add 180° to the number of degrees shown on the protractor:

180° + 55° = 235°

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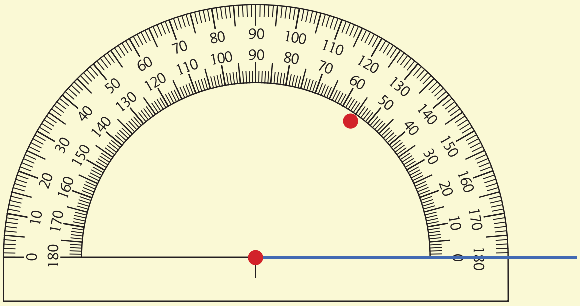
Example 2

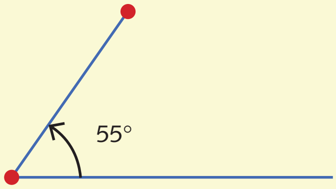
Draw a 55° angle.

Solution

First, draw one arm of the angle.



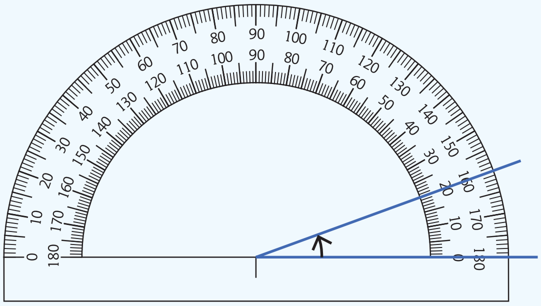
Then place your protractor at the vertex and mark a dot at 55°. Now join the dot and the vertex with a line to make the second arm of the angle. Label the angle. Your dots do not need to be quite so large.



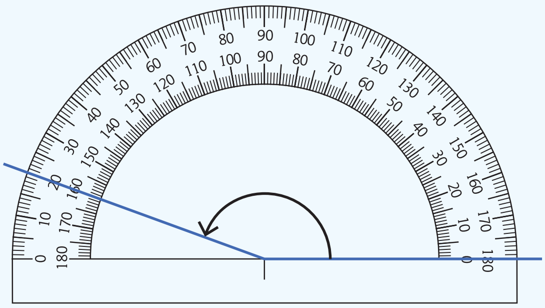
10C Whole class CONNECT, APPLY AND BUILD

1 What is the size of each of these angles?

a



b



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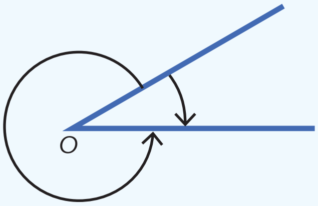
2 Draw each of these angles. Ask a partner to check your drawings using a protractor.

a 45° **b** 90° **c** 175° **d** 75°

3 **a** Draw 2 lines meeting at a vertex. Here is one example:



b Measure each angle.

c What should the sum of the 2 angles be?

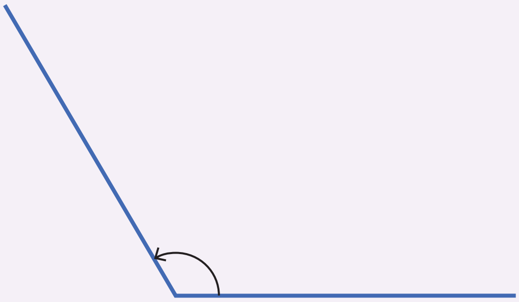
4 Using the opposite ends of the protractor, draw each of these angles in two ways.

a 30° **b** 60° **c** 110° **d** 150°

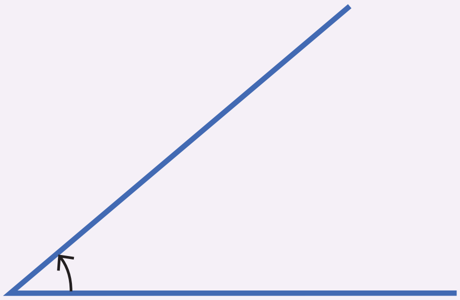
10C Individual

1 Measure each of these angles using a protractor.

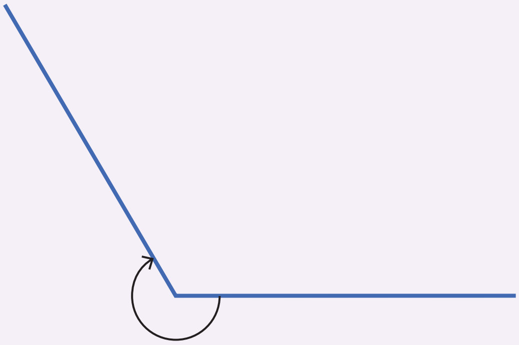
a



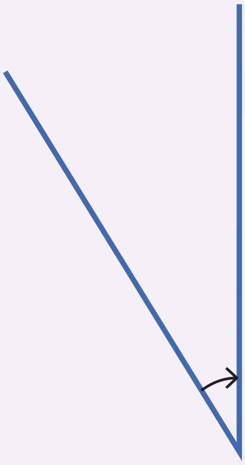
b



c



d



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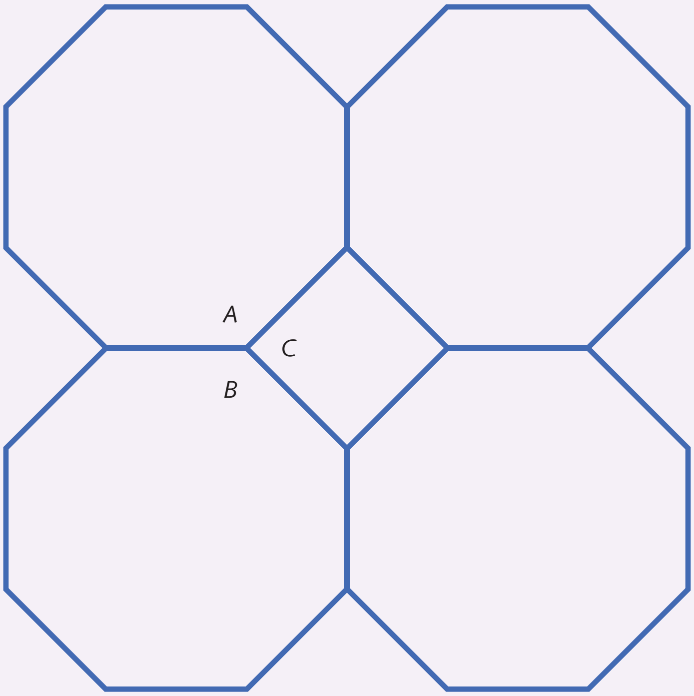
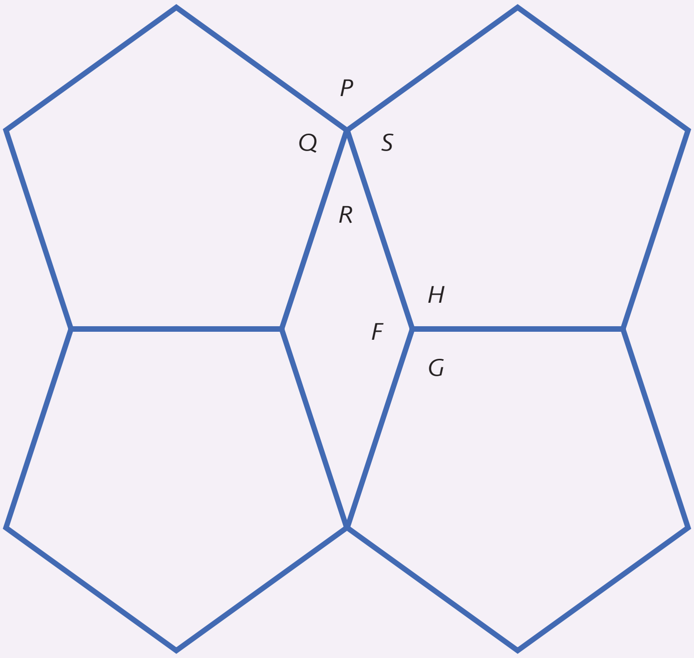
2 Measure the angles marked with letters.

a What is the sum of the angles *A*, *B* and *C*?



b What is the sum of the angles *P*, *Q*, *R* and *S*? What is the sum of the angles *F*, *G* and *H*?



c What did you notice about the sum of the angles about a point?

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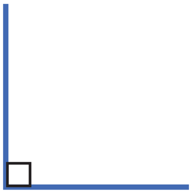
10D Review questions

1 Draw a picture of a house that contains at least one of each of the following kinds of lines:

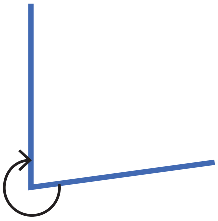
- a set of parallel lines
- 2 lines that are perpendicular
- a vertical line
- an acute angle

2 What type of angle are these marked angles?

a



b



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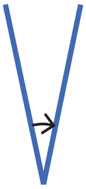

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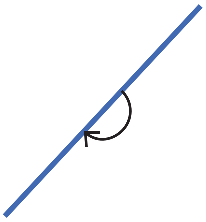
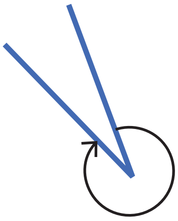


e



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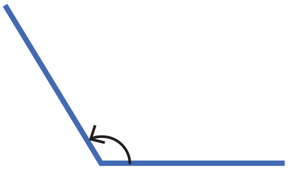
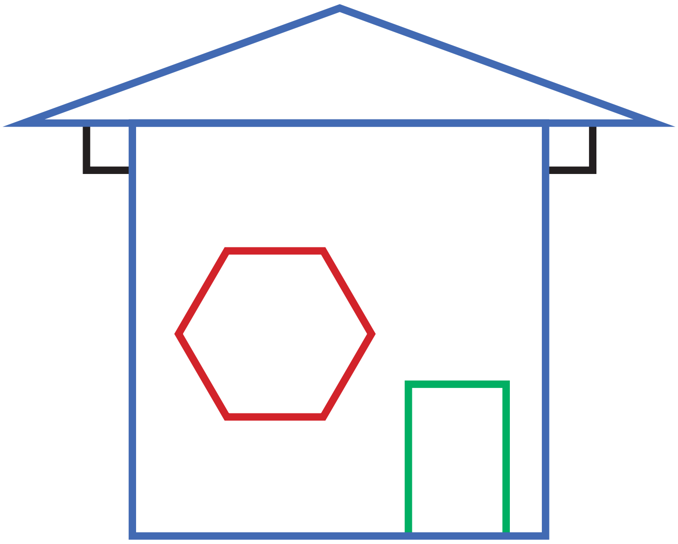


3 **a** Copy the picture below and name 5 different kinds of angles.

b Measure each of the 5 angles using a protractor and record the measurements on your angles.



4 Draw each of these angles. Ask a partner to check your drawings using a protractor.

a 180° **b** 90° **c** 135° **d** 100° **e** 200° **f** 315°

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CHAPTER 11 Preparation

Useful skills for this chapter:

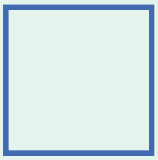
- some understanding of triangles, rectangles, squares and circles.

KICK OFF

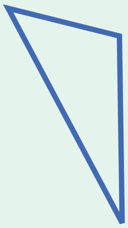
1 Copy the shapes and label them with as many words that apply.

Triangle
2 equal sides
Square
3 equal sides
Rectangle
4 equal sides
Quadrilateral

a



b



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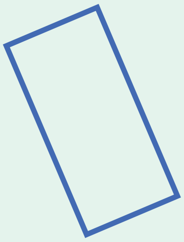
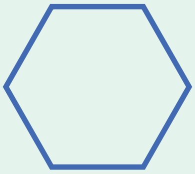
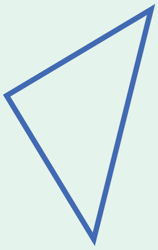


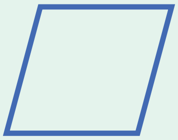
d



e



f



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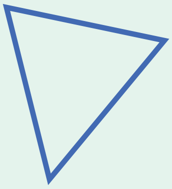

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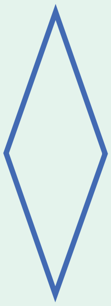

Show what you know

1 Draw each shape.

- **a** A rectangle with one side equal to 6 cm
- **b** A 3 cm square
- **c** A triangle with one side equal to 4 cm
- **d** A rhombus

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CHAPTER

11

Measurement and Geometry

Two-dimensional shapes

In this chapter we look at two-dimensional shapes, which are also known as **polygons**.

A polygon is a two-dimension shape enclosed by three or more line segments called **sides**. Exactly two sides meet at each vertex, and the sides do not cross.

Polygons are named according to the number of sides that they have, or their angles.

Polygons have no thickness, but there are solid objects that are like two-dimensional shapes with thickness. Can you find some in your classroom?

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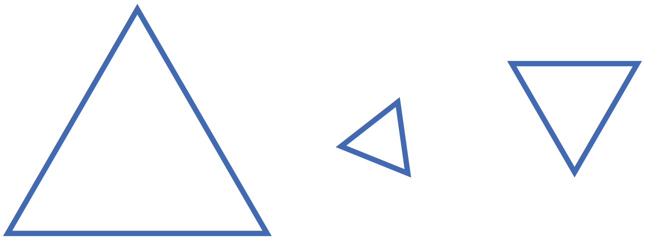
11A Triangles

What is a triangle? Think of words that start with 'tri'. A triathlon is a three-event race and a tripod is a three-legged stand for keeping a camera or telescope steady. The prefix 'tri' means 'three'. So a triangle has three angles. It also has three straight sides.

Triangles can be sorted according to the lengths of their sides or according to the sizes of their interior angles.

Equilateral triangles

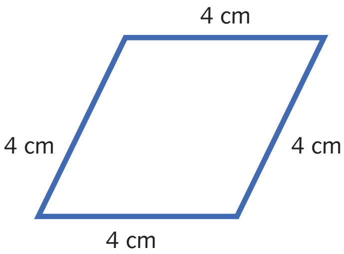
A triangle with all of its sides the same length is called **equilateral**. 'Equilateral' comes from two Latin words meaning 'equal' and 'sides'. Here are some pictures of equilateral triangles.



If all three angles in a triangle are the same, we call it **equiangular**, from two Latin words meaning 'equal' and 'angles'.

Every equiangular triangle is also equilateral. This is a special property of triangles.

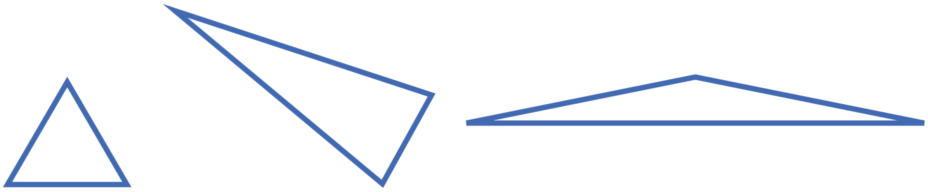
This shape has equal sides but different angles.



This shape has equal angles but different sides.

Isosceles triangles

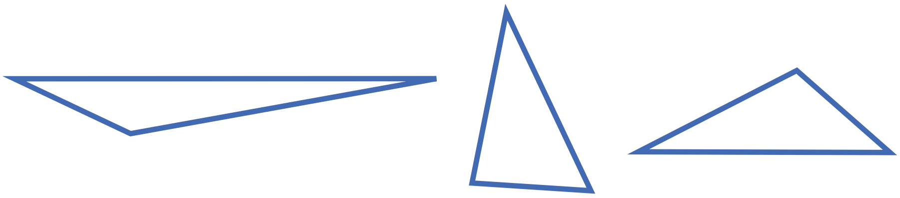
A triangle with at least two sides the same length is called **isosceles**, from two Greek words meaning 'equal' and 'legs'. Every equilateral triangle is isosceles, but there are isosceles triangles that are not equilateral. Here are some pictures of isosceles triangles. Which one is equilateral and which ones are isosceles but not equilateral?



If a triangle has exactly two angles the same, then it has to be isosceles, but need not be equilateral. You can see in the pictures above that the triangle in the middle and the one on the right have exactly two angles equal.

Scalene triangles

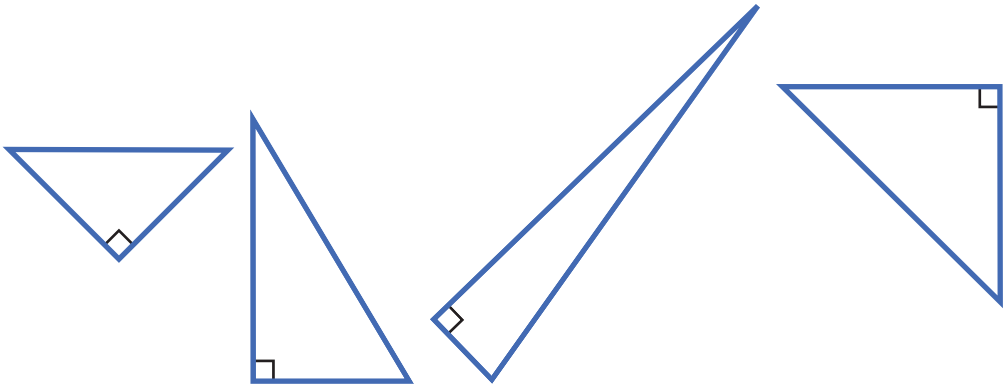
The only other thing that can happen is that all of the sides of the triangle have different lengths. We call these triangles **scalene**, from a Latin word meaning 'to mix things up'. Here are some pictures of scalene triangles.



If all three angles in a triangle are different then the triangle has to be scalene. Draw a few to convince yourself this is true.

Right-angled triangles

When one of the angles in a triangle is 90°, we call it a **right-angled triangle**. Here are some right-angled triangles. Which ones are isosceles and which ones are scalene?



Can a right-angled triangle be equilateral? Either draw one or explain why there aren't any.

Can you see why there cannot be two right angles in a triangle?

Draw some diagrams to help.

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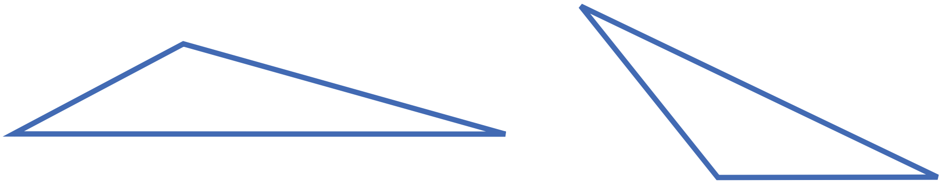
Obtuse-angled triangles

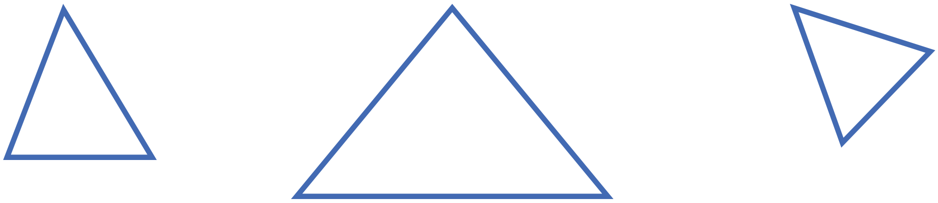
When the biggest angle is more than 90°, we call the triangle an **obtuse-angled triangle**. Here are some obtuse-angled triangles. Which one is isosceles and which one is scalene?



Can an obtuse-angled triangle be equilateral? Either draw one or explain why there aren't any.

Acute-angled triangles

If all of the angles are less than 90°, we call the triangle an **acute-angled triangle**. Here are some acute-angled triangles. Which ones are isosceles and which one is scalene?



Can an acute-angled triangle be equilateral? Draw one.

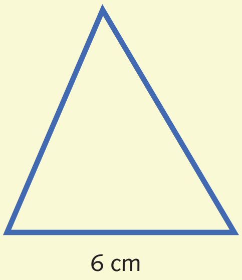
Example 1

a Draw an acute-angled triangle with one side 6 cm in length.

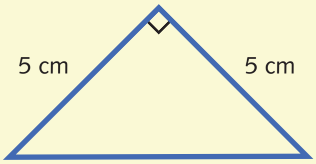
b Draw an isosceles triangle with one angle a right angle.

Solution

a Acute-angled triangles have all angles less than 90°. Here is one with one side 6 cm in length. Yours may look different.



b Isosceles triangles have 2 sides equal. The only way to draw this is with the right angle between the 2 equal sides. Here is one possibility.



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11A Whole class CONNECT, APPLY AND BUILD

1 Draw and then cut out as many different types of triangles as you can from what you have learnt so far. Label each triangle and make a poster to display your work.

11A Individual

1 Use a ruler and a pencil to draw:

a an isosceles triangle with two sides 4 cm in length

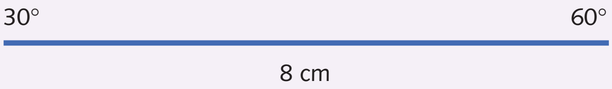
b an obtuse-angled, scalene triangle with one side equal to 5 cm

c a right-angled triangle that is not scalene

d a triangle with two angles equal to 60°.

2 We sometimes use the word ‘base’ to name the side of the triangle that it ‘sits’ on. Use a protractor and a ruler to construct triangles using the base and the angles shown. Measure the third angle in your triangle and label the size of it in your diagram.

a



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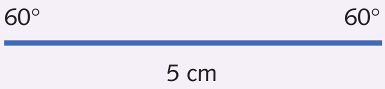

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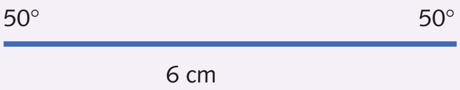

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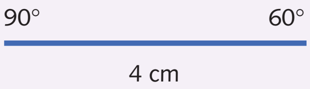


3 **a** Draw a square. Now draw in its diagonals.

b Measure the four angles around the centre point where the diagonals cross. What do you notice?

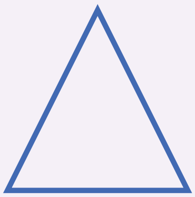
c Draw a rectangle that is not a square. Now draw in its diagonals.

d Measure the angles around the centre point where the diagonals cross.

e What do you notice?

4 Copy each shape and draw a line inside each to form two right-angled triangles.

a



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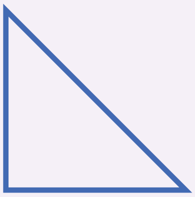

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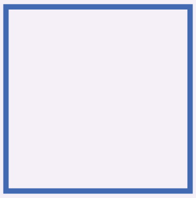


11B Quadrilaterals

Quadruplets are four children born to the same mother at the same time.

A ‘quad’ vehicle has four wheels.

Can you think of other words that start with ‘quad’?

What is a quadrilateral?

In Latin, ‘latus’ means ‘side’. So a **quadrilateral** is a shape with four sides. It has four vertices also.

There are many different kinds of quadrilaterals; some have special names. We know two kinds of quadrilaterals already. Rectangles and squares have four sides.

Rectangle

A rectangle is a quadrilateral in which all the angles are right angles.

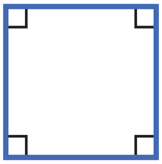
The opposite sides of a rectangle have the same length. These sides are parallel to each other.

Properties of a rectangle

1 All angles are right angles.
2 Opposite sides are parallel.
3 Opposite sides have the same length.

Square

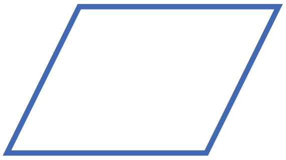
A square is a very special kind of rectangle.
All of its sides have the same length.



Parallelogram

A parallelogram is a quadrilateral with opposite sides parallel. It looks like a ‘pushed over’ rectangle.

Rectangles and squares are special kinds of parallelograms. They have four right angles as well as opposite sides parallel.



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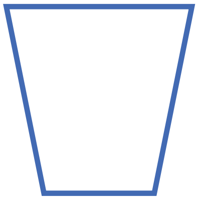
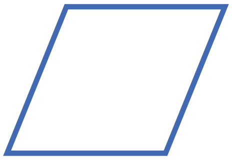
Trapezium

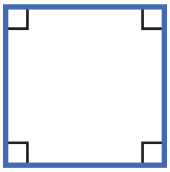


A trapezium has two sides that are parallel. You might have seen a table at school with this shape.

Rhombus



A rhombus is a parallelogram with four equal sides. Think of a rhombus as a square pushed sideways.

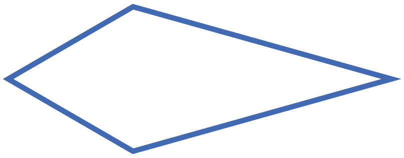


A square is a special kind of rhombus. If you have a rhombus with four right angles, it is a square.

Look at a pack of cards and find a 'diamond' card. Can you see that the diamond is a rhombus?

A diamond is a rhombus drawn vertically.

Kite



A kite has two pairs of adjacent sides equal.

So a rhombus and a square are special kinds of kite.

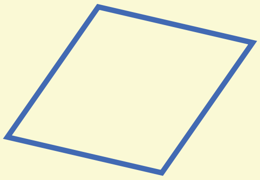
Example 2

a Draw a parallelogram that is also a kite. What other name could you give to this shape?

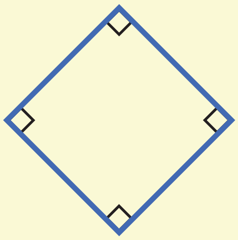
b Draw a rectangle with equal sides. What other name could you give to this shape?

Solution

a A parallelogram that is also a kite is a rhombus because all four sides are equal.



b A rectangle with equal sides is a square.



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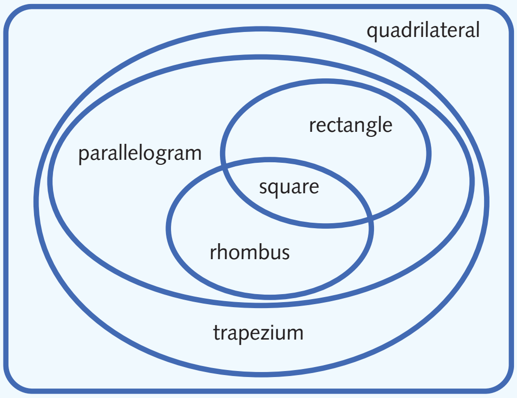
11B Whole class CONNECT, APPLY AND BUILD

○ **1** Draw and then cut out as many different types of quadrilaterals as you can make from what you have learnt. Label each quadrilateral and make a poster to display your work.

● **2** Use the Venn diagram on the right to put extra labels on the quadrilaterals you have made above. For example, if you made a square, the Venn diagram tells you that a square is also a rectangle, a rhombus, a parallelogram, a quadrilateral and a trapezium. So you can put 6 labels on your square. Isn't that amazing?



11B Individual

○ **1** Draw:

a a square with 5 cm sides

b a trapezium with a base of 6 cm and the side opposite its base equal to 4 cm

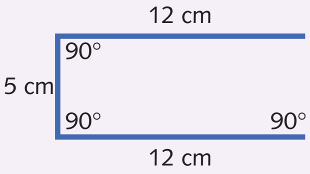
c a parallelogram with at least one angle equal to 130°

d a rectangle with one pair of sides equal to 1 cm and the other pair longer than your left thumb.

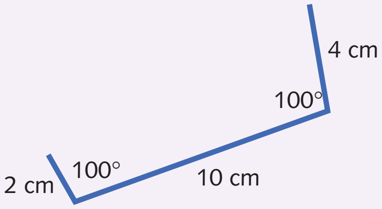
● **2** Draw a rhombus with at least one right angle. What do you notice?

● **3** Construct quadrilaterals using the sides and angles shown. Measure the missing sides and missing angles and mark each on your drawing.

a



b



c What is the sum of the angles in each?

d What do you notice about the missing side in **a**?

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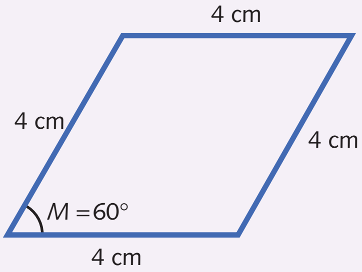
4 Draw a shape that has four sides of 4 cm and the angle at M is as follows. (You may need to use trial and error to get the sides to meet.) The first one has been done for you:

a $M = 60°$

b $M = 90°$

c $M = 150°$

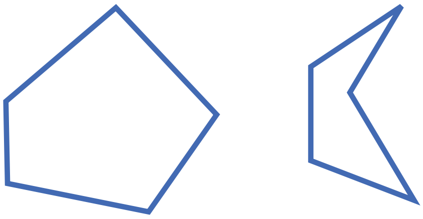


11C Other polygons

In this section we look at how shapes with more than four sides are named. As before, the name of each shape tells us something about its properties.

Pentagons

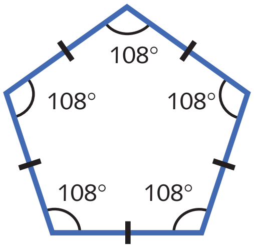
The Greek prefix ‘penta’ means ‘five’ and ‘gon’ means ‘angle’. So a pentagon has five angles. It also has five vertices and five sides. Here are two pentagons.



Regular pentagons

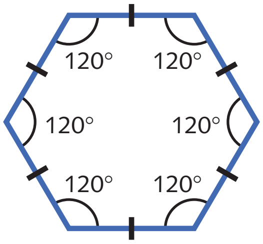
Regular pentagons have five equal angles and five equal sides. Each angle is 108°.

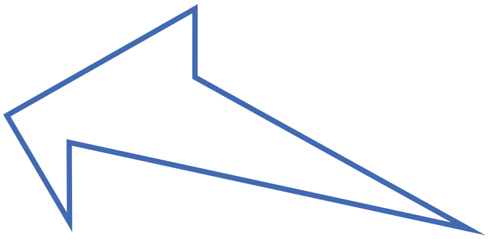
The marks on the sides in the diagram indicate that the side lengths are all the same.



Hexagons

The Greek prefix ‘hexa’ means ‘six’ and ‘gon’ means ‘angle’. So a hexagon has six angles. It also has six vertices and six sides. Here are two hexagons. The first one is a regular hexagon. The second one is a non-convex irregular hexagon.





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Regular hexagons

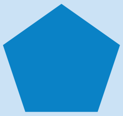
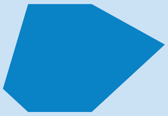
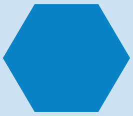
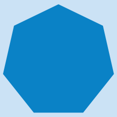
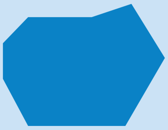
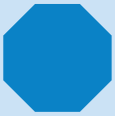
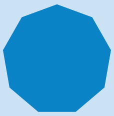
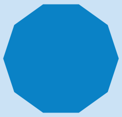
Regular hexagons have six equal angles and six equal sides. Each angle is 120°.

Two-dimensional shapes are named according to the number of sides. We could start the list below by calling a one-sided shape a monogon and a two-sided shape a digon.

But what would they look like? Try for yourself. Do you agree that one-sided shapes and two-sided shapes do not make any sense?

We have already discussed a three-sided shape – which we call a triangle – but it could also be called a trigon. A four-sided shape is known as a quadrilateral, but it could be called a tetragon.

A regular polygon has all sides equal and all angles equal.

Number of sides	Greek or Roman prefix	Name	Irregular example	Regular polygon
5	Penta	Pentagon		
6	Hexa	Hexagon		
7	Hepta	Heptagon		
8	Octa	Octagon		
9	Ennea	Nonagon or enneagon		
10	Deca	Decagon		

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11C Whole class CONNECT, APPLY AND BUILD

1 **a** Draw a sketch of a regular pentagon. Now draw lines to show how you could cut the pentagon into 5 isosceles triangles.

b Draw a regular pentagon. Now draw lines to show how you could cut the pentagon into 3 triangles.

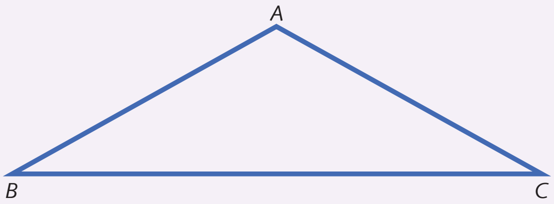
Can the pentagon be cut into 3 triangles in another way?

c Are any of your triangles special, like equilateral, isosceles or scalene?

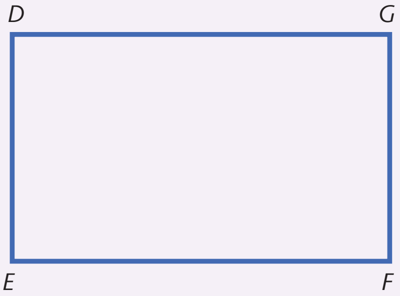
11C Individual

1 Measure the sides and angles of these shapes.

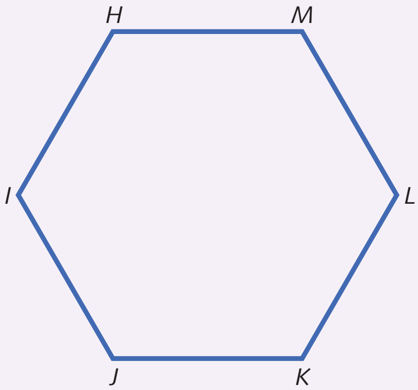
a



b



c



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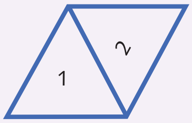
2 I am a shape. What shape am I?

- **a** I have 6 equal sides and 6 equal angles.
- **b** I have 12 sides.
- **c** I have the same number of sides as an octopus has legs.
- **d** I have 5 sides.
- **e** I have 10 sides.
- **f** My prefix means 5 and the rest of my name is the same as 10–sided.

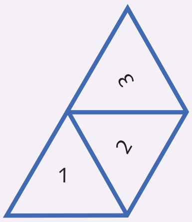
3 Draw or trace these shapes to complete the questions below.

- **a** Draw a rectangle. Draw a line to show how you could cut the rectangle into 2 right-angled triangles. In how many ways can you do this?
- **b** Draw a square. Now draw a line to show how you could cut the square into 2 rectangles. How can you make them equal rectangles?
- **c** Draw a square. Now draw lines to show how you could cut the square into 3 equal rectangles.
- **d** Draw a rhombus. Now draw a line to show how you could cut the rhombus into 2 equal triangles. In how many ways can you do this?
- **e** Draw or trace a regular hexagon. Now draw lines to show how you could cut the hexagon into 6 equilateral triangles.
- **f** Draw a square. Now draw a line to show how you could cut the square into one triangle and one irregular pentagon.
- **g** Draw or trace a regular hexagon. Now draw a line to show how you could cut the hexagon into one isosceles triangle and one irregular pentagon.

4 **a** Take an equilateral triangle. (You might have one in a set of plastic shapes.) Trace it. Now trace a second triangle that has one edge in common with the first triangle.



Trace a third triangle that has an edge in common with the second, and a vertex in common with the first and the third. Now you should have a trapezium.



- **b** Keep tracing triangles, going around the vertex at the centre all triangles have in common, until you have a hexagon.
- **c** How many triangles did you draw?

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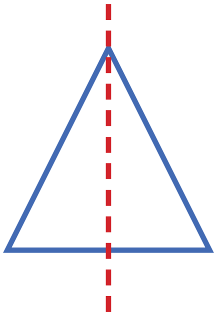
11D Symmetry of two-dimensional shapes

In mathematics when the pieces of a two-dimensional shape match up exactly across a straight line, we say the shape is symmetrical about the line.

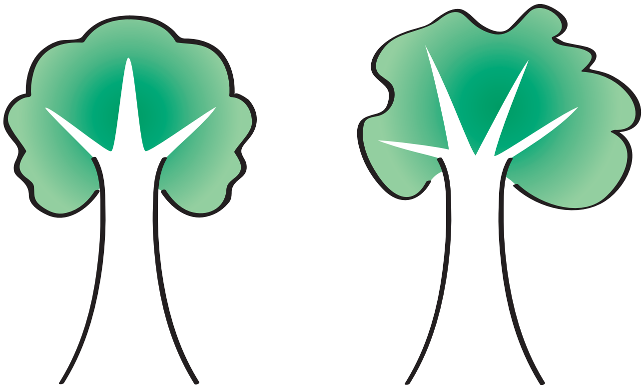
For example, this triangle is symmetrical about the red dotted line:



In nature, we see symmetry in animals and in plants.

The line is called a line of symmetry.

When we say that something is symmetrical, we mean that it is identical on both sides of the line of symmetry. An example of symmetry is the drawing of the tree on the left.



The opposite of symmetrical is asymmetrical, as shown in the picture of the tree on the right.

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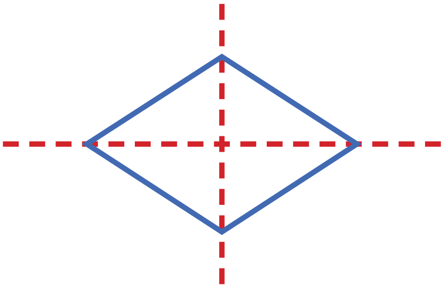
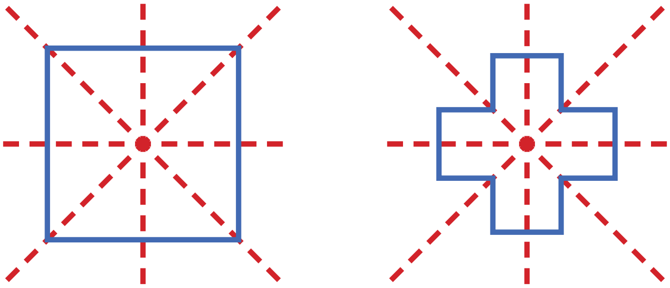
A shape can have more than one line of symmetry.

The shape on the right has two lines of symmetry.

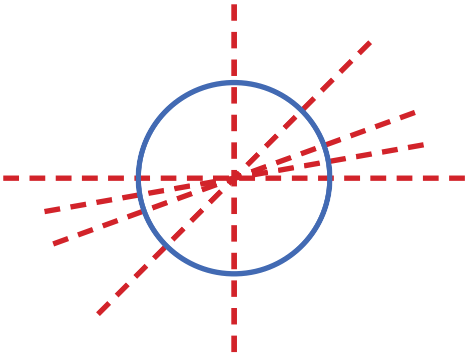


The shapes below have four lines of symmetry.



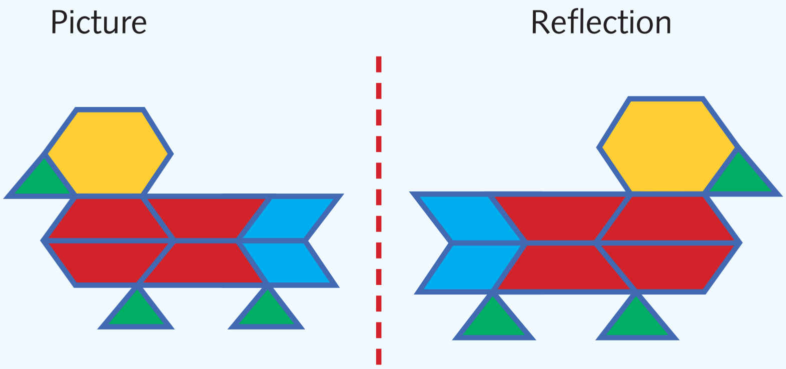
Imagine folding the shape over along a line of symmetry. The two halves then match each other exactly. The image is reflected in the line. We call the line the **axis of reflection** or **the axis of symmetry**.

A circle has infinitely many lines of symmetry! It would not be possible to draw them all.



11D Whole class CONNECT, APPLY AND BUILD

1 Create a picture using your class set of pattern blocks or use triangle-grid paper to draw one that includes hexagons, trapezia, triangles and rhombuses. Ask your partner to make its reflection. Here is one example.



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2 Draw half of a picture and ask your partner to complete it so that the object you have drawn is symmetrical about a line.

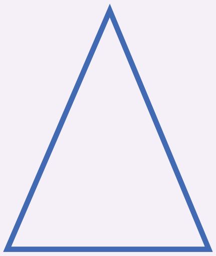
3 Use triangle grid paper (see **BLM 15** in the Interactive Textbook) and create a picture that has:

a one line of symmetry **b** two lines of symmetry **c** three lines of symmetry

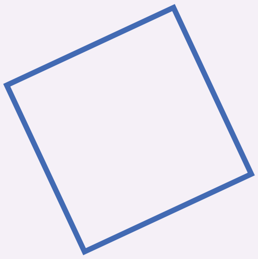
11D Individual

1 Copy these shapes and draw in their lines of symmetry.

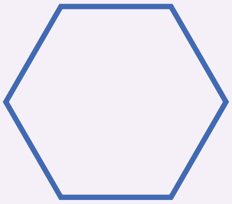
a



b



c

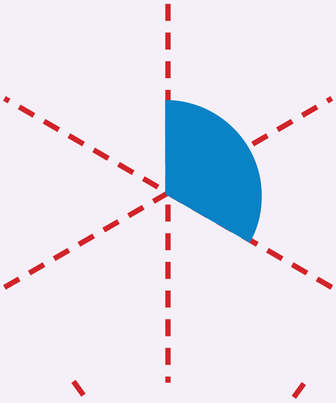


2 **a** Draw 5 regular polygons of different sizes.

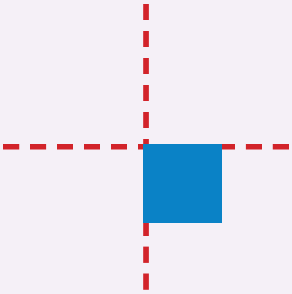
b Mark in the lines of symmetry with a dotted line.

3 Copy each diagram, then complete the missing parts of each shape. The dotted lines are lines of symmetry.

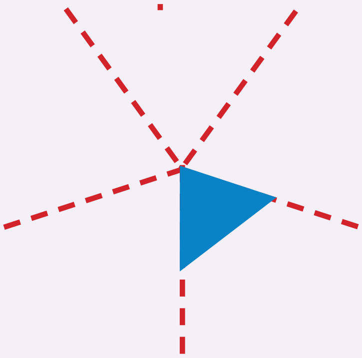
a



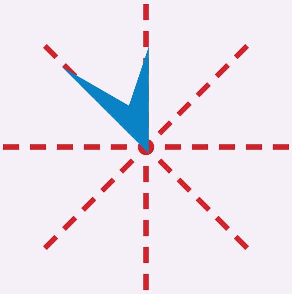
b



c



d



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11E Transformations and tessellation

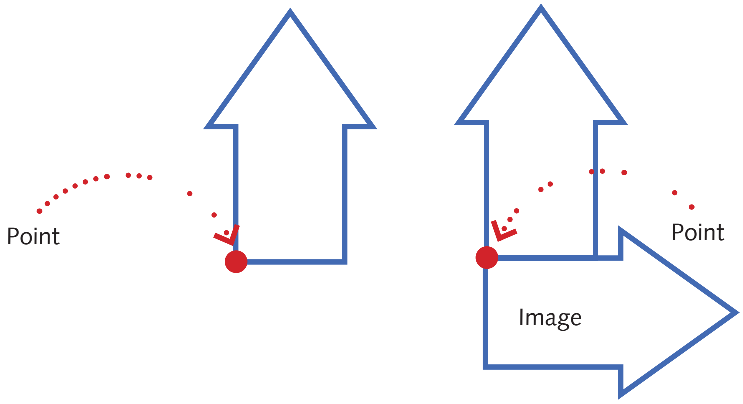
We see patterns all around us. Many patterns are made by shapes fitting together.

Rotation, reflection and translation are some of the different ways we can transform a two-dimensional shape.

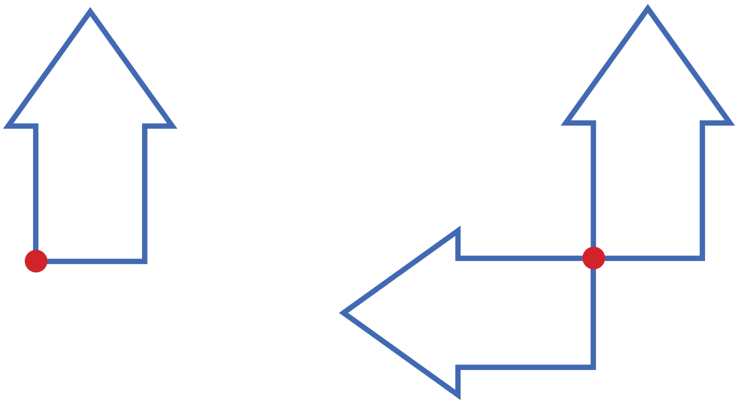
Rotation

We rotate a shape about a point when we turn it through an angle about the point.

This shape has been rotated clockwise through 90° about the point marked with a red dot. The word 'image' has been used to label the shape after rotation in the diagram below.



We can rotate anticlockwise about a point.



This arrow has been rotated anticlockwise through 90°.

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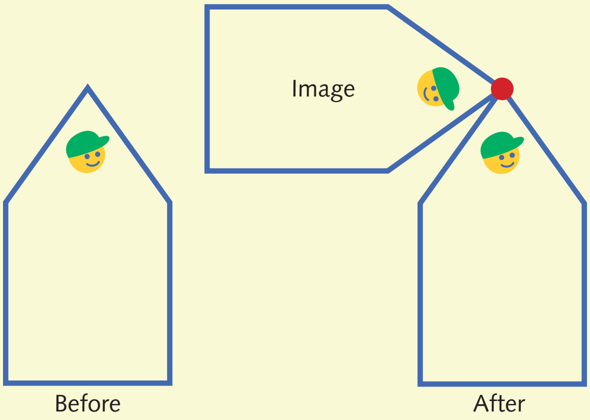
Example 3

How has this shape been moved?

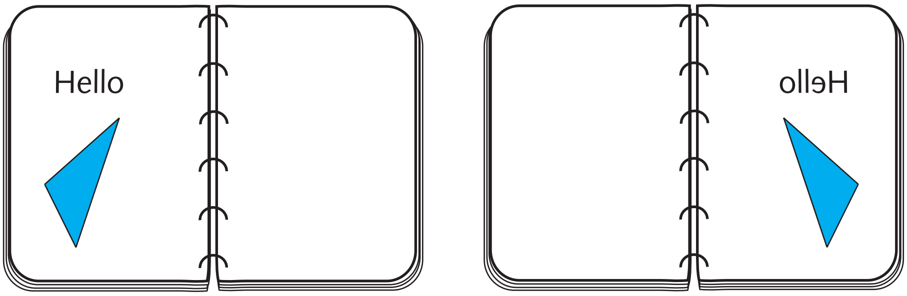


Solution

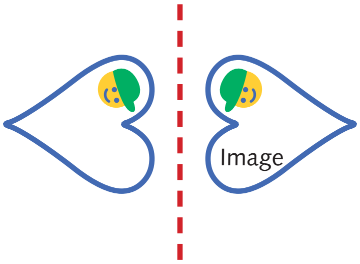
The shape has been rotated 90° in a clockwise direction.

Reflection

A reflection is a transformation that flips a figure about a line. This line is called the axis of reflection. A good way to understand this is to suppose that you have a book with clear plastic pages and a triangle drawn, as in the first diagram below. If the page is turned, the triangle is flipped over. We say it has been reflected; in this case the axis of reflection is the binding of the book.



This shape has been reflected in the vertical line.



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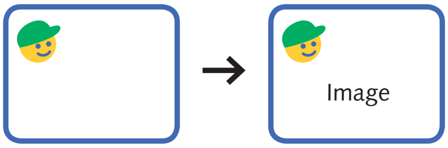
Translation

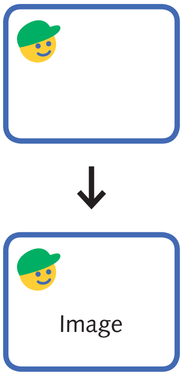
When we translate a shape, we slide it. We can slide it left or right, up or down.

Translations move the shape without rotating it.

This shape has been translated vertically.



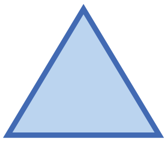
This shape has been translated horizontally.



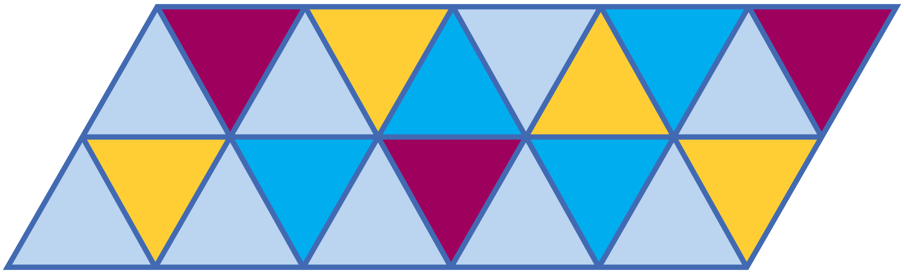
Tessellation

A **tessellation** is a tiling pattern made by fitting together two-dimensional shapes with no gaps or overlaps. The tessellation can continue in all directions.

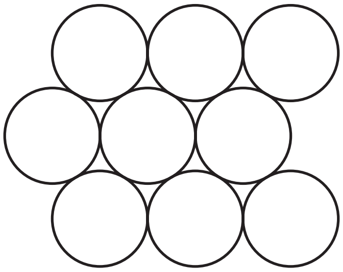
For example, we could start with an equilateral triangle.



We can rotate it 180° and shift it so the triangles fit together perfectly. The tiling can continue horizontally and vertically. We say that the equilateral triangle **tessellates**.



Circles do not tessellate because we cannot rotate and shift them to fill up the whole space without gaps or overlaps.



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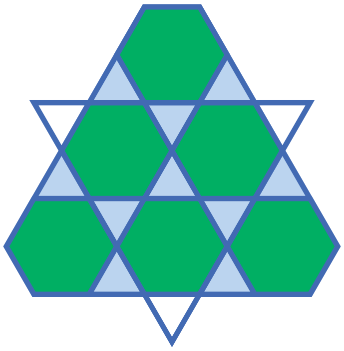
It is possible to tessellate two or more shapes.

The tessellation below uses regular hexagons and equilateral triangles.



11E Whole class CONNECT, APPLY AND BUILD

1 Use your class set of shapes or cut out some of your own. Take turns giving instructions to your partner to translate a shape in different ways.

2 Look around the school for tessellating patterns. Take digital photographs of them and describe the shapes used. Draw in the lines of symmetry.

11E Individual

1 Use your class set of pattern blocks or use triangle-grid paper to draw and colour a tessellating pattern that fills a 10 cm × 10 cm space on the page and uses:

a only triangles

b only hexagons

c only trapezia

d hexagons and triangles

2 **a** Draw a tessellation pattern on triangle-grid paper using rhombuses and trapezia.

b Draw a tessellation pattern on triangle-grid paper using hexagons, trapezia, triangles and rhombuses.

3 **a** Draw the possible shapes that can be made from three identical regular hexagons. Rotations and reflections are considered the same.

b Create a shape made from 3 hexagons that will tessellate. Use triangle grid paper to demonstrate your tessellation.

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11F Enlargement transformations

A scale drawing can be used when an object is too large to be shown at full size on a page, for example a road map of a suburb or a plan of a building.

Scale drawings are also helpful when we want to see a very small object in a larger size so we can see more of its detail, for example an enlargement of a diagram of a tiny insect or a detailed picture of a leaf.

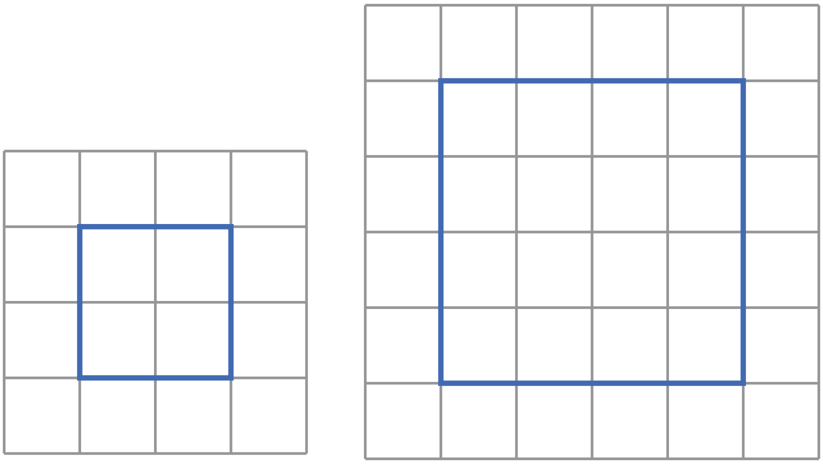
The human head louse is 1 to 2 millimetres in length. Here is an enlarged picture of a head louse.

A scale drawing or enlargement has exactly the same shape as the original object, but a different size.

In this section we look at enlargements of some two-dimensional shapes.

Below on the left is a square of side length 2 centimetres drawn on centimetre grid paper. The perimeter of this square is 8 centimetres and the area is 4 cm^2.

We can enlarge the square by doubling its side length as shown on the right.



The side length is now 4 cm, the perimeter of the larger square is 16 centimetres and the area is 16 cm^2. The side lengths were multiplied by 2, which doubled the perimeter. The area is now four times the size.

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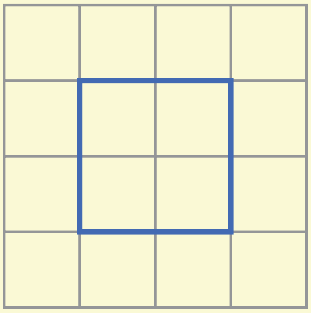
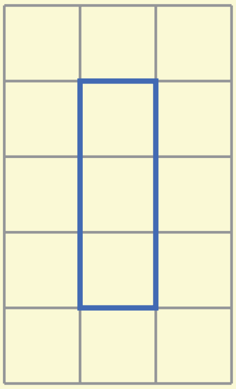
Example 4

a Enlarge the following shapes drawn on centimetre grid paper (**BLM 14**) by multiplying each side length by 3.

i



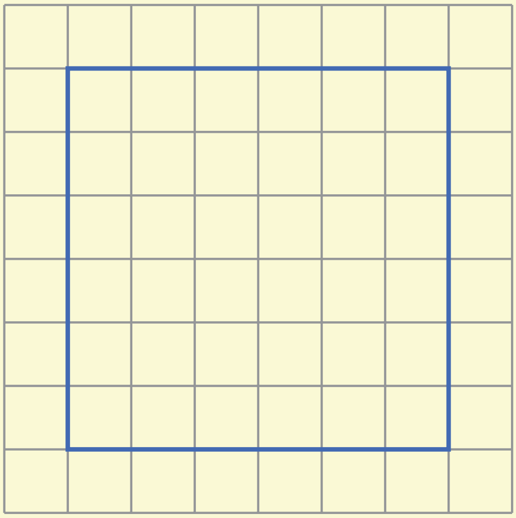
ii



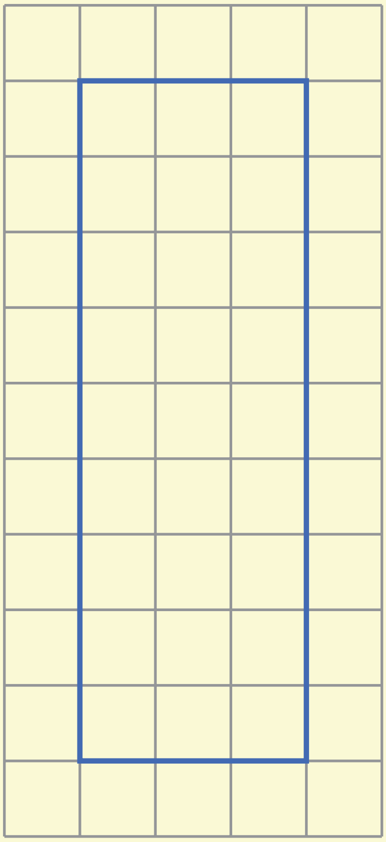
b What happens to the perimeter and area of each shape when you enlarge each side length by multiplying it by 3?

Solution

a **i**



ii



b If each side length is multiplied by 3, the perimeter is multiplied by 3 and the area is multiplied by 9.

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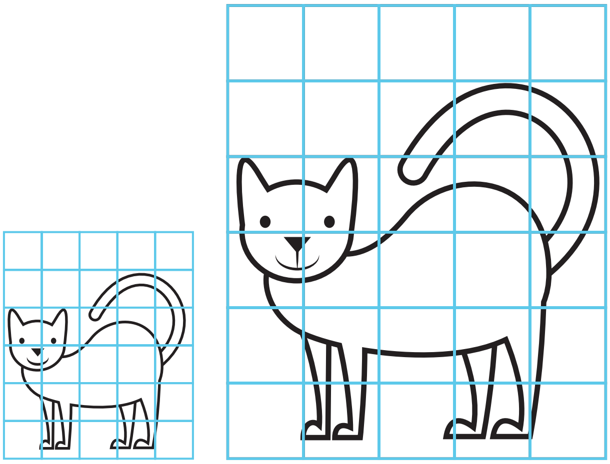
Enlargements can be created using grid paper of two different sizes. On the left is a picture of a cat traced onto 1-centimetre grid paper. On the right, using 2-centimetre grid paper, is the enlargement. Focusing on one square at a time, we copy the drawing into the corresponding square on the larger grid. It is helpful to number the squares so that you know which you are copying from and to.



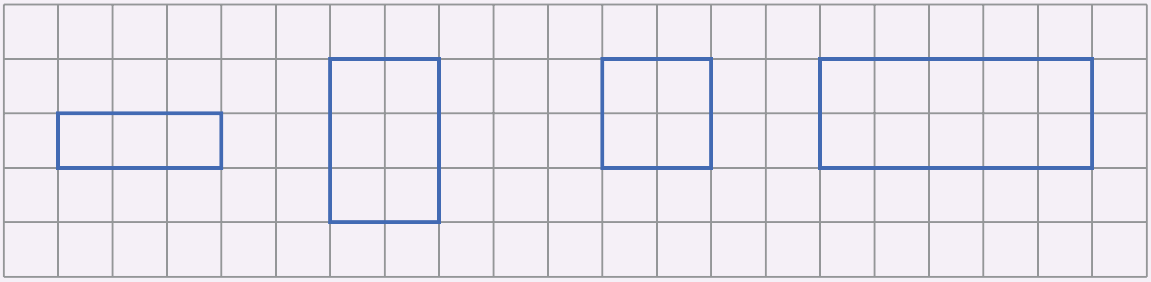
11F Whole class CONNECT, APPLY AND BUILD

1 Cut out a picture from a magazine. Trace it on to the 1-centimetre grid paper in **BLM 14** (available to download from the Interactive Textbook). Enlarge the picture by tracing it onto 2-centimetre grid paper.

11F Individual

1 Enlarge each shape onto grid paper by multiplying each side length by the given number.

a × 2 **b** × 4 **c** × 3 **d** × 2



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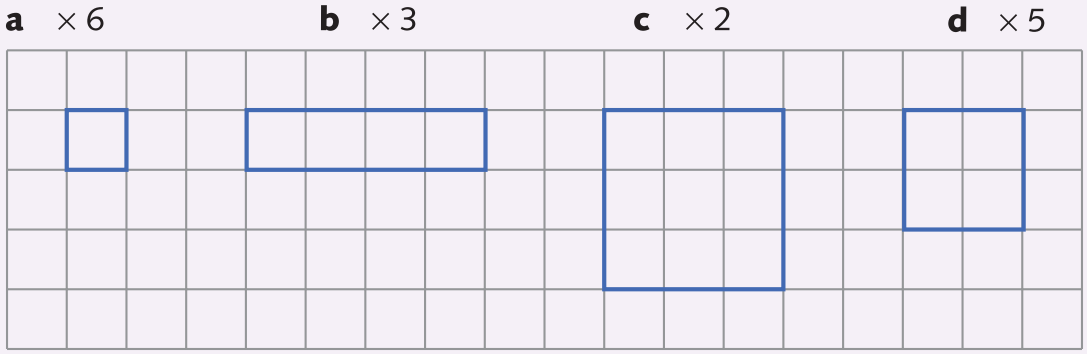
2 These shapes have been drawn on centimetre grid paper. Calculate the area (*A*) and perimeter (*P*) for each after it is enlarged by multiplying each side length by the given number.



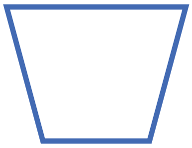
11G Review questions

1 Use a ruler and a protractor to draw:

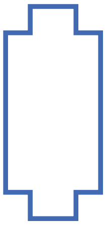
- **a** a triangle with 1 side of length 5 cm
- **b** a scalene triangle with 1 side equal to 5 cm
- **c** a right-angled triangle that is not isosceles
- **d** a triangle with 1 angle equal to 30°
- **e** a quadrilateral with no right angles
- **f** a rectangle with 1 side equal to 6 cm
- **g** a rhombus with 1 angle equal to 45°

2 Copy these shapes and draw in their lines of symmetry.

a

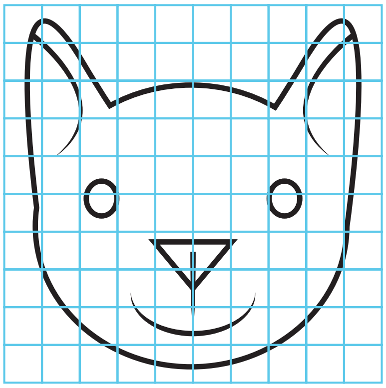


b



c

3 You will need 2-centimetre grid paper. Enlarge the cat's face onto the larger grid paper by numbering and copying each square.



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CHAPTER 12 Preparation

Useful skills for this chapter:

- understanding of two-dimensional shapes
- identifying and naming cubes, rectangular prisms and some other polyhedra
- drawing simple three-dimensional shapes
- the ability to calculate the volume of a cube and a rectangular prism
- some experience making three-dimensional shapes from construction equipment.

KICK OFF

1 Guess the shape

a I am 2-dimensional. I have 3 vertices and 3 sides that are all the same length. What am I?

b I am 3-dimensional. I have 6 faces, 8 vertices and 12 edges. My faces are all the same shape and size. What am I?

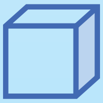
c I am 2-dimensional. I have 4 right angles and 2 pairs of sides that are the same length. What am I?

d I am 3-dimensional. I have 4 faces, 4 vertices and 6 edges. My faces are all the same shape and size. What am I?

Show what you know

1 Name the following solids.

a



b

c

d

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CHAPTER

12

Measurement and Geometry

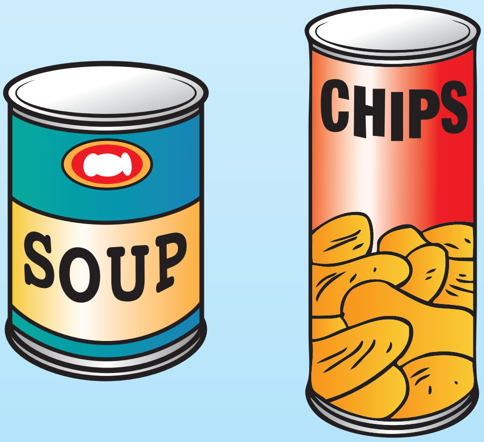
Three-dimensional objects

In this chapter we will look at three-dimensional shapes or objects. Everything around us exists in three dimensions. So you are a three-dimensional object and a car is a three-dimensional object too.

When we go shopping we see a lot of three-dimensional shapes with special mathematical names and properties.

Chocolate comes in boxes that are rectangular prisms and triangular prisms.

Soup and potato chips are sometimes packaged in cylinders.



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12A Polyhedra

Many three-dimensional shapes have special names – for example, cubes and pyramids.

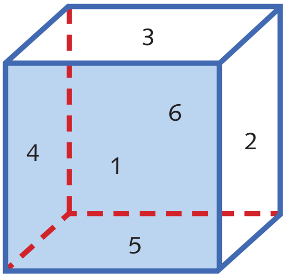
A **polyhedron** is a three-dimensional object with flat faces and straight edges. The faces are polygons. They are joined at their edges. The word 'poly' means many, and the word 'hedron' means face.

The plural of polyhedron is **polyhedra**, so we can have one polyhedron and two or more polyhedra.

When we describe polyhedra, the properties we are interested in are the faces, vertices and edges.

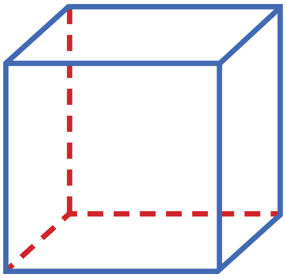
A face of a polyhedron is the shape that makes up one of its flat surfaces.

- The faces of a cube are all squares.
- A cube has six faces.



An edge of a polyhedron is a line where two faces meet.

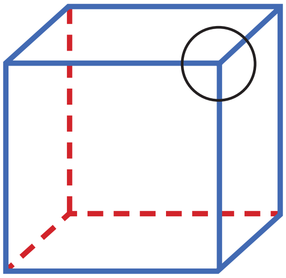
- A cube has 12 edges.



A vertex of a polyhedron is the point at which three or more edges meet. The plural of vertex is vertices.

- A cube has eight vertices.

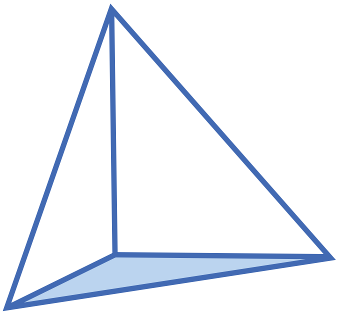
Polyhedra have special names depending on the number of faces that they have. There are some similarities with the naming of polygons.



Tetrahedrons

The smallest number of faces a polyhedron can have is four. The Greek prefix 'tetra' means four. A tetrahedron has four vertices, four faces and six edges.

A tetrahedron is also called a triangular-based pyramid.



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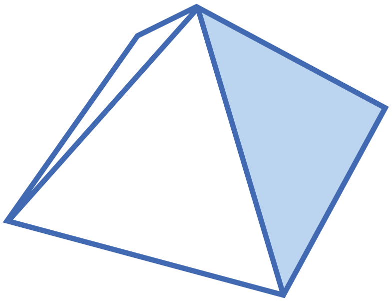
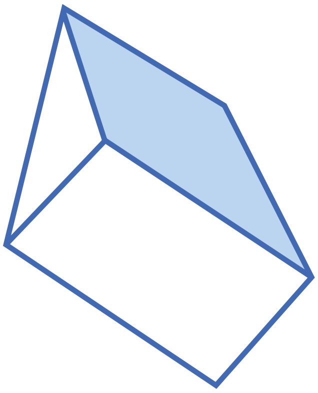
Pentahedrons

Here are two different pentahedron. 'Penta' means five. You might know this pentahedron as a square-based pyramid. It has five vertices, five faces and eight edges.



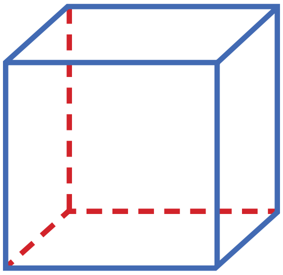
This pentahedron has six vertices, five faces and nine edges. It is called a triangular prism.



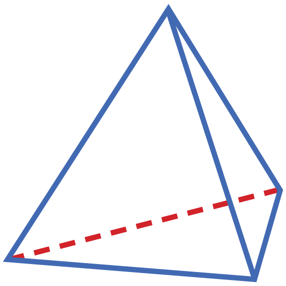
Regular polyhedra

For polyhedra, 'regular' means that all of the faces are identical regular polygons and that the same number of faces meet at each vertex. The word 'regular' in mathematics means following a rule like this.

A cube has six faces, all of them identical squares. Three faces meet at each vertex.



A regular tetrahedron has four faces. The Latin 'tetra' means four. The four faces are identical equilateral triangles. Three faces meet at each vertex.



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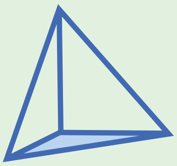
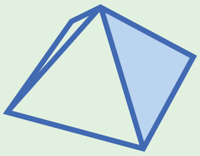
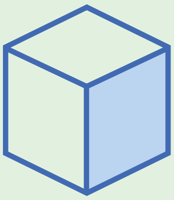
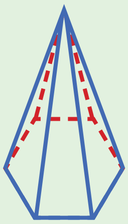
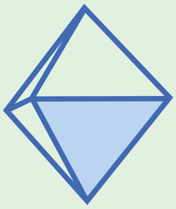
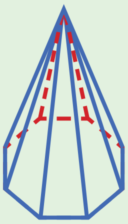
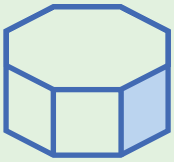
Number of faces	Name of polyhedron	Example
4	Tetrahedron	 This example is also known as a triangular-based pyramid.
5	Pentahedron	 This example is also known as a square-based pyramid.
6	Hexahedron	 This example is also known as a cube.
7	Heptahedron	
8	Octahedron	 This example is like two square-based pyramids joined together at the square faces.
9	Nonahedron	
10	Decahedron	

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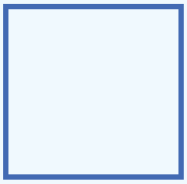
12A Whole class CONNECT, APPLY AND BUILD

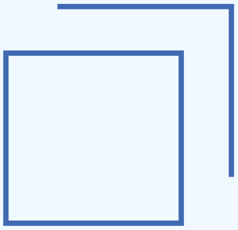
1 Practise drawing sketches of polyhedra. Show the edges that you cannot see with a dotted line. Complete the statements for each.

a Start with a cube.

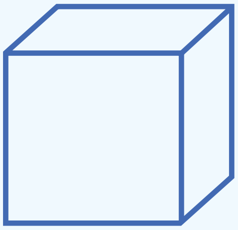
STEP 1:
Draw a square.



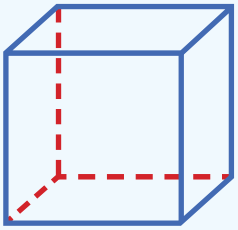
STEP 2:
Draw 2 lines at right angles to each other as shown:



STEP 3:
Join the vertices that you can see with solid lines.



STEP 4:
Connect to the vertex that you cannot see with dotted lines



A cube has _____ faces, _____ edges and _____ vertices.

b Sketch a tetrahedron. Start with the front triangular face. A tetrahedron has _____ faces, _____ edges and _____ vertices.

c Sketch a pentahedron that is a square-based pyramid. Start with the square base. A square pyramid has _____ faces, _____ edges and _____ vertices.

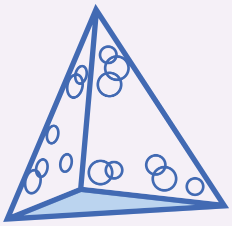
d Sketch a pentahedron that is a triangular prism. Start with a triangle face. A triangular prism has _____ faces, _____ edges and _____ vertices.

12A Individual

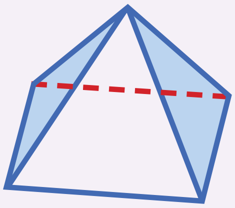
1 Each of the items below has the shape of one of the polyhedra. Count the number of faces and use the list of prefixes to help you name each polyhedron.

tetra = 4
penta = 5
hexa = 6
hepta = 7
octa = 8
nona = 9
deca = 10

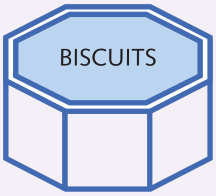
a



b



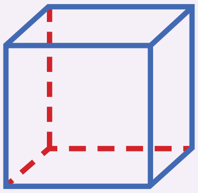
c



d

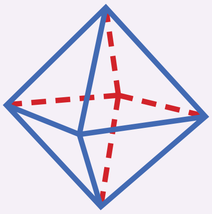
2 These polyhedra have been drawn so that each face, edge and vertex can be seen. Name the shape and complete the statement about faces, edges and vertices.

a



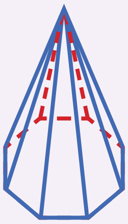
A ______ has ______ faces, ______ edges and ______ vertices.

b



An ______ has ______ faces, ______ edges and ______ vertices.

c



A ______ has ______ faces, ______ edges and ______ vertices.

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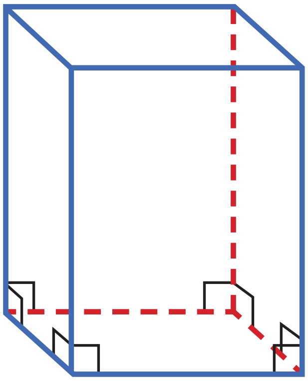
12B Prisms, cylinders and pyramids

Prisms

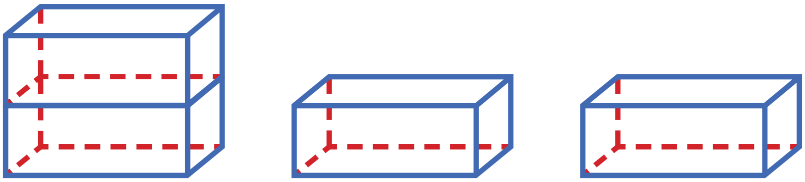
A prism is a polyhedron with a base and a top that are the same. All of the side faces are rectangles perpendicular to the base. This is also known as a right prism.



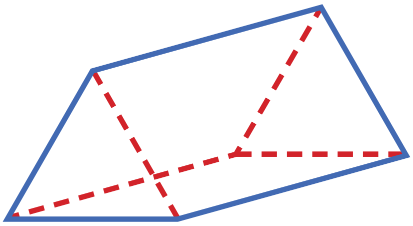
A prism is named according to the shape of its base. The one in the diagram on the left is a rectangular prism, because its base is a rectangle.

A rectangular prism is also a hexahedron because it has six faces.

A cross-section of a rectangular prism can be seen when we slice horizontally through this block of cheese with a knife, parallel to the base. Every cross-section is an identical rectangle.



If we look at a triangular prism, we can see that its base is a triangle. So is the face opposite the base. It is called the base even if the triangular prism is 'sitting' on one of its rectangular faces as in the picture below. The other three faces are rectangles. If we make a slice parallel to the base we get a triangle identical to the base.



A triangular prism is also a pentahedron because it has five faces.

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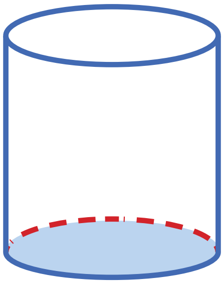
Cylinders



This three-dimensional shape is called a **cylinder**. It has a circular base and top.

Every cross-section is a circle of the same size.

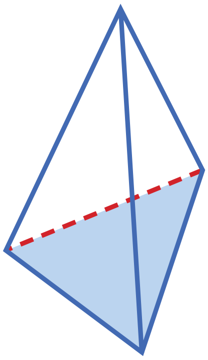
Cylinders are not prisms because they do not have rectangular side faces.

Cylinders are not polyhedra because they do not have polygonal faces.

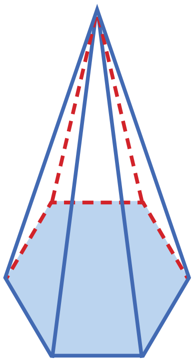
Pyramids

A pyramid is a polyhedron that has a polygon for a base and all the other faces are triangles which meet at one vertex called the apex.

This is a triangular-based pyramid. It has four faces, so it is also a tetrahedron.



This is a hexagonal-based pyramid. It has seven faces, so it is also a heptahedron.

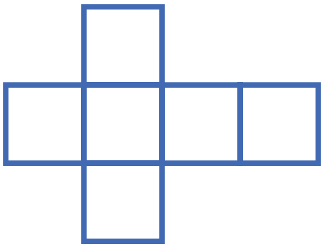


Nets of three-dimensional shapes

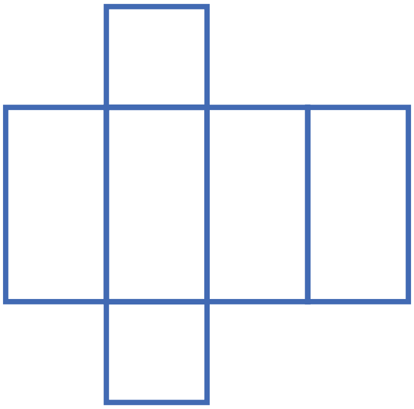
A net is like an unfolded solid. Every polyhedron can be cut into a net.

When we 'unfold' a cube, we have six squares joined together. Because the cube has six square faces, the net must have six squares.

Below is the most familiar net of a cube.



Below is a net for a square prism.



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12B Whole class CONNECT, APPLY AND BUILD

1 You will need a variety of models of prisms and pyramids. Count the number of faces for each shape. Place the shapes in increasing order, according to the number of faces.

2 Make these models of prisms and other polyhedra using toothpicks for the edges, and tiny balls of clay or plasticine or frozen peas for the vertices. If you use frozen peas or clay, allow your constructions to dry on a window-sill and handle them gently.

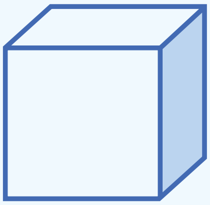
- **a** Use 12 toothpicks and 8 vertices to make a cube.
- **b** Use 8 toothpicks and 5 vertices to make a square pyramid.
- **c** Use 18 toothpicks to make a hexagonal prism.
- **d** Make a pentagonal prism.
- **e** Use 4 vertices and 6 edges to make a __________. (Complete)
- **f** Make a heptagonal pyramid.

3 Use construction equipment to make 4 different 3D shapes.

- **a** Name each shape.
- **b** Draw a sketch of each shape.
- **c** Describe each shape in terms of faces, vertices and edges.
- **d** Flatten out the pieces of the shape so that the pieces are still joined together. This will make a net of the shape. Sketch the net.

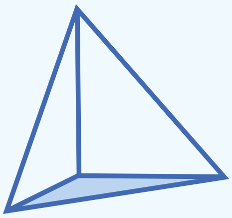
4 What might the net of each shape look like? Sketch it.

a

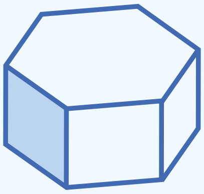


b

c



d



5 Visualise the following and then make from plasticine.

- **a** What do you get if you slice the top off a tetrahedron?
- **b** What kind of polyhedron do you get if you slice the top off a hexagonal pyramid?

6

- **a** Draw a heptahedron that is not a pyramid.
- **b** Draw an octohedron that is not a pyramid.
- **c** Continue this pattern for the next 2 shapes.

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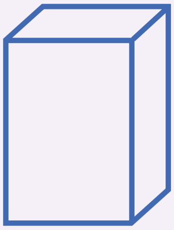
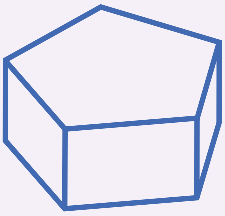
12B Individual

1 Name the base of each prism.

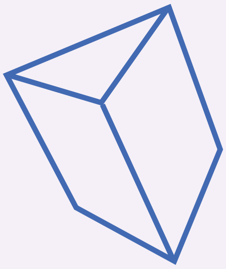
a



b



c



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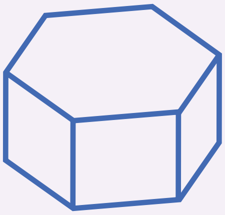
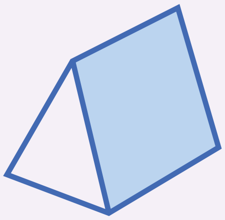


2 Match each 3D shape to its net.

a



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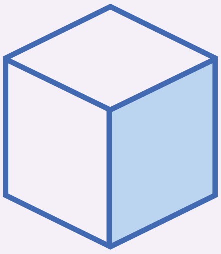

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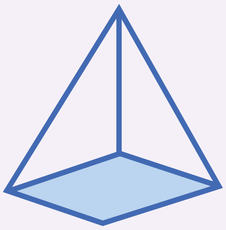

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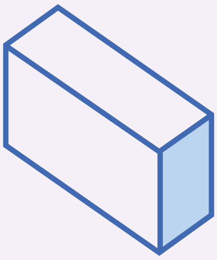
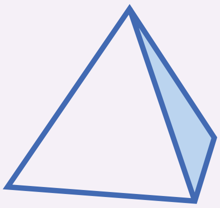
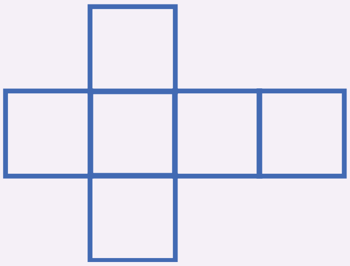


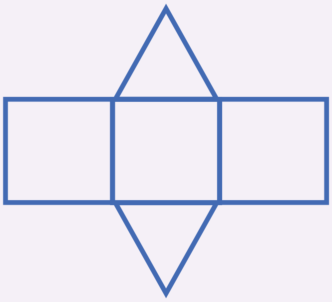
e



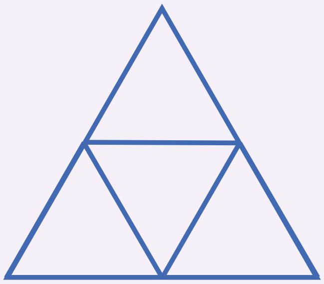
1



2



3



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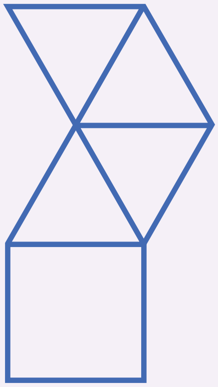
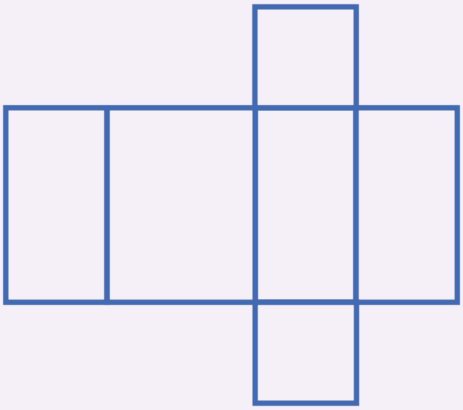


5



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12C Review questions

1 Draw a sketch of each of these polyhedra. Show the edges that you cannot see with a dotted line.

a Rectangular prism

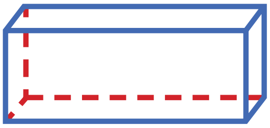
b Octahedron

c Triangular prism

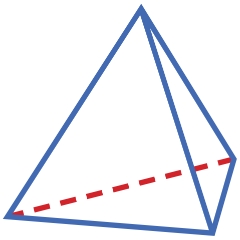
d Rectangular pyramid

2 Name the polyhedra and complete the statement about faces, edges and vertices.

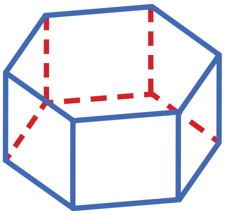
a This ________ has ____ faces, _____ edges and ____ vertices.



b This ________ has ____ faces, ____ edges and ____ vertices.

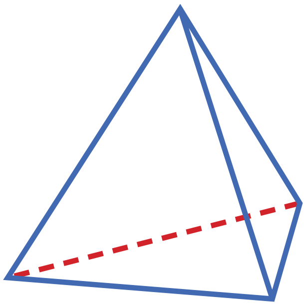


c This ________ has ____ faces, ____ edges and ____ vertices.



3 Name these 3-dimensional shapes.

a



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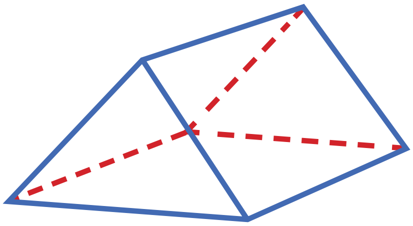

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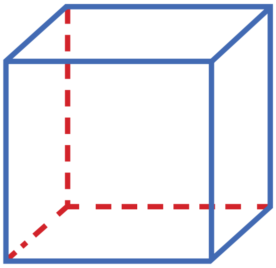

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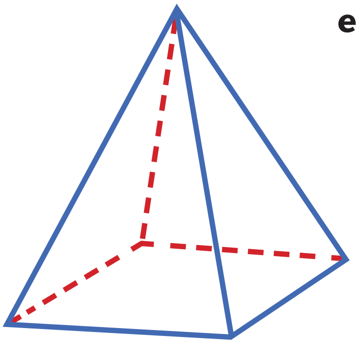

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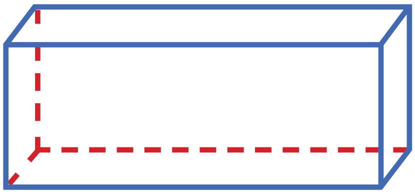

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CHAPTER 13 Preparation

Useful skills for this chapter:

- knowledge of the cardinal points of the compass
- being able to recognise and use grid references.

KICK OFF

Use a compass to navigate your way around the school.

1 Sketch a map of the school and mark in:
  - **a** north
  - **b** the location of your classroom in relation to the office
  - **c** the location of your house in relation to the school

2 Describe a route for your friends to follow using the compass. For example, face north and take 10 steps, then turn west. Take 5 steps, then turn towards the south and take 2 steps. Where do you end up?

Show what you know

1 What are the 4 cardinal points of the compass?

2 Who am I? I am a compass point and:
  - **a** I am midway clockwise between south and north.
  - **b** I am midway clockwise between north and south.

3 If I look directly north and then turn round 180 degrees, in which direction am I looking?

4 If I am looking due south and I turn round 180 degrees, in which direction am I looking?

5 Draw a compass rose showing north, south, east and west.

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CHAPTER 13

Measurement and Geometry

Maps and coordinates

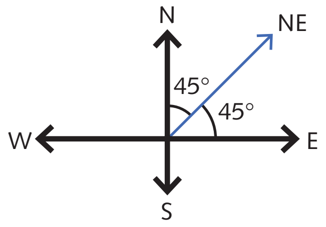
When we look at a map, we usually see an arrow marking the north–south line or direction. Here are some examples.

We use a compass to see the direction we are travelling in. It is marked with north, south, east and west. Sometimes we see a diagram of a compass on a map.

The Cartesian plane is named after the French mathematician and philosopher Rene Descartes (1596–1650). He introduced coordinate axes to show how algebra could be used to solve geometric problems.

13A Reading maps

Using the points of the compass



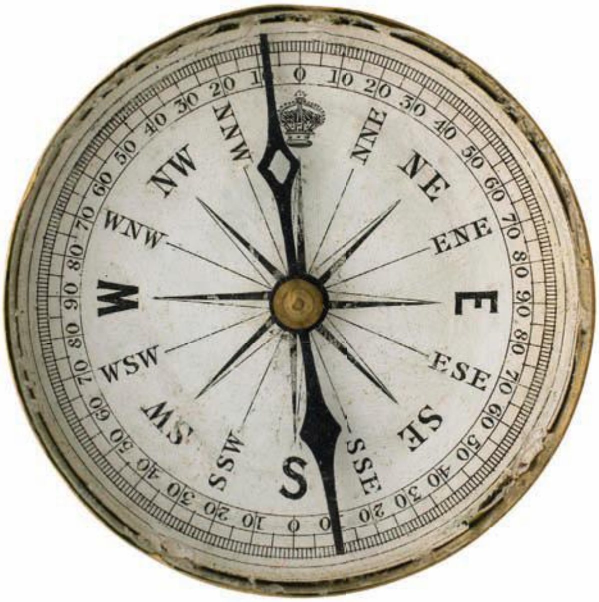
In the middle of the day in the southern hemisphere, the Sun is to the north. The Sun rises in the east and sets in the west.

The four points of the compass are called north, south, east and west. The north–south line is perpendicular to the east–west line.

If you face north, then east is 90° to the right.

Half-way between each pair of cardinal points is another compass point:

- Half-way between north and east is called north-east (NE).
- Half-way between north and west is called north-west (NW).
- Half-way between south and west is called south-west (SW).
- Half-way between south and east is called south-east (SE).



Using maps

A street map is divided into columns and rows.

Each square is in one column and one row. It has a grid reference like F7 to describe its location.

When reading the coordinates on a grid, you read the horizontal axis first followed by the vertical axis. So we get a letter first, followed by a number.

A map of Manly, NSW, is shown on the next page. The square marked is F7 because it is where column F and row 7 intersect. The label 'F7' is called the coordinates of the square. It contains a letter and a number.

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13A Whole class CONNECT, APPLY AND BUILD

1 **a** Discuss where the Sun rises. Point your arm to where the Sun rises.

b Someone calls out ‘north’. Use your left arm and hand to point to north. Check with a compass if you have one.

c Take turns calling out ‘north’, ‘south’ and ‘west’ at random. Everyone points to that direction using their left arm. Keep your right arm pointing east throughout.

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2 **a** Look at maps and street directories to find the north marker. From this find east, west and south on the map.

b Draw a compass showing north, south, east and west.

c Draw lines with arrows to show NE, SE, SW, NW.

d NNE is exactly halfway between N and NE. Mark that direction with a line and arrow head.

e Mark these points of the compass also: SSE, WNW, SSW.

3 Use the Sun or a compass to help you place cards marked north, south, east and west on the appropriate walls in the classroom.

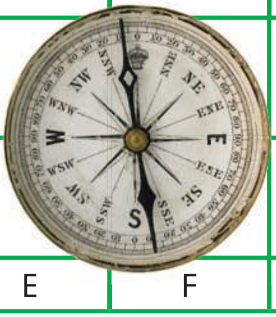
a Face north. Turn to east. What angle have you turned?

b Face north. Turn to south. What angle have you turned?

c Face north. Turn to your right until you are facing west. What angle have you turned?

Look at the map of The Dalby Pet Show below to answer questions 4 and 5.

	A	B	C	D	E	F	
1				**silkworms**		**cats**	1
2	**dogs**						2
3				**tortoises**		**lizards**	3
4		**guinea pigs**	**fish**		**snacks**		4
5			**hermit crabs**				5
6	**mice**						6
	A	B	C	D	E	F	



4 What would I find in:

a B4? **b** D1? **c** F3? **d** A2? **e** C5? **f** E4?

5 Write the coordinates for:

a fish **b** mice **c** cats **d** tortoises

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13A Individual

1 Draw a map of your school, or part of your school if it is large. Label the bottom and left-hand sides of your page so that you can work out the grid references of 4 of the buildings.

Use the map of Manly below to answer questions 2–5.

2 What would I find at grid reference:

a D4? **b** H6? **c** B7? **d** B3? **e** G11? **f** A7?

3 Name the coordinates for each of the following.

a Manly West Park **b** Freshwater Beach

c Lagoon Park **d** Manly Oval

e The junction of Sydney Road and Pittwater Road

f Manly Oceanworld

4 Follow these directions.

Start at the junction of Sydney Road and Pittwater Road and travel north until you come to Raglan Street.

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Turn left into Raglan Street and go west to Griffiths Street.

Travel along Griffiths Street and turn left into Waratah Street.

Turn left at the end of Waratah Street. Which road are you in now?

5 Write your own directions for others in your group to follow a route on the Manly map. Can they arrive at the right place?

Here is a map that includes New South Wales, Victoria and parts of Queensland and South Australia. **Use it for questions 6–8**.

6 Which capital city has these grid references?

a F11 **b** N2 **c** K8 **d** I9 **e** A8

7 Which towns are found at:

a C5? **b** D10? **c** I11? **d** G10? **e** J7?

f L7? **g** M5? **h** G3? **i** D11? **j** J10?

8 Write grid references for:

a Toowoomba **b** Nowra **c** Mount Gambier

d Bendigo **e** Coffs Harbour **f** Port Pirie

g Swan Hill **h** Moree **i** Coonabarabran

j Dalby **k** Sale **l** Ivanhoe

m Flinders Island **n** Leigh Creek **o** King Island

p Parkes **q** Wollongong **r** Bourke

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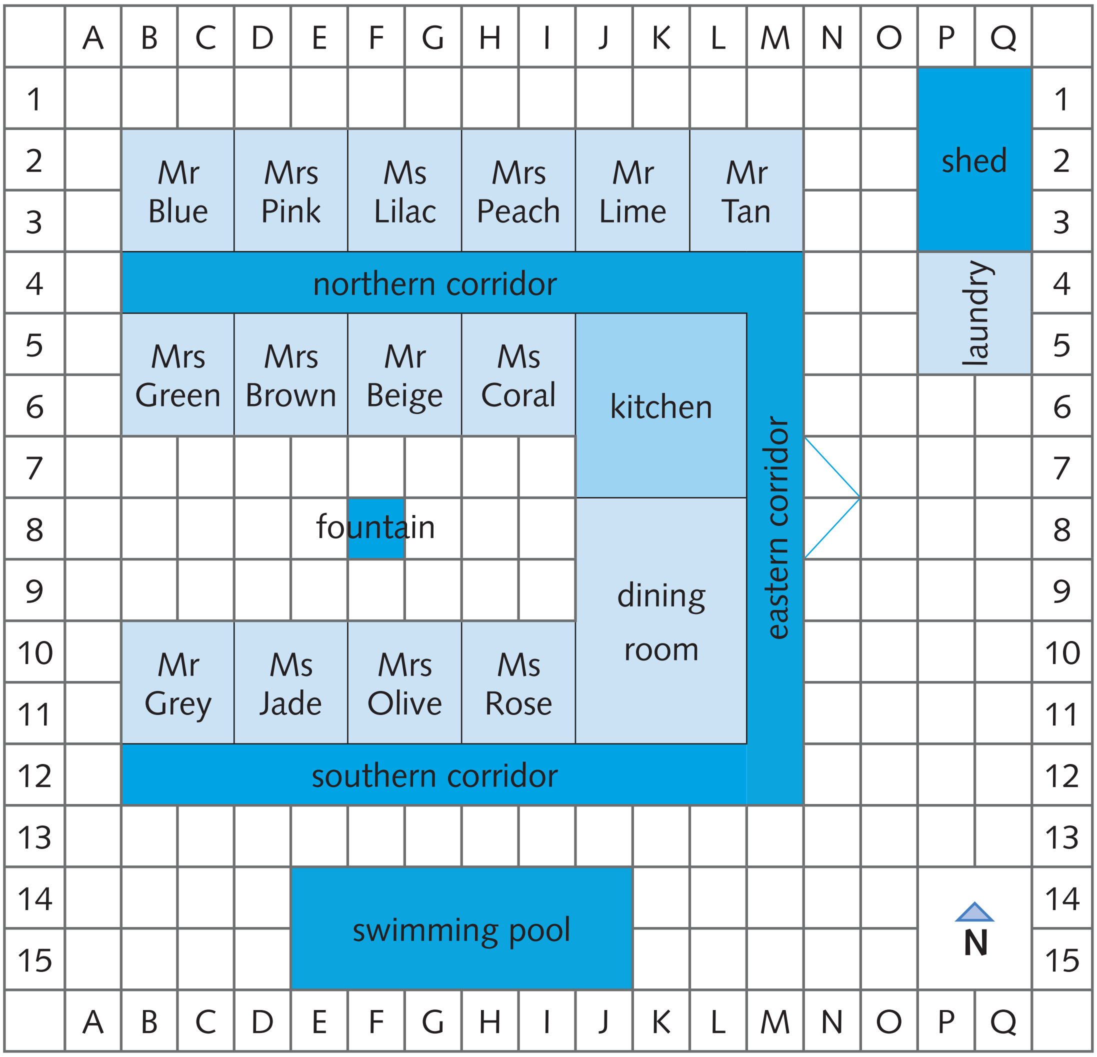
13B Review questions

Here is a map of the Frank Brian Nursing Home.



1 What would I find at:

a P3? **b** L9? **c** I15? **d** C3? **e** K6? **f** G6?

2 Write a map reference for:

a Mrs Olive's room **b** the dining room **c** Ms Rose's room

d Mr Tan's room **e** the shed **f** the fountain

3 From the map, give the coordinates and name the resident(s) who live:

a nearest the swimming pool

b north of Mrs Brown

c next to the dining room

d west of Ms Lilac

e at the intersection of the northern and eastern corridor

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CHAPTER 14 Preparation

Useful skills for this section:

- previous experience using balances and scales to measure mass
- the ability to identify the place value of decimal numbers.

KICK OFF

Start with any 1-digit number other than zero. Add 10. Multiply the sum by 100. Add 300. Divide by 10 and subtract 130. What number do you have? Start with a different 1-digit number. What pattern can you see?

Show what you know

1 **a** Write down 3 grocery items whose weight is measured in grams.
b Write down 3 grocery items whose weight is measured in kilograms.

2 You will need some Plasticine.
a Make a ball of Plasticine that you estimate would have a mass of 10 grams.
b Make 3 balls of Plasticine that have a total mass of 20 grams.

3 Write the unit of measurement you would use to measure the mass of each of these items.
a A person
b A cup of rice
c Scissors
d A pencil
e A backpack
f A pencil sharpener
g A lunch box
h A brick
i An elephant

4 Write how many grams there are in:
a 5 kg
b 7 kg
c 12 kg

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CHAPTER 14

Measurement and Geometry

Measurement

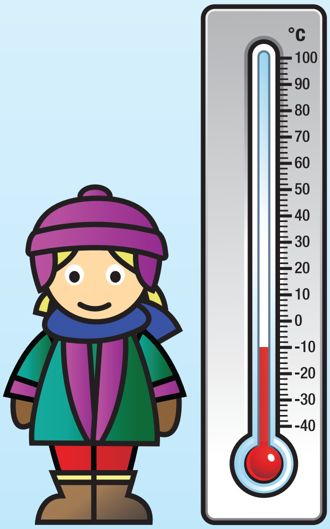
In this chapter we are going to look at mass, time and temperature.

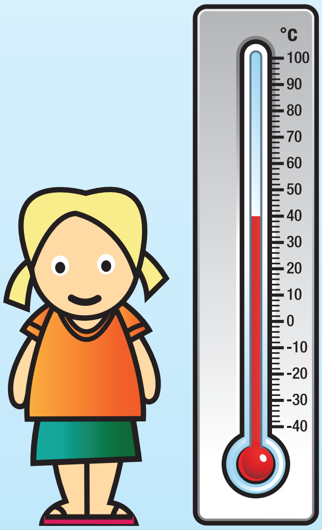
Temperature is how hot or cold something is. Something with a high temperature is hot, like an oven. Something with a low temperature, like a block of ice, is cold.

The air around us also gets hot and cold over the course of the year.

In winter, the temperature is low – we dress in warm clothes and stay out of the wind.

In summer, the temperature is high – we dress in cool clothes and play in the shade.





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14A Mass

The units of measurement we use for measuring mass are milligrams, grams, kilograms and tonnes. We can convert from one unit to another by multiplying or dividing by 1000.

The basic unit for measuring mass is the **kilogram** (**kg**).

The prefix **kilo** means one thousand. There are 1000 **grams** (**g**) in 1 kilogram.

1000 grams = 1 kilogram

If we have 2 kg and we want to know how many grams that is, we multiply by 1000.

1 kg is the same as 1000 g

So 2 kg = 2 × 1000 g
= 2000 g

If we have 3000 g and we want to know how many kilograms that is, we divide by 1000.

1000 g = 1 kg
So 3000 ÷ 1000 = 3 kg

A paperclip weighs about 1 gram, so a kilogram of paperclips would be about 1000 paperclips!

Example 1

When Joseph was born he weighed 5 kilograms.

How many grams is that?

Solution

We need to multiply the kilograms by 1000 to find the number of grams.

5 kg = 5 × 1000 g
= 5000 g

There are 5000 grams in 5 kilograms.

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Example 2

When Lachlan was born he weighed 3585 grams.

How many kilograms is that?

Solution

We need to divide the grams by 1000 to find the number of kilograms.

$$\begin{aligned} 3585 \text{ g} &= 3585 \div 1000 \text{ kg} \\ &= 3.585 \text{ kg} \end{aligned}$$

There are 3.585 kg in 3585 grams.

For very small amounts we use **milligrams** (**mg**).
A pinch of salt weighs about 1 milligram.

The prefix **milli** means one-thousandth.

One milligram is $\frac{1}{1000}$ of a **gram** (**g**).
So 1000 milligrams = 1 gram

Example 3

Rita drinks two cups of milk per day. One cup of milk contains 300 milligrams of calcium. The recommended daily intake for a child of 11 is 0.9 grams. Is Rita getting enough calcium from the milk she drinks?

Solution

1000 mg = 1 g. To convert milligrams to grams, divide by 1000.

$$\begin{aligned} 300 \text{ mg} &= 300 \div 1000 \text{ g} \\ &= 0.3 \text{ g} \end{aligned}$$

Two cups of milk is 0.6 g of calcium. Rita needs at least three cups of milk to get her recommended daily intake of calcium. So two cups is not enough.

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For very heavy objects we use **tonnes** (**t**). There are 1000 kilograms in 1 **tonne** (**t**).

So 1000 **kilograms** (**kg**) = 1 **tonne** (**t**).

Example 4

Dale's car weighs 1587 kilograms. How many tonnes is that?

Solution

1 t = 1000 kg. To convert kilograms to tonnes, divide by 1000.

$$\begin{aligned} 1587\text{ kg} &= (1587 \div 1000)\text{ t} \\ &= 1.587\text{ t} \end{aligned}$$

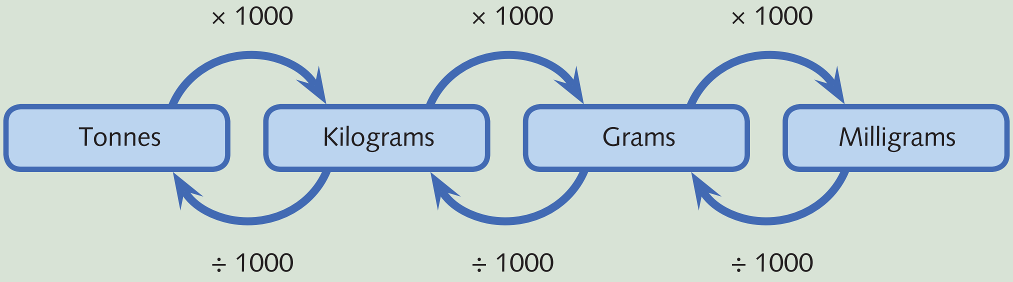
There are 1.587 tonnes in 1587 kilograms.

Remember

The standard unit of measurement for mass is the **kilogram**.

To convert tonnes to kilograms, kilograms to grams or grams to milligrams multiply by 1000.

To convert milligrams to grams, grams to kilograms or kilograms to tonnes, divide by 1000.



14A Whole class CONNECT, APPLY AND BUILD

1 You will need a kilogram weight and a set of scales.

a Draw a chart with 3 columns with these headings:
'Less than 1 kg'; 'About 1 kg' and 'More than 1 kg'.

b Compare different objects in the classroom to the 1 kg mass by holding each in your hand.

c Draw a picture of each object in the appropriate column.

d Finally, measure the mass of each object using the scales and write the measurement underneath the picture of the object.

2 Work in groups of three. Compare a kilogram mass with two 500 g masses. Do they feel the same?

a How many kilograms are there in 500 g?

b Next, compare four 250 g masses with a single kilogram mass.
Do they feel the same?
How many kilograms are there in 250 g?

3 Estimate how many of these items you would need to have a total mass of $\frac{1}{2}$ kg. Check your estimate using scales.

a Maths books
b Dictionaries
c Pencils

4 Convert to grams.

a 1250 mg
b 3400 mg
c 3500 mg
d 275 mg
e 3 kg
f 12 kg
g 0.03 kg
h 124 kg

5 **a** Estimate the mass of a 1-centimetre-cube block. Weigh it.

b It might be hard to accurately measure the mass of 1 block.
So this time weigh a hundred 1-centimetre blocks and divide the result by 100.
Was the mass of 1 block different to what you found in part **a**? Discuss which is the more accurate measurement.

14A Individual

1 Write 'more than $\frac{1}{2}$ kg' or 'less than $\frac{1}{2}$ kg' for each.

a 450 g
b 0.6 kg
c 750 g
d 0.2 kg
e 510 g
f 0.3 kg

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2 Write ‘more than $\frac{1}{4}$ kg’ or ‘less than $\frac{1}{4}$ kg’ for each.

a 0.5 kg
b 200 g
c 0.7 kg
d 650 g
e 0.1 kg
f 125 g
g 1000 g
h 4999 g

3 Convert to grams.

a 1500 mg
b 3250 mg
c 2750 mg
d 0.4 kg
e 1.250 kg
f 3.7 kg
g 999 kg
h 10 000 kg

4 Write these masses in kilograms.

a 4000 g
b 3500 g
c 2040 g
d 2250 g
e 5250 g
f 600 g
g 35 g
h 10 g

5 Convert these measurements to tonnes.

a 4250 kg
b 2750 kg
c 3200 kg
d 1700 kg

6 **a** How many kilograms are there in 3560 g?
b How many grams are there in 0.7 kg?
c How many grams are there in 450 mg?
d How many kilograms are there in $1\frac{1}{4}$ t?
e How many tonnes and kilograms are there in 2500 kg?
f How many milligrams are there in $4\frac{1}{4}$ g?

7 **a** Joanna bought 750 g of peas. How many kilograms did she buy?
b Joel carried 13.68 kg of bricks in his wheelbarrow. How many grams did he carry?
c Chris put 0.125 kg of butter in the cake mixture. How many grams of butter did Chris use?

8 To build his driveway Les needs 8250 kg of sand, 4850 kg of gravel and 10 500 kg of crushed rock. Les wants to get all of his materials delivered in containers by a single truck. Is this possible if the truck can carry a maximum load of 25 tonnes?

Reflection

1 A stallholder at the Victoria Market knows that each large apple he is selling weighs about 150 g.

a A customer asks him for $1\frac{1}{2}$ kg of apples. How many apples should he pick out?
b Another customer wants about 1 kg of apples. How many should he pick out?
c Discuss how you worked this out.

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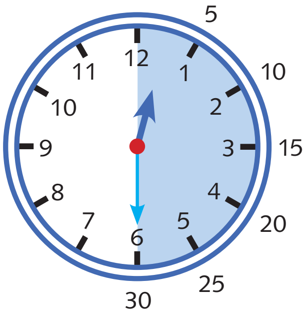
14B Reading and recording time

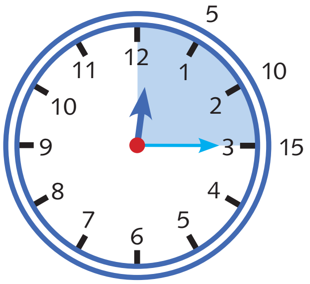
The basic unit of measurement for time is the **second** (**s**).

- There are 60 seconds in 1 minute.
- There are 60 minutes in 1 hour.
- There are 24 hours in 1 day.
- There are 7 days in 1 week.

We can also use fractions when we record time.



There are 30 minutes in half an hour.



There are 15 minutes in quarter of an hour.

There are two ways of recording the time of day.

Using a 12-hour clock

When we use the 12-hour system the day is broken up into two 12-hour blocks. 11:30 a.m. means eleven thirty in the morning and 11:30 p.m. means eleven thirty in the evening.

We write 'a.m.' to show that we mean the morning. The letters 'a.m.' come from the Latin words 'ante meridiem' meaning 'before noon'.

We write 'p.m.' to show that we mean the afternoon or evening. The letters 'p.m.' come from the Latin words 'post meridiem' meaning 'after noon'.

Midnight is written as 12:00 a.m. and midday is written as 12:00 p.m.

Using a 24-hour clock

When we use 24-hour time, all times are measured from midnight one day up until the midnight the next day. So 11:30 a.m. is written as 1130 and 11:30 p.m. is written as 2330.

We do not use a.m. or p.m. with the 24-hour clock. Midnight is written as 0000 and midday is written as 1200.

Twenty-four-hour time is most often used when it is important to avoid confusion about a time that could either be morning or evening, for example in the armed forces, by airlines for flight times and in hospitals.

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These morning times are recorded in this way using the 24-hour clock:

6:00 a.m. is written as 0600 6:05 a.m. is written as 0605
7:00 a.m. is written as 0700 7:05 a.m. is written as 0705
8:00 a.m. is written as 0800 8:05 a.m. is written as 0805

Using 24-hour time we record these afternoon times in this way:

1:00 p.m. is written as 1300 1:05 p.m. is written as 1305
2:00 p.m. is written as 1400 2:05 p.m. is written as 1405
3:00 p.m. is written as 1500 3:05 p.m. is written as 1505

12-hour clock	**6:00 a.m.**	**1:00 p.m.**	**3:00 p.m.**	**6:00 p.m.**	**9:30 p.m.**	**12:00 a.m. midnight**
						
24-hour clock	**0600**	**1300**	**1500**	**1800**	**2130**	**0000**

Example 5

Grace's bedroom clock shows 1745. What time is that in 12-hour time?

Solution

1745 is after 1200 so it is after noon. 1745 is 5 hours and 45 minutes after 1200, so it is 5:45 p.m.

Example 6

Justin told Colby the time was 7:20 p.m. What time was that in 24-hour time?

Solution

'p.m.' means it is after noon. In 24-hour time, noon is 1200, so 7:20 p.m. is 7 hours and 20 minutes after noon, which is 1920.

14B Whole class CONNECT, APPLY AND BUILD

1 Work with a partner to draw a time line showing 24 hours from midnight on 1 day to midnight the next day. Write in the 12-hour times along the bottom of the time line. Write the 24-hour times along the top of the time line.

Use the time line to help you convert these 12-hour times to 24-hour time:

a 8 a.m. **b** 6:30 a.m. **c** 7:42 a.m. **d** 9:40 a.m.

2 Use the time line you made with your partner. One person says a time in either 12-hour or 24-hour time and the other person converts it to the other time format. Repeat, swapping roles.

3 Convert these 24-hour times to 12-hour times. (Remember to write a.m. or p.m.)

a 0400 **b** 0535 **c** 1400 **d** 1510

14B Individual

1 Change these 12-hour times to 24-hour times.

a 11 a.m. **b** 4:52 a.m. **c** 3 p.m. **d** 1:19 p.m.

2 Change these 24-hour times to 12-hour times.

a 1300 **b** 0800 **c** 1900 **d** 2100 **e** 2300 **f** 0827 **g** 0010

3 Change these 24-hour times to 12-hour times.

a 1200 **b** 0000 **c** 2359 **d** 0003 **e** 1001

4 Write each of these times in 12-hour and 24-hour time.

a Two o'clock in the afternoon **b** Ten o'clock in the morning

c Eleven o'clock in the evening **d** Twenty-three minutes past 5 in the morning

5 Put these times in order, starting at midnight.

3:45 p.m.	midnight	1310	7:15 p.m.	5:05 a.m.
noon	2320	10:25 p.m.	0450	2055

6 Mum put on the roast at 4:30 p.m. It finished cooking 2 hours later. What time did it finish in 24-hour time?

7 The DVD player showed 19:45. What time is that in 12-hour time?

8 Write 20 minutes to 6 in as many different ways as you can.

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14C Elapsed time

Sometimes we need to know how much time has elapsed between two times on the clock. For example, when I am making a cake that needs 35 minutes to cook, I need to know what time I should take it out of the oven.

There are a number of ways of doing this.

One way is to count on from one time to another:

I put the cake in the oven at 2:50 p.m.

Build up from 2:50 p.m. to 3:00 p.m. = 10 minutes

35 minutes – 10 minutes = 25 minutes to go

I add 25 minutes to 3:00 p.m. and get 3:25 p.m.

So I would take the cake out at 3:25 p.m.

Example 7

a Sharni left home at 8:15 a.m. to walk to school. She arrived at school at 8:40 a.m. How long did it take her to walk to school?

b When walking home from school, Sharni left at 3:30 p.m. and instead of walking straight home she went to the shops. She got home at 4:28 p.m. How long did it take her to walk home from school?

Solution

a Both times are between 8:00 a.m. and 9:00 a.m.
So we subtract 15 from 40. It takes 25 minutes.

b Sharni starts at 3:30 p.m.
Build up from 3:30 to 4:00 = 30 minutes
Build up from 4:00 to 4:28 = 28 minutes
Add 30 minutes and 28 minutes = 58 minutes
It took Sharni 58 minutes to walk home from school via the shops.

Timetables

We need timetables to help us know when we have to do things.

We have timetables at school and for buses, trains and television.

Calculating elapsed time helps us to understand and use timetables.

Example 8

This is a Year 5/6 timetable. How much time is spent doing Maths each week?

Time	Monday	Tuesday	Wednesday	Thursday	Friday
9:00–10:00	English	English	Maths	English	Maths
10:00–11:00	English	English	English	English	English
11:00–11:20	RECESS				
11:20–12:30	Society	Maths	English	Music	Library
12:30–13:30	LUNCH				
13:30–14:30	Music	PE	Art	Maths	Science
14:30–15:15	Maths	Health	Art	Italian	PE

Solution

Monday:	14:30–15:15 = 45 minutes
Tuesday:	11:20–12:30 = 70 minutes
Wednesday:	9:00–10:00 = 1 hour
Thursday:	13:30–14:30 = 1 hour
Friday:	9:00–10:00 = 1 hour
Total:	3 hours 115 minutes, which is 4 hours 55 minutes

14C Whole class CONNECT, APPLY AND BUILD

1 **a** Start at 3:00 p.m. Count on 3 hours. What time is it in 24-hour time?

b Start at 22:10. Count on 40 minutes. What time is it?

c What time is it 10 minutes after 2:55 p.m.?

d What time is it 3 hours before 12:00 p.m.?

e What time is it 3 hours before 2:10 p.m.?

2 **a** Calculate the amount of time you spend each day at school. How much is this per week?

b Calculate the amount of time you spend in class each day when you are at school. How much is this per week?

c How much of 1 week do recess and lunchtime take up?

3 This is a train timetable for the Central to Jackson line. One train leaves Central every 10 minutes and it is 4 minutes between stops. Copy the timetable and complete it, showing the arrival times of trains at each destination.

Destination	Train 1	Train 2	Train 3	Train 4	Train 5
Central	14:32				
Scotsville					
Newcombe					
Harcourt					
Jackson					

4 The school bus leaves at 3:40 p.m. It stops at the first bus stop 15 minutes later for 2 minutes. Then it travels for a further 8 minutes to the second stop. What time is it when it gets to the second stop?

14C Individual

1 Four friends entered the Southern District Fun Run. The Fun Run started at 11:30 a.m. Here are the times when each of the friends finished the run. Calculate how long each of them took to finish the Fun Run.

Name	Finishing time
Anton	1156
Sienna	1227
Ryan	1238
Georgia	1304

a Who ran the fastest time?

b Who came second among the friends? How long did that person take?

c What was the difference in the times of the slowest and the fastest runner?

2 It takes 3 minutes to cook an egg in boiling water. Fiona puts an egg into boiling water when the clock is showing 3:58 p.m. When should she take it out?

3 Add 45 minutes onto these times.

a 1725 **b** 11:55 a.m. **c** 0504 **d** 2123 **e** 2339

4 What is the time 50 minutes before these times?

a 3:30 p.m. **b** 1:27 p.m. **c** 12:42 a.m. **d** 1821 **e** 0026

5 How much time until midday?

a 0645 **b** 1057 **c** 0913 **d** 0429 **e** 1104 **f** 0731

6 Kylie went to sleep at 9:38 p.m. She woke up at 6:56 a.m. How long was Kylie asleep?

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7 Here is a train timetable.

Station	Arrival times								
Rockford	0820	0940	1100	1220	1340	1500	1620	1740	1900
Northington	0836	0956	1116	1236	1356	1516	1636	1756	1916
Paradise	0854	1014	1134	1254	1414	1534	1654	1814	1934
Clearview	0910	1030	1150	1310	1430	1550	1710	1830	1950
Winston	0925	1045	1205	1325	1445	1605	1725	1845	2005
Blainey	0939	1059	1219	1339	1459	1619	1739	1859	2019

a How long does it take to travel from Rockford to Blainey?

b Sam lives at Rockford. She needs to be at Winston at 2:45 p.m. Which train will she need to catch?

c How long will Sam's train trip take?

8 Mai Lin has to catch the 1645 flight to Perth. She needs to check in at the airport 60 minutes before the flight. Mai Lin lives 1 hour and 15 minutes from the airport. What time will the taxi need to pick Mai Lin up?

9 Frank has to exercise for 35 minutes before school. It takes him 45 minutes to get ready for school and 25 minutes to get to there. What time should he get up if he wants to be at school at 0835?

10 Brooke took 3 hours and 25 minutes to complete the marathon. If she finished at 1145, what time did she start?

11 London is 11 hours behind Melbourne during daylight saving. Calculate the time in London when it is the following daylight saving times in Melbourne.

a 9 p.m. Monday

b 5:45 p.m. Tuesday

c 1109 Saturday

d 7:24 a.m. Sunday

Homework

1 Find how long it takes for you to get to school. Write the time you usually leave home and the time you usually arrive at school. Count on to find the elapsed time. Calculate how much time you spend travelling to and from school each day. How long would that be over 1 week?

2 Find out from an adult what time they leave for work and what time they arrive at work. Calculate how much time the adult spends travelling to and from work each day. How long would that be over 1 week?

3 Provide TV program guides. Select one channel on one day and calculate how much time it broadcasts news and current events.
Do the same for lifestyle programs and children's programs.
Which channel spends longest on children's programs?

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14D Temperature

We use thermometers to measure temperature. A doctor might use a thermometer to measure your body temperature. In the freezer section of the supermarket, a thermometer helps the manager make sure that food is kept at the right temperature. At home, we use thermometers in the oven to help us cook food at the right temperature.

The unit of measurement for temperature is the **degree Celsius** (°**C**).

0°C is the freezing point of water. Water starts forming ice at this temperature.

100°C is the boiling point of water.

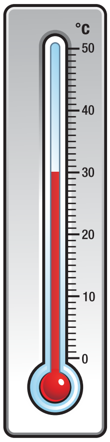
37.4°C is the usual body temperature of a healthy person. An increase or decrease of even 1°C means a person is sick.

Different thermometers are used for different tasks.

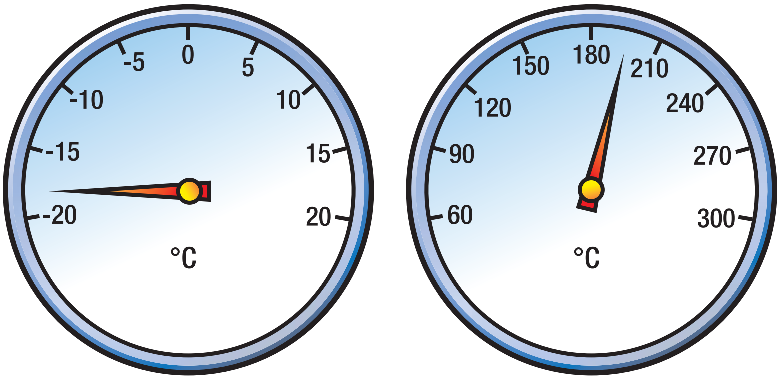
When a person is feeling unwell, we take their temperature using a digital thermometer, like the one shown on the right.

Why do you think the scale starts at 35°C and goes up in steps of 0.1°C at a time?

To measure the temperature in a room, we might use a thermometer like this one. It starts at 0°C and the scale is in steps of 10°.



A thermometer used to measure temperature in a freezer starts below 0°C like the one on the left.



Some thermometers start above 0°C. The thermometer on the right might be used for high temperature situations such as the inside of an oven.

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14D Whole class CONNECT, APPLY AND BUILD

1 Locate the weather section in a newspaper or the weather forecast on the web.

- **a** Is it hotter today than yesterday?
- **b** Will it be cooler tomorrow than today?
- **c** Which places in Australia might be cooler or hotter than your classroom?

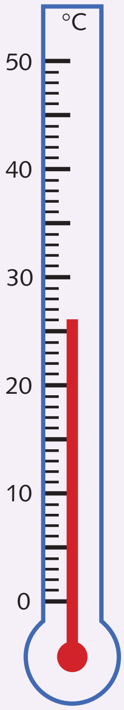
2 Work with a partner.

- **a** Measure the temperature at 4 different places in your school, including inside and outside, at 3 different times during the day. Make sure your thermometer shows a steady temperature before you take the readings.
- **b** Discuss why the temperature was different inside and outside, and if there was one area in the school that was warmer or cooler than another area. For example, in Australia the wall facing north may be hotter because the Sun shines on it in winter.

14D Individual

1 Write the temperature that is shown on these thermometers.

a



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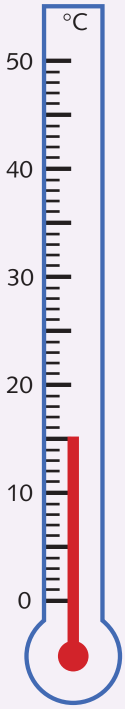

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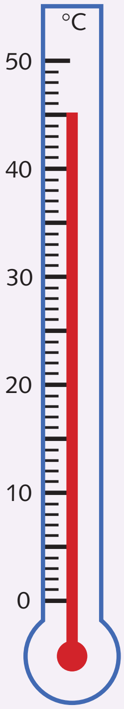
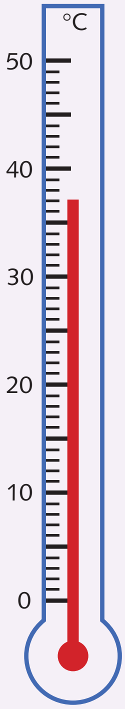
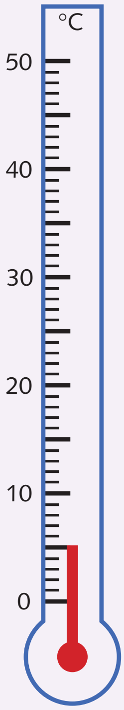


d



e



2 Draw a suitable thermometer showing each of these temperatures.

a 37.5°C **b** 38°C **c** 36.5°C **d** 38.5°C

3 Here are the maximum and minimum temperatures of 7 capital cities on one spring day. Calculate the difference between the highest temperature and the lowest temperature recorded for each city.

City	Sydney	Hobart	Brisbane	Perth	Adelaide	Darwin	Melbourne
Max.	25°C	20°C	28°C	27°C	26°C	32°C	22°C
Min.	14°C	11°C	18°C	15°C	13°C	19°C	12°C

14E Review questions

1 How many grams are there in:

a 3000 mg? **b** 1500 mg? **c** 0.6 kg? **d** 1.8 kg?

e 4.125 kg? **f** 150 kg? **g** 1500 kg? **h** 15 000 kg?

2 Write these masses in kilograms.

a 8000 g **b** 1200 g **c** 70 g **d** 128 g

3 **a** Alexandra bought 875 g of nails. How many kilograms did she buy?

b Glenn carried 18.24 kg of luggage. How many grams did he carry?

4 Change these 12-hour times to 24-hour times.

a 6 a.m. **b** 1:25 p.m. **c** 3:38 p.m. **d** 11:59 p.m.

5 Change these 24-hour times to 12-hour times.

a 1400 **b** 0432 **c** 1358 **d** 1845 **e** 2127

6 Write each of these times in 12-hour and 24-hour time.

a Four o'clock in the afternoon

b Five o'clock in the morning

c Twelve minutes past five in the evening

d Twenty-seven minutes to six in the morning

e Quarter past eight in the evening

7 Tarryn set her DVD player clock by her watch, then went outside to spray-paint her car. She looked at her watch when she started painting the car. It said the time was 11:30 a.m. When she finished, the clock on her DVD player said 1708. How long did it take to paint the car?

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8 Add 25 minutes onto these times.

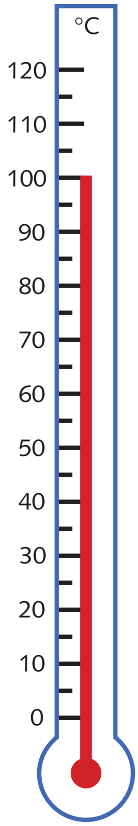
a 1925 **b** 10:55 p.m. **c** 0738 **d** 2123

9 What is the time 1 hour and 20 minutes before these times?

a 10:30 a.m. **b** 11:15 p.m. **c** 2:02 a.m. **d** 1433

10 Write the temperature shown on these thermometers.

a



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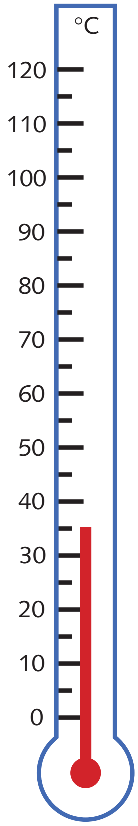

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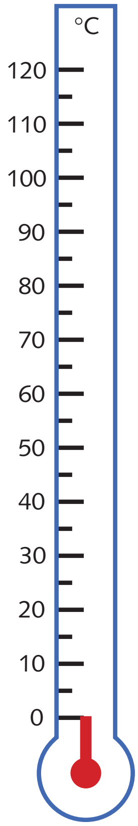

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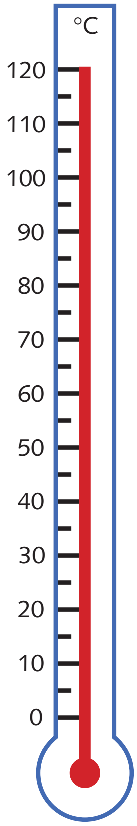

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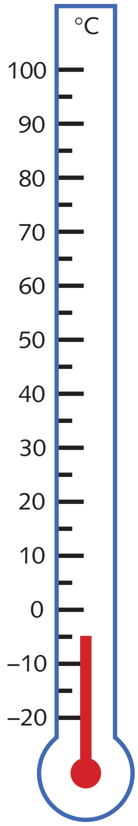

11 Copy and complete this table for maximum temperatures, minimum temperatures and the difference between them in 8 Australian towns on one day.

City	Minimum temperature	Maximum temperature	Difference between minimum and maximum temperatures
Wagga Wagga	11°C	13°C	
Kapunda	5°C		12°C
Meekatharra		25°C	17°C
Humpty Doo	17°C	31°C	
Murgon		19°C	19°C
Tooborac	3°C		12°C
Wynyard	1°C		11°C
Tharwa	0°C	4°C	

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CHAPTER 15 Preparation

Useful skills for this chapter:

- an understanding of decimals on the number line
- the ability to convert decimals to fractions and vice-versa
- the ability to compare decimal numbers of different lengths.

KICK OFF

Write the decimal equivalent for:

a $\frac{1}{2}$ **b** $\frac{1}{4}$ **c** $\frac{1}{10}$

d $\frac{3}{4}$ **e** $\frac{6}{10}$ **f** $\frac{9}{10}$

g $\frac{99}{100}$ **h** $\frac{47}{100}$ **i** $\frac{1}{100}$

Show what you know

1 Draw a number line from 0 to 3 and mark these decimals on it:
0.8 1.6 0.05 2.9 0.55

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CHAPTER

15

Number and Algebra

Decimal arithmetic

In this chapter, we extend our understanding of the operations of addition, subtraction, multiplication and division to include decimals.

We can use decimals to do operations involving small pieces of things.

For example, if we cut a loaf of bread into ten slices, each slice is 0.1 loaves, and the complete loaf is 1.0 loaves. A sandwich is made from two slices, which is 0.2 loaves.

How many sandwiches can we make if one slice of the loaf gets torn up?

How much bread is there if we have one full loaf, 0.5 of another loaf and 0.9 of a third?

How many slices would there be if we had 10.3 loaves, and how many double-decker sandwiches (which use 0.3 of a loaf) could we make from them?

These are questions we can answer using decimal arithmetic.

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15A Adding decimals

We can add 0.4 to 0.5 because:

$$\begin{aligned} 0.4 + 0.5 &= \frac{4}{10} + \frac{5}{10} \\ &= \frac{9}{10} \\ &= 0.9 \end{aligned}$$

We can set out this addition using the addition algorithm.

Place the numbers one under the other with the decimal points and the places lined up. Then go through the same steps as in the addition algorithm used for whole numbers.

$$\begin{array}{r} 0.4 \\ +\ 0.5 \\ \hline 0.9 \\ \hline \end{array}$$

We say 4 tenths plus 5 tenths is 9 tenths.

Write 9 in the tenths column.

We have no 'ones' so we write 0 in the ones column.

Don't forget to place the decimal point between the ones and the tenths!

Example 1

Add 0.4 and 0.9 by first converting to fractions, then using the addition algorithm.

Solution

$$\begin{aligned} 0.4 + 0.9 &= \frac{4}{10} + \frac{9}{10} \\ &= \frac{13}{10} \\ &= 1.3 \end{aligned}$$

$$\begin{array}{r} 0\ .4 \\ +\ 0_1.9 \\ \hline 1\ .3 \\ \hline \end{array}$$

When we add the 4 and the 9 in the tenths place, we get 13 tenths. This is the same as one whole plus 3 tenths. We write down the 3 in the tenths place and carry the whole to the units place.

We can use the addition algorithm to add three or more decimal numbers.

	T	O	•	t	h
		7	•	8	4
		8	•	9	6
+	1	4	•	3_1	9
			•		9

First, place the decimal point in the answer between the ones and the tenths place.

Now deal with the hundredths.

4 hundredths plus 6 hundredths makes 10 hundredths, plus 9 hundredths makes 19 hundredths.

Write down 9 in the hundredths column and carry 1 into the tenths.

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	T	O	•	t	h
		7	•	8	4
		8	•	9	6
+	1	4_2	•	3_1	9
			•	1	9

Now work with the tenths.

8 plus 9 makes 17 tenths, plus 3 makes 20 tenths.

Adding the carry from before makes 21 tenths.

21 tenths is the same as 2 ones and 1 tenth.
Write down 1 tenth and carry 2 into the ones column.

	T	O	•	t	h
		7	•	8	4
		8	•	9	6
+	1_2	4_2	•	3_1	9
	3	1	•	1	9

Now add the ones and finally the tens.

The sum of 7.84, 8.96 and 14.39 is 31.19.

Example 2

Matthias went to the movies and bought a ticket for $7.00, a large soft drink for $4.90, a choc-top for $4.05 and some popcorn for $3.75. How much did he spend?

Solution

$$\begin{array}{rr} & 7.00 \\ & 4.90 \\ & 4.05 \\ + & 3_1.7_15 \\ \hline & 19.70 \\ \hline \end{array}$$

First, line up the decimal points.

Matthias spent $19.70.

Remember

The addition algorithm can be used to add two or more decimal numbers.

When doing addition with decimals, always line up the decimal points and line up the places.

15A Whole class CONNECT, APPLY AND BUILD

1 You will need a six-sided die labelled:

0.1 0.2 0.3 0.4 0.5 0.6

a Roll the die twice. Mentally calculate the sum of the numbers rolled. Do this a number of times.

b Roll the die three times. Mentally calculate the sum of the numbers rolled.

c Vary the game by having different groups of children compete to get the highest cumulative score after 10 rolls.

2 Dominic threw a 10-sided die (numbered from 0.0 to 0.9) twice. The sum of the 2 numbers thrown was 1.3.

a What might Dominic's 2 throws have been?

b What else could his 2 throws have been? Give at least 2 other answers.

c Jenny said that Dominic could make a total of 2 with 1 more throw. What would Dominic need to throw in order to get a total of 2.0?

15A Individual

1 Calculate these mentally.

a 0.3 + 0.4
b 1.6 + 0.3
c 2.1 + 3.4
d 0.6 + 0.7
e 0.06 + 0.02
f 0.07 + 0.04
g 1.03 + 0.06
h 4.08 + 0.9

2 Use the addition algorithm to calculate these.

a 1.5 + 1.4
b 2.8 + 4.1
c 1.5 + 3.6
d 3.4 + 3.4
e 2.56 + 6.33
f 0.08 + 1.31
g 11.43 + 3.3
h 85.8 + 67.3
i 1.6 + 3.7
j 5.3 + 3.8
k 8.9 + 4.8
l 0.8 + 12.7
m 20.83 + 6.26
n 34.87 + 26.82
o 4.89 + 5.07
p 2.87 + 12.46
q 20.573 + 854.903
r 39.586 + 3.684

3 James places 3 blocks of wood end-to-end. The blocks are 0.45 m, 0.2 m and 0.38 m long. What is the total length?

4 A truck driver is loading 3 cars onto his truck. The cars weigh 1.673 tonnes, 1.459 tonnes and 2.875 tonnes. He is not allowed to carry more than 5.8 tonnes. Can he carry all 3 cars?

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15B Subtracting decimals

We use the subtraction algorithms to subtract decimals. Be sure to line up the decimal places and put the decimal points one under the other.

Example 3

Calculate:

a 1.6 – 0.4 **b** 3.83 – 2.75

Solution

a

$$\begin{array}{r} 1.6 \\ -\underline{0.4} \\ \underline{1.2} \end{array}$$

b **Decomposition** or **Equal addition**

$$\begin{array}{r} 3.{}^{7}\cancel{8}\,{}^{1}3 \\ -\,\underline{2.\;7\;5} \\ \underline{1.\;0\;8} \end{array} \qquad \begin{array}{r} 3.8\;{}^{1}3 \\ -\,\underline{2.7_{1}\;5} \\ \underline{1.0\;\;8} \end{array}$$

When the decimal numbers are different lengths, we align the decimal points and the places and put a 0 on the end of the shorter number to let us do the subtraction.

Example 4

Calculate 1.6 – 0.94.

Solution

Insert a zero at the end of 1.6 to match the 4 in the hundredths place of 3.94.

Trading **Borrow and pay back**

$$\begin{array}{r} {}^{0}\cancel{1}.\;{}^{15}\cancel{6}\,{}^{1}0 \\ -\;\underline{0.\;\;9\;4} \\ \underline{0.\;\;6\;6} \end{array} \qquad \begin{array}{r} 1\;.{}^{1}6\;{}^{1}0 \\ -\,\underline{0_{1}.\;9_{1}\;4} \\ \underline{0\;.\;6\;\;6} \end{array}$$

Remember

The subtraction algorithms can be used to subtract one decimal number from another.

15B Individual

1 Calculate mentally.

a 1.5 – 1.2 **b** 0.9 – 0.6 **c** 0.8 – 0.7 **d** 4.08 – 4.02
e 10.8 – 1.6 **f** 10.3 – 10 **g** 2.3 – 1.8 **h** 5.05 – 3.03

2 Use one of the subtraction algorithms to calculate these.

a 1.8 – 0.2 **b** 9.6 – 5.1 **c** 7.3 – 3.2
d 5.394 – 4.202 **e** 5.792 – 4.683 **f** 0.9738 – 0.8509
g 1.6839 – 0.9999 **h** 34.7929 – 17.6 **i** 560.8 – 277.0379
j 70.07 – 31.305 **k** 18.89 – 16.748 **l** 1.6 – 0.000 95

3 Write the number that is one-tenth less than these.

a 1.8 **b** 4.7 **c** 13.59 **d** 28.46 **e** 60.382

4 Write the number that is one-hundredth less than these.

a 16.451 **b** 82.116 **c** 0.3892 **d** 60.382 **e** 4.7

5 Subtract 1.2 from each number.

a 8.4 **b** 4.1 **c** 8.583 **d** 100

6 Subtract each number from 10.

a 3.6 **b** 1.8 **c** 9.3845 **d** 0.003 8572

7 Simon has a length of timber that is 1356 mm long.

a Convert this to metres.
b Convert this to centimetres.
c How much is left when Simon cuts an 83 centimetre piece off?

8 Helena wants to make 8 bags of popcorn each weighing 0.375 grams for her friends.

a Calculate the total mass of the popcorn Helena will use for her friends.
b Popcorn comes in a 2 kg bag for $3.75 or a 5 kg bag for $6.25.
What should Helena purchase?
c After making the 8 bags, how much popcorn is left over?

9 The kitchen bench is 62.4 centimetres deep. How far does it stick out from the cupboards, if they are 57.9 cm deep?

10 How much will have to be cut from a piece of glass that is 68.15 centimetres long, so that it will fit into a space that is 64.28 cm wide?

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11 Martin started to mark out his garden bed. He made the first section 8.15 metres, the second section 6.38 metres, the third section 2.55 metres and the last section 3.72 metres. If he has 22 metres to use, how much has he left over?

12 A relay team completed each leg of their event in the following times: 26.48 seconds, 42.38 seconds, 38.75 seconds and 35.93 seconds. Calculate the time taken in minutes and seconds.

15C Addition with money

1 **a** \$8.85 + 2.95 + 4.60 **b** \$3.15 + 5.55 + 7.45
c \$6.30 + 5.75 + 2.90 **d** \$4.65 + 3.25 + 2.85
e \$12.35 + 15.60 + 7.85 **f** \$19.75 + 13.55 + 12.85
g \$33.80 + 42.65 + 21.55 **h** \$35.25 + 28.85 + 37.50

2 **a** \$327.25 + 292.60 + 135.70 **b** \$227.90 + 431.25 + 279.35
c \$418.35 + 196.65 + 252.35 **d** \$576 + 260.45 + 309.85

3 Use the addition algorithm to calculate the following.

a Six hundred and seventy-nine dollars + four hundred and forty-five dollars + seven hundred and five dollars

b Five hundred and sixty-three dollars + two hundred and seventy-nine dollars + nine hundred and forty-seven dollars

c Four thousand two hundred and nineteen dollars + two thousand three hundred and ten dollars + one thousand and eleven dollars

d Five thousand dollars + seven thousand two hundred and two dollars + six thousand eight hundred and fifteen dollars + eighty-five dollars

4 Dad went to the hardware store and bought a fan for \$13.97, 15 metres of hose for \$39.93, a hose reel for \$14.95 and a 4-way tap for \$12.78.

How much did he spend, rounded off to the nearest 5 cents?

5 Jane bought a pair of sneakers for \$138.95 while Kali paid \$18.55 more for her pair.

a How much did Kali pay for her sneakers?

b What was the total cost of the two pairs of sneakers?

6 Peter paid \$119.95 for a 16 GB personal music player and \$398.85 for a 12.0 MP digital camera. How much did he spend altogether?

15D Subtraction with money

1 **a** \$9.15 – \$4.60 **b** \$6.40 – \$3.55 **c** \$12.10 – \$9.85
d \$17.50 – \$12.95 **e** \$134 – \$118.50 **f** \$221 – \$168.75

2 **a** \$3856 – \$1367 **b** \$5360 – \$2995
c \$7005 – \$4888 **d** \$27 366 – \$14 895
e \$55 775 – \$33 990 **f** \$88 050 – \$25 366

3 Use the subtraction algorithm for the following.

a Eight hundred and two dollars minus five hundred and forty-seven dollars
b Six hundred and twenty-six dollars minus four hundred and forty-eight dollars
c Four thousand seven hundred dollars minus three thousand six hundred and forty-eight dollars
d Seven thousand and seventy-seven dollars minus three thousand and eighty-eight dollars
e Ten thousand dollars minus four thousand six hundred and forty-five dollars

4 Angel had \$22.75 and her brother had \$31.20. How much less money did Angel have than her brother?

5 Copy and complete the table. The first one has been done for you.

		Usual price	Sale price	Reduction
a	Jacket	\$69.25	\$55.99	\$13.26
b	Pullover	\$19.95	\$	\$5.99
c	Printed top	\$21.99	\$17.59	\$
d	Jeans	\$34.49	\$	\$6.50
e	Cord pants	\$87.45	\$22.99	\$
f	Polo neck	\$17.39	\$	\$2.40
g	Waffle top	\$18.19	\$14.59	\$
h	Men's jeans	\$139.45	\$	\$7.46

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15E Plan an overseas dream holiday

Plan an 8-week overseas holiday for a family of four. Use the internet and brochures from travel agents to find out about the cost of travel and accommodation.

You have a budget of $50 000.

1 Provide a detailed daily budget and itinerary. Explain how you arrived at each amount. Include in your budget:
  - airfares
  - accommodation fees
  - transport within the country you visit. Will you travel by bus, car or train? Include the cost of fuel if you intend to travel by car.
  - the cost of meals and snacks each day
  - entry fees for attractions, museums and entertainment.

2 What is the total cost for the holiday?

3 How much is this per person per day?

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15F Review questions

1 Use the addition algorithm to calculate these.

a 1.2 + 1.1 **b** 1.4 + 3.2 **c** 1.8 + 3.1

d 2.4 + 2.3 **e** 4.03 + 7.88 **f** 18.68 + 7.73

g 63.281 + 28.031 **h** 31.564 + 7.65

2 Binh walked 1.8 km to the shops and then a further 1.9 km to school. How far did she walk?

3 Three cars are parked in the driveway end-to-end with no gaps. The cars are 3.6 m, 3.92 m and 4.03 m. What is the total length of the cars?

4 Use one of the subtraction algorithms to calculate these.

a 2.5 – 1.3 **b** 8.4 – 6.2 **c** 7.84 – 1.97

d 5.08 – 3.11 **e** 18.402 – 0.999 **f** 0.0492 – 0.0054

5 Write the number that is one-tenth less than these.

a 0.7 **b** 1.0 **c** 45.113 **d** 103.06 **e** 99

6 Write the number that is one-hundredth less than these.

a 0.3841 **b** 195.72 **c** 1.03 **d** 4 **e** 100

7 Subtract 1.83 from each number.

a 9.99 **b** 5.32 **c** 18.3 **d** 100 **e** 5

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8 Calculate the following.

a \$1.24 + \$3.34 + \$5.41

b \$8.64 − \$6.42

c \$2.35 + \$4.44 + \$3.21

d \$9.75 − \$7.53

e \$500 + \$505.25 + \$509.90

f \$2234.55 – \$999.99

9 Calculate the following additions and subtractions.

a Twenty-four dollars and forty-two cents + twenty-five dollars and fifty-eight cents.

b Six hundred and seventy-eight dollars and ninety-nine cents minus one hundred and twenty-three dollars and forty-four cents.

c Four hundred and seventy-seven dollars and sixty-six cents + five hundred and twenty-two dollars and thirty-four cents + ten dollars and ten cents.

d Twelve thousand and twelve dollars minus three thousand, one hundred and twenty-four dollars.

10 **a** Mike, Sarah and Matt were fruit shopping at the market. Mike bought a mango for \$4.10, Sarah bought a punnet of raspberries for \$8.89, and Matt bought a watermelon for \$11.25. How much did they spend in total?

b Phoenix and Raven save most of their pocket money each week. At the end of the month, Phoenix has \$86.42 and Raven has \$74.08. How much less money does Raven have?

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CHAPTER 16 Preparation

Useful skills for this chapter:

- previous experience in presenting information in a table
- previous experience in collecting and organising data and presenting it on a bar chart.

KICK OFF

Draw this diagram and write the letters A to G inside it according to these instructions.

Place A so it is in the circle only.

Place B so it is in the triangle only.

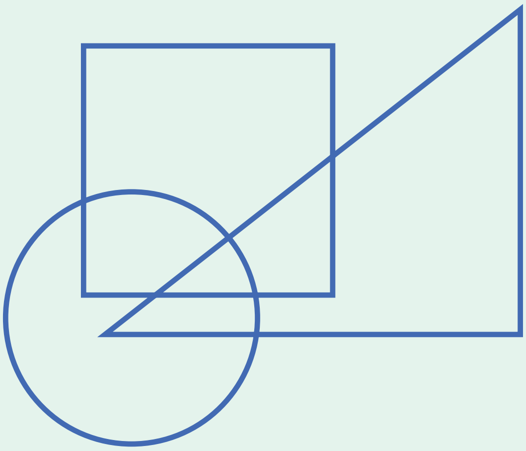
Place C so it is in the square only.

Place D so it is in the circle and the triangle, but not in the square.

Place E so it is in the square and the triangle, but not in the circle.

Place F so it is in the circle and the square, but not in the triangle.

Place G so it is in all three shapes.



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CHAPTER

16

Statistics and Probability

Statistics and probability

When we gather information, we are collecting data. Sometimes we can collect data about people's opinions. Sometimes the data we collect might be about physical features such as eye colour or height. We can organise the data that we collect into tables or diagrams and we can graph it in different ways.

Collecting and studying data in this way is called **statistics**. People who gather and analyse statistics are called statisticians. The word 'statistics' has the same origin as the word 'state' because the oldest use of statistics was to help governments make decisions.

The statistical process

When we plan a statistical data investigation we need to decide the problem we are going to investigate and we pose some questions that we might like answers for.

For example, if the student council wanted to make some suggestions about changing the school uniform we might ask 'What uniform pieces are most popular among Year 5 students?' or 'Which colours are preferred from the choices available for school T-shirts?' and 'Who makes the decisions about buying uniforms?'.

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Then we think about what data we need to collect so that we can answer those questions. There are lots of ways to collect, organise and present the information, so there are many choices to be made.

Finally we look at the data now that it has been organised and presented in tables, charts and graphs and interpret that information in order to make some conclusions and recommendations. In our school uniform example we might make some suggestions to the school staff about the types of T-shirts that Year 5 students like from the information we have collected.

The statistical data investigation process will be explained in more detail in a later section of this chapter where you will use it to carry out your own data investigations.

Types of data

There are different types of data. For each type there are different ways to present the data and different things to consider when collecting and recording the data.

There is data that we can count. We get **count data** when we investigate situations such as:

- the number of trees in different backyards
- the number of goals scored in a netball match, or
- the number of jelly beans in a packet.

There is data that we can measure. Here are some situations where you might collect **measurement data**:

- the height of students in your class
- the age of students when they first rode a bike without training wheels
- the amount of water left in everyone's drink bottles after lunch.

Then there is data that belongs in categories. Sometimes there is a choice to be made about which category the data belongs to. **Categorical data** includes:

- types of houses
- colours of cars
- hairstyles.

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16A Posing questions, collecting and presenting data

One way of collecting data is to ask questions. This is called conducting a **survey** or taking a **poll**. We need to ask clear questions to get accurate data. When we are conducting a survey, we also need to think about the people who will be asked the questions. Will the people interviewed be able to give us the information we need?

For example, if we wanted to find out about the favourite holiday destination for retired people, we would not ask school children because they are not retired. We would ask retired people.

Tally marks

When we collect data, we can use tally marks. Each stroke stands for one item, and the fifth stroke is made across a group of four.

A tally of five is written like this: 𝍸

Ten is written as two bundles of five: 𝍸 𝍸

Then we count by fives to work out how many there are in the tally.

Example 1

This data table with tally marks shows the preferences of students and teachers who use the school canteen.

	Favourite drinks		
	Water	Milk	Fruit juice
Students	𝍸 𝍷𝍷𝍷𝍷	𝍸 𝍷𝍷𝍷	𝍸 𝍸 𝍷𝍷𝍷
Teachers	𝍸	𝍷𝍷𝍷	𝍸 𝍷𝍷𝍷

a What is the most popular canteen drink?
b What is the least popular canteen drink?

Solution

When we look at the data table, we can see the most popular drink is fruit juice (21 tally marks) and the least popular drink is milk (11 tally marks).

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Two-way tables

Tables and diagrams can help us understand data.

We can use them to group data in different ways. We can record opinions from different groups using a two-way table. We summarise the tally marks by writing the number that our tally marks represent.

Here is the data from the example on the previous page shown in a two-way table.

	Favourite drinks		
	Water	**Milk**	**Fruit juice**
Students	9	8	13
Teachers	5	3	8

Suppose we collect data about students who like swimming and students who like athletics. Some students like just one, some students like both and some students do not like either. We can use a two-way table to show this data.

	Likes swimming	**Does not like swimming**
Likes athletics	Jason + Ali	Rebecca + Jules
Does not like athletics	Simone + Luke	Flavia

Example 2

Mum asked the family which vegetables they like: carrots or peas. Dad likes carrots and peas, Melia likes just carrots, Joshua likes just peas and Emma doesn't like carrots or peas. Mum likes just carrots. Present this data in a two-way table.

Solution

A two-way table can show this data.

	Likes peas	**Doesn't like peas**
Likes carrots	Dad	Melia + Mum
Doesn't like carrots	Joshua	Emma

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16A Whole class CONNECT, APPLY AND BUILD

1 Make this two-way table on the floor with masking tape and labels.

	Likes football	Dislikes football
Likes netball		
Dislikes netball		

Students write their names on a piece of cardboard and place the names in the box that best reflects their preferences. How many students like both football and netball? How many students don't like either netball or football?

2 **a** Draw a two-way table to show the results of this survey.

Favourite ball games		
	Boys	Girls
Netball	卌 |	卌 卌 ||||
Volleyball	卌 卌 ||	卌 卌
Basketball	卌 卌 |||	卌 卌 |
Soccer	卌 卌 ||||	卌

b What is the most popular ball game overall?

c What is the least popular ball game overall?

d How many students were surveyed?

e What is the most popular ball game among girls?

f What is the most popular ball game among boys?

3 The sport teacher wanted to buy some new equipment for students to use at playtime. He could buy only 2 types of equipment. Each child in the class was surveyed; they could only vote once each.

Four boys voted for tennis balls.
Seven girls voted for skipping ropes.
Two girls voted for footballs.
Six boys voted for basketballs.
One boy voted for skipping ropes.
Three girls voted for tennis balls.
Five boys voted for footballs.
Four girls voted for basketballs.

a Draw a two-way table to record this data.

b How many students were surveyed?

4 Ask students to vote for their favourite season in the year. Group votes in fives using tally marks (卌). Represent the data in a two-way table.

5 Work with a partner to find data for the following.

You are organising a class pizza lunch and you need to find out what sort of pizzas to order.

Write a list of the categories of people you would interview.

Write the question you would ask.

Survey to gather the data. Record your data using tally marks.

Present your data in a data table.

16A Individual

1 Use the table to complete the questions that follow:

	Likes grapes	Doesn't like grapes
Likes mangoes	4	3
Doesn't like mangoes	6	5

a How many people like mangoes but don't like grapes?

b How many people like grapes but don't like mangoes?

c How many people like mangoes and grapes?

d How many people don't like either mangoes or grapes?

e How many people were surveyed?

2 Draw a two-way table to display this data.

- Mia wanted ice-cream and peaches for dessert.
- Charlie only wanted ice-cream.
- Marissa didn't want any dessert at all.
- Keilah only wanted peaches.

Homework

Select four television programs that at least one member of your family enjoys. Ask your family to vote 'like' or 'dislike' for each program from the list. Present your data in a two-way table.

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16B Graphs

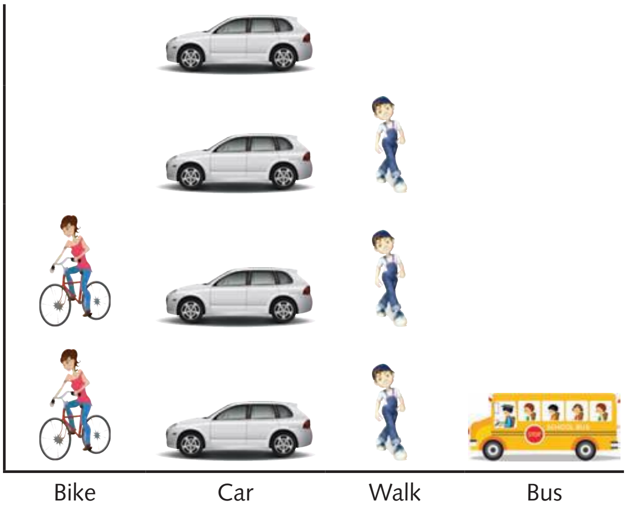
A graph helps us organise the information we have collected and makes it easier to make conclusions about our data.

Pictographs

A pictograph uses symbols to show the number of items in the same category.

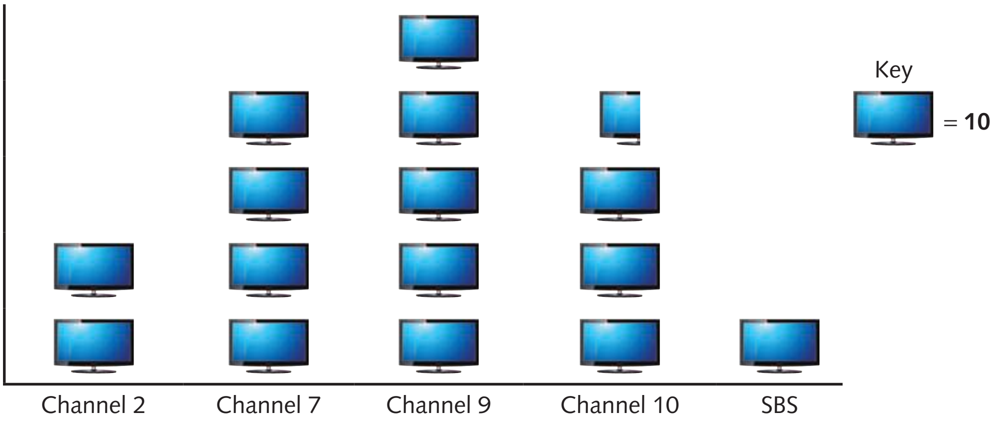
If we ask people how they travel to school, we can use a picture of a bike, a car, a bus or a person walking to show this information on a pictograph. There is one picture for each person's choice.

Getting to school



If we are surveying a large number of people we can use one picture to represent a number of people. In the example below, the pictograph shows data collected about favourite television stations. One television represents 10 people. Half a television represents five people. The **key** tells us how many people are represented by each picture.

Favourite television station



Example 3

School children were surveyed to find out their favourite subject at school.

55 students voted for Maths.

65 students voted for English.

15 students voted for Science.

40 students voted for Art.

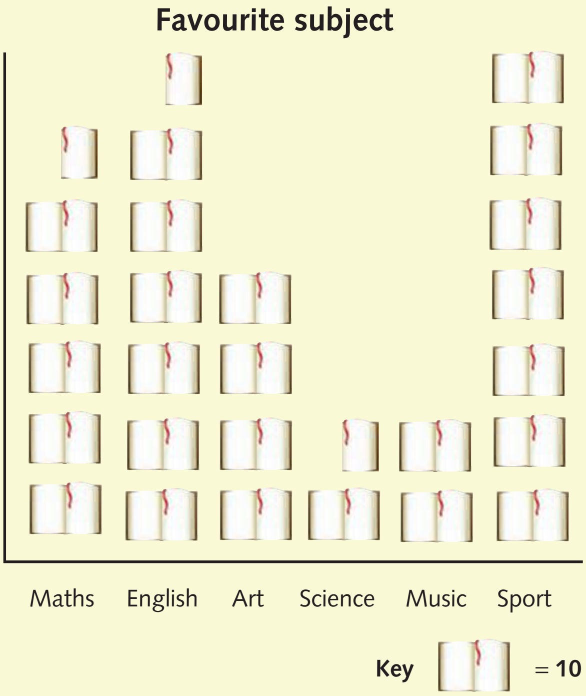
20 students voted for Music.

70 students voted for Sport.

Represent this data in a pictograph.

Solution

We can draw a pictograph with each picture representing 10 people.

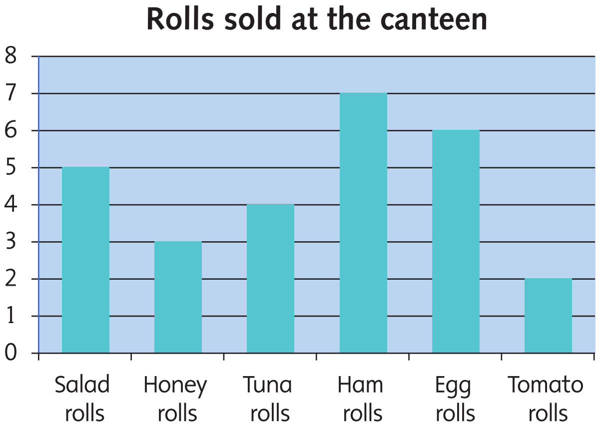


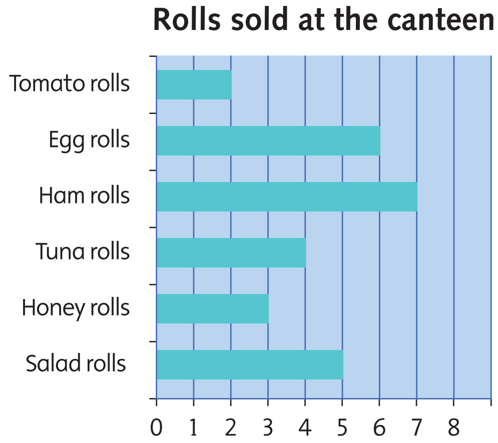
Column graphs

A column graph uses columns of different lengths to represent different quantities. The columns can be either vertical or horizontal. Column graphs are also known as bar graphs or bar charts.

Numbers along one axis show the number represented by each column on the graph. The numbers, measurements or categories being represented are written along the other axis.

Here are two column graphs for the same data collected about types of bread rolls sold at a school canteen.





The scale on a column graph must go up in the same-sized steps.

We can read the graphs to find out information. In the example above:

- the most popular filling is ham
- there were seven ham rolls sold and only two tomato rolls.

Example 4

A survey was taken to find how many different kinds of vehicles passed the local school between 8:00 a.m. and 9:00 a.m. Here are the results of the survey.

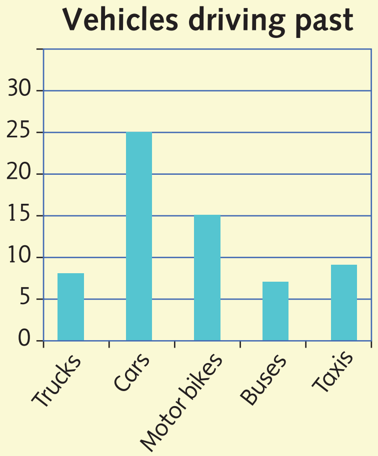
Vehicles driving past				
Trucks	Cars	Motorbikes	Buses	Taxis
8	25	15	7	9

a Present this data in a bar chart.

b How many more cars passed the school than motorbikes?

Solution

a



b There were 10 more cars than motorbikes passing by the school.

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16B Whole class CONNECT, APPLY AND BUILD

1 **a** Survey students to find their eye colour. Copy and complete the data table.

Eye colour				
Blue	**Brown**	**Green**	**Hazel**	**Other**

b Create a large sized pictograph that represents the occurrence of different eye colours in your class.

c Draw a large column graph to represent your data about eye colour.

2 Here is some information Clara collected about the coins in her piggy bank.

Coins in Clara's piggy bank					
\$2	\$1	50*c*	20*c*	10*c*	5*c*
3	2	6	7	5	10

a Draw a column graph to represent this data.

b Which denomination had the fewest number of coins?

c How much money did Clara have altogether?

16B Individual

1 **a** Draw a pictograph with a key and pictures to represent this data.

Money raised for charity					
Year 5J	**Year 5L**	**Year 6P**	**Year 6B**	**Year 7M**	**Year 7D**
\$35	\$40	\$25	\$45	\$60	\$55

Write the answers to these questions about your pictograph.

b Which class raised the most money?

c How much money was raised by Year 6 altogether?

d Which year level raised the most money?

e How much money was raised altogether?

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2 **a** Draw a column graph to represent this data.

Electrical goods sales					
Toaster	**Iron**	**Blender**	**Kettle**	**Microwave**	**Hair dryer**
15	18	15	13	8	7

Answer these questions about the graph.

b Which item was sold the most?

c Which item was sold the least?

d Which 2 items sold the same number?

e How many kettles and toasters were sold altogether?

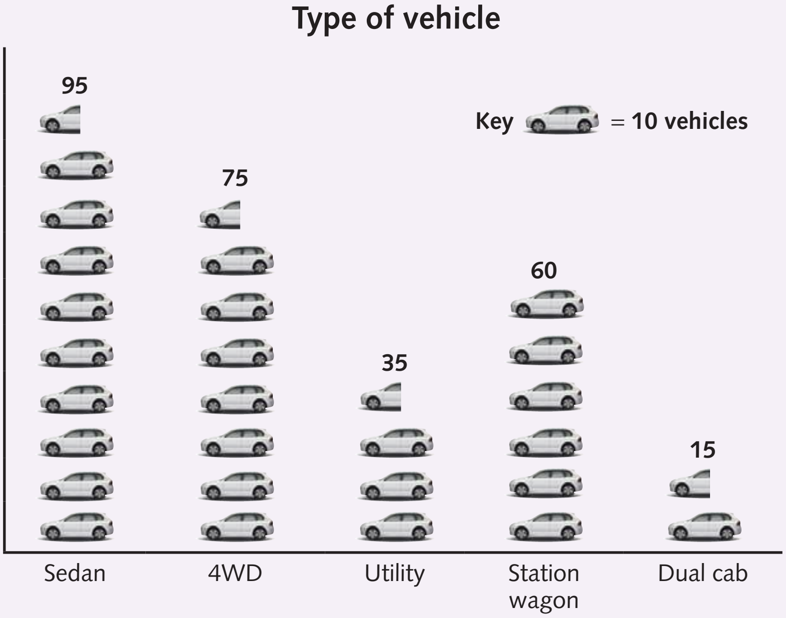
f How many items were sold altogether?

3 **a** Draw a column graph to show this data.

Favourite restaurants					
Chinese	**Italian**	**Vietnamese**	**Indian**	**Greek**	**Thai**
19	27	18	21	7	24

b Write 4 questions you could ask about the graph.

4 These vehicles checked into the shopping centre car park.



a How many more sedans than station wagons?

b How many more utilities than dual cabs?

c Which 2 vehicle types when added together equal the number of sedans?

d How many vehicles are there all together?

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16C Dot plots

A dot plot is used for count data, where one dot drawn above a baseline represents each time a particular value occurs in the data. If a value occurs three times, there are three dots in a line above that value.

Ms Apap's Year 5 students collected data about the number of hours they spent on the computer one week. Parts of hours were rounded up to whole hours. At first the teacher wrote the numbers on the board as a list:

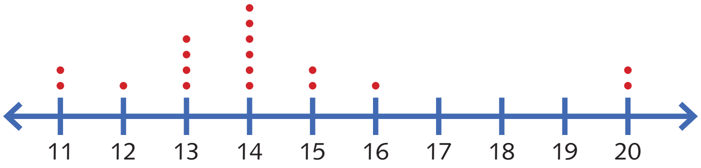
14, 20, 13, 13, 14, 11, 12, 20, 13, 15, 11, 13, 14, 14, 15, 16, 14, 14

The list did not tell them very much, so they tallied the number of times each value occurred and organised the data into a frequency table.

Number of hours of computer use by children in 5A

Value (number of hours)	Tally	Frequency
11	||	2
12	|	1
13	||||	4
14	𝍸 |	6
15	||	2
16	|	1
17		0
18		0
19		0
20	||	2

Then they organised the data into a dot plot, placing one dot above the line to record each time the number below the line occurred in the data. The dots must be carefully lined up so that they are spaced evenly and can be read easily.



From the dot plot we can see that the most frequently occurring value was 14. This means that the most frequently occurring number of hours of computer use was 14.

Dot plots are useful when we want to see what the data has to say very quickly.

16C Whole class CONNECT, APPLY AND BUILD

○ **1** Record the number of pieces of fruit eaten by students in your class over the last 7 days.

Create a dot plot on a very large piece of paper for this data by drawing a baseline and using evenly placed round stickers for the dots. Discuss what you can see from the dot plot.

○ **2** Measure the length of pencils in everyone's pencil case to the nearest centimetre. Create a dot plot on a piece of paper or using an interactive whiteboard for this data. Use one dot for each time a particular length of pencil occurs in the data. Discuss what you can see from the dot plot.

○ **3** **a** Roll a 6-sided die 25 times. Create a dot plot for this data.

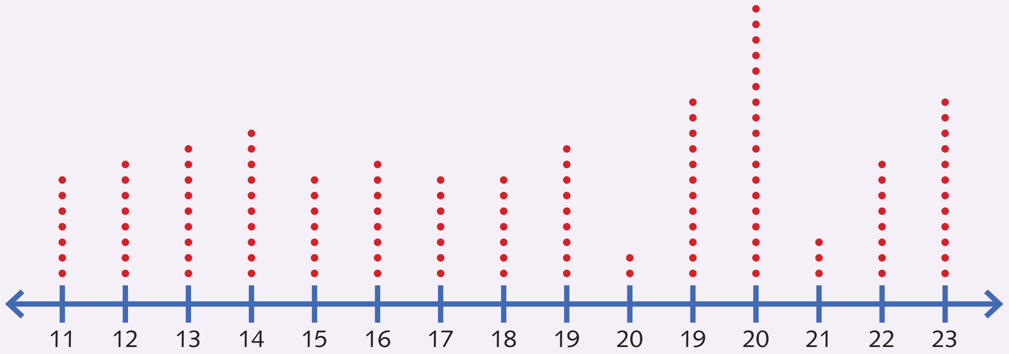
b Which number was rolled most often?

○ **4** **a** Roll two 6-sided dice 25 times, calculate the sum of the 2 dice for each roll and create a dot plot for this data.

b Which sum was rolled most often?

16C Individual

○ **1** Amelia sold televisions and recorded the number sold each day. Here is a dot plot for her data.



a What was the highest number of televisions sold in 1 day?

b What was the most frequently occurring number for televisions sold in 1 day?

c On how many days did Amelia collect data?

2 Matthew and Christopher recorded the time it takes to ride to school each day in whole minutes.

9, 8, 9, 9, 10, 12, 9, 8, 9, 9, 7, 8, 9, 12, 9,
10, 11, 12, 9, 8, 10, 9, 7, 8, 7, 9, 9, 9, 9, 10

a Create a dot plot for this data.

b What is the most frequently occurring time taken to ride to school?

c On the days that they get green lights all the way, the trip to school takes Matthew and Christopher less than 10 minutes. On how many days did all green lights occur?

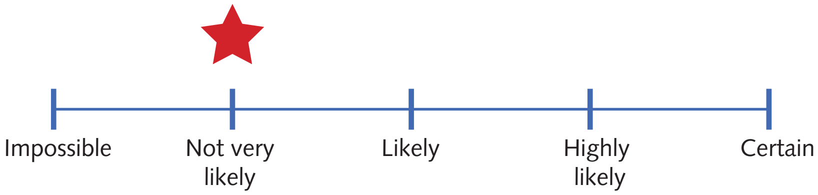
16D Probability

If we want to measure the length of something, we might use metres or kilometres. What if we want to measure the chance of a particular event occurring?

Until now you have probably spoken of the chance of something happening using words such as ‘likely’ or ‘unlikely’, with some events being ‘certain’ or ‘impossible’.

In mathematics we use the word **probability** to describe the chance of an event taking place.

The chance of the Prime Minister walking into your classroom in the next 5 minutes is not very likely, but it is not impossible. Here is a word scale to show probability.



Writing probabilities

We can measure probability on a scale from 0 to 1, where 0 means that there is no chance of an event occurring, and 1 means that the chance that the event will occur is certain. We can describe the chance of an event happening, such as the result of a spin on a spinner, and write it as a fraction.

On this spinner the possible events are the four different colours: red or green or blue or orange.

It is certain that we will spin one of the four colours, so the chance of spinning any colour on the spinner is one. On a spinner split into four segments of equal size, the chance of spinning just one of the colours, such as red, is equally likely. We say that the chance of

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spinning red is one out of four. This is because there is only one way to spin red, but four different colours on the spinner and each event is equally likely.

The probability of spinning red on this spinner is one in four, or $\frac{1}{4}$. The numerator is the number of ways the event may happen, and the denominator is the number of equally likely possibilities.

16D Individual

1 For a standard 6-sided die numbered from 1 to 6:

a List the events that are possible.

b If you rolled the die once, what is the probability of rolling a 1? Write your answer as a fraction.

c If you rolled the die once, what is the probability of rolling a 4? Write your answer as a fraction.

d If you rolled the die once, what is the probability of rolling a 7? Write your answer as a fraction.

e If you rolled the die once, what is the probability of rolling an even number? Write your answer as a fraction.

f If you rolled the die once, what is the probability of rolling a number less than 6? Write your answer as a fraction.

g If you rolled the die once, what is the probability of rolling 1, 2, 3, 4, 5 or 6? Write your answer as a fraction.

2 Angelique has a bag of 10 coloured discs. In the bag, there are 5 blue discs, 3 pink discs and 2 yellow discs. If Angelique picks 1 disc, what is the probability that it would be:

a yellow? **b** pink? **c** blue?

3 **a** What is the probability of tossing a head if you toss 1 coin? Write the answer as a fraction.

b What is the probability of tossing 2 heads when tossing 2 coins?

Complete this table to help you work out the different coin combinations that are possible.

		Coin one	
		Head	**Tail**
Coin two	**Head**		
	Tail	Tail, Head	Tail, Tail

16E Review questions

1 In the Tan family, different people like different fruits for dessert. Mum likes kiwi fruit and strawberries. Anh likes neither. Dad likes strawberries but not kiwi fruit, and Jed likes kiwi fruit but not strawberries.

Draw a two-way table to represent this data.

2 School children were surveyed to find out their favourite football code:

- 12 students voted for rugby.
- 9 students voted for AFL.
- 13 students voted for soccer.
- 2 students voted for gridiron.

Represent this data in a pictograph.

3 Slippery Banks School children were asked about their preference for the colour of the new school T-shirt.

School T-shirt colours

Red	Blue	Yellow	Orange	Pink	Green
60	20	55	20	5	85

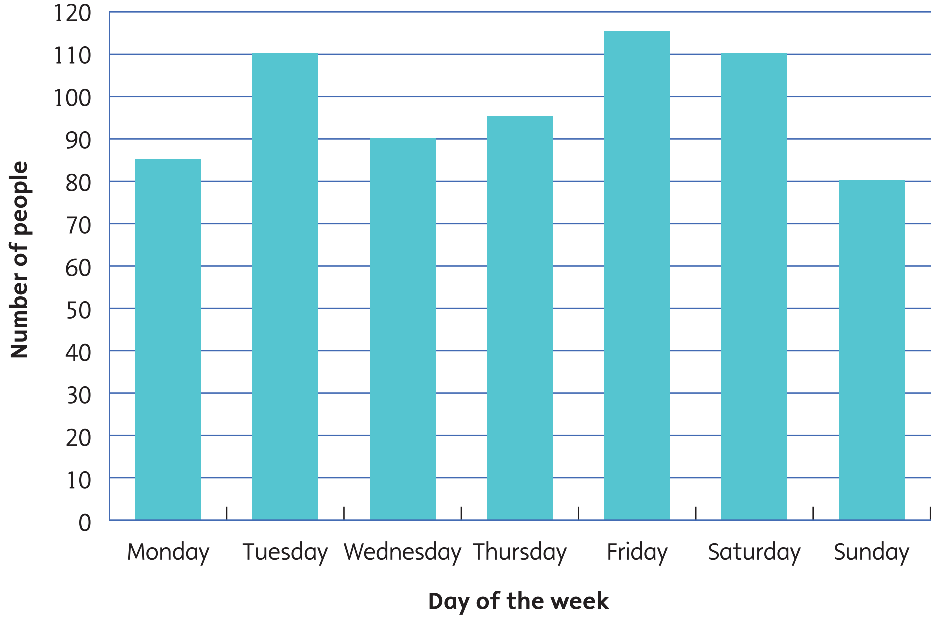
a Draw a vertical bar chart to show this data.

b How many children voted?

c Which colour is the most popular?

4 Online school council elections were held in the first week in April. The number of people who voted each day is shown on this column graph.

Council elections



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Look at the column graph at the bottom of the previous page.

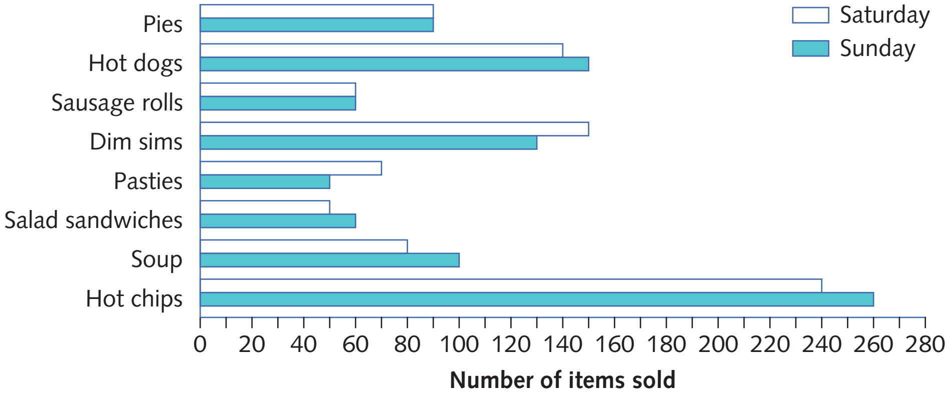
a How many people voted from Monday to Friday?

b How many people voted on Saturday and Sunday?

c On which 2 days did the least number of people vote? Saturday and Sunday or Wednesday and Thursday?

d If 800 people were eligible to vote, how many of these did not vote?

5 The football canteen has the following food on its menu. The manager recorded the sales for Saturday and Sunday.



a Calculate the total for each food item over the 2 days.

b Which food item sold the most?

c Which food item sold the least?

d Which 2 items together sold the same amount?

e Hot dogs come in packets of 20. How many packets would have been needed? How many hot dogs were left over?

6 James counted the number of pencils in each class member's pencil case.

12, 10, 11, 12, 12, 9, 8, 12, 11, 10, 11, 12, 10, 9, 8, 9, 10, 12, 11, 12, 11, 10

a Draw a dot plot for this data.

b What is the most frequently occurring number of pencils?

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Answers

Chapter 1: Whole numbers

Show what you know

4 a

56	57	58	59
66	**67**	68	69
76	**77**	78	79
86	87	**88**	89

b

271	272	273	274
281	282	**283**	284
291	292	293	294
301	302	303	304

1A WHOLE CLASS

4 **a** 87 **b** 949 **c** 3805 **d** 432
e 127 **f** 9275 **g** 75 634 **h** 2853

1A INDIVIDUAL

1 **a** 427 **b** 3452 **c** 5013 **d** 4002

2 **a** twenty-one
b forty-five
c one hundred and twenty-seven
d eight hundred and two
e two thousand three hundred and nine
f nine thousand nine hundred and one

3 **a** 325 **b** 2191 **c** 5111 **d** 1647

4

Number	Place-value parts				
	Tens of thousands	Thousands	Hundreds	Tens	Ones
12 345	1	2	3	4	5
34				3	4
128			1	2	8
8324		8	3	2	4
13 042	1	3	0	4	2

5 **a** 345 **b** 26 077

6 **a** 4 **b** 400 **c** 2000
d 20 **e** 10 000 **f** 20 000
g 900 **h** 400 000

7 **a** 6347 **b** 1473 **c** 6521 **d** 1278

8 **a** 97 216 **b** 35 184 **c** 86 259

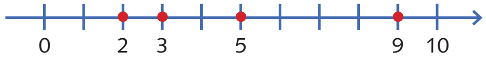
1B WHOLE CLASS

3 **a** 9999 **b** 1000

1B INDIVIDUAL

1

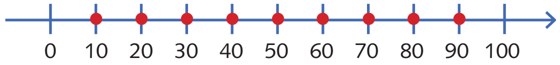
2



3

4

5



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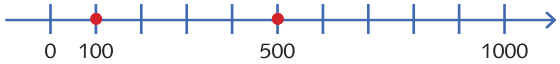

9

10 **a** 500 **b** 782 **c** 1081
d 1125 **e** 12 192

11 **a** 300 **b** 582 **c** 881
d 925 **e** 11 992

12 **a** 4000 **b** 1439 **c** 3733
d 4033 **e** 20 999

13 **a** 6000 **b** 1222 **c** 10 000
d 43 **e** 20 837

14 **a** 317 **b** 925 **c** 590
d 1954 **e** 13 299

15 **a** 8276 **b** 15 818 **c** 20 690
d 3200 **e** 71 000

1C INDIVIDUAL

1 **a** 11, 12, 13, 14, 15, 16, 17, 18, 19, 20
b 98, 99, 100, 101, 102, 103, 104, 105, 106, 107
c 56, 55, 54, 53, 52, 51, 50, 49, 48, 47
d 1007, 1006, 1005, 1004, 1003, 1002, 1001, 1000, 999, 998

2 **a** 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 49, 53, 57, 61, 65, 69, 73, 77, 81, 85 . . .
b 70, 77, 84, 91, 98, 105, 112, 119, 126, 133, 140, 147, 154, 161, 168, 175 . . .
c 11, 22, 33, 44, 55, 66, 77, 88, 99, 110, 121, 132, 143, 154, 165, 176, 187 . . .

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d 500, 495, 490, 485, 480, 475, 470, 465, 460, 455, 450, 445, 440, 435, 430 . . .

e 1000, 991, 982, 973, 964, 955, 946, 937, 928, 919, 910, 901, 892, 883 . . .

3 a 323 326 329 332

b 658 649 640 631

c 2501 2508 2515 2522

d 3675 3664 3653 3642

1D REVIEW QUESTIONS

1 a 247 **b** 43 082

2 a nineteen

b forty-six

c three hundred and eighty-one

d seven thousand two hundred and fifty-four

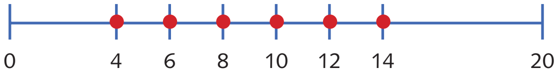
3 a 80 **b** 200 **c** 4000

4

	Number	Place-value parts				
		Tens of thousands	Thousands	Hundreds	Tens	Ones
a	2306		2	3	0	6
b	479			4	7	9
c	89 210	8	9	2	1	0
d	2007		2	0	0	7

5 a 834 **b** 2901 **c** 65 032

6



7

8 a 38 **b** 126 **c** 7208

9 a 300 **b** 813 **c** 1076

d 1304 **e** 59 183

10 a 100 **b** 613 **c** 876

d 1104 **e** 58 983

11 a 1200 **b** 1713 **c** 1976

d 2204 **e** 60 083

12 a 9000 **b** 3141 **c** 23

d 9045 **e** 60 111

13 a 7, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, 40, … and so on

b 4, 13, 22, 31, 40, 49, 58, 67, 76, 85, 94, … and so on

c 804, 799, 794, 789, 784, 779, 774, 769, 764, … and so on

d 1000, 993, 986, 979, 972, 965, 958, 951, 944, … and so on

14 a 809 820 831 842

b 863 869 875 881

c 329 338 347 356

d 1202 1198 1194 1190

e 13 667 13 661 13 655 13 649

Chapter 2: Addition and subtraction

Show what you know

1 a 11 **b** 16 **c** 11 **d** 12

e 11 **f** 13 **g** 11 **h** 13

2 a 23 **b** 43 **c** 32 **d** 14

e 6 **f** 18 **g** 30 **h** 22

i 41 **j** 9 **k** 27 **l** 14

3 a 31 **b** 37 **c** 21 **d** 93

e 56 **f** 47 **g** 43 **h** 26

i 40 **j** 80

2A WHOLE CLASS

1 a 10 **b** 8 **c** 12 **d** 16

e 14 **f** 18

2 a 11 **b** 9 **c** 13 **d** 17

e 15 **f** 19

3 a 15 **b** 24 **c** 30 **d** 65

e 82 **f** 107

4 Answers will vary.

5 a 61 **b** 32 **c** 83 **d** 460

e 772 **f** 32 **g** 2742 **h** 90

2A INDIVIDUAL

1 a 11 **b** 11 **c** 12 **d** 12

2 a 32 **b** 23 **c** 73 **d** 61

3 a 5 **b** 2 **c** 7 **d** 11

e 20 **f** 17

4 Answers will vary.

5 a 60 **b** 120 **c** 100

d 130 **e** 141 **f** 144

g 583 **h** 538 **i** 455

j 241 **k** 903 **l** 705

6 a 55 **b** 89 **c** 58

d 77 **e** 77 **f** 160

g 714 **h** 986 **i** 1021

7 a 113 cars **b** 568 children

8 b 45 **c** 77 **d** 78 **e** 163

9 a 310

b 75 (There are a total of 150 birds in trees with even numbers, so there are 75 pairs.)

10 There are 45 numbers.

101 112 123 134 145 156 167 178 189

202 213 224 235 246 257 268 279

303 314 325 336 347 358 369

404 415 426 437 448 459

505 516 527 538 549

606 617 628 639

707 718 729

808 819

909

11 a

9	**2**	**7**
4	**6**	**8**
5	**10**	3

b

15	**8**	13
10	12	**14**
11	**16**	9

c

13	6	11
8	**10**	**12**
9	**14**	7

d

18	**4**	14
8	12	**16**
10	**20**	6

12 Answers will vary.

13 Either 9 + 8 + 7 + 65 + 4 + 3 + 2 + 1 = 99 or 9 + 8 + 7 + 6 + 5 + 43 + 21 = 99

2B WHOLE CLASS

1 a 66 **b** 944 **c** 4870

2B INDIVIDUAL

1 a 58 **b** 97 **c** 195 **d** 999

e 783 **f** 568 **g** 898 **h** 996

i 32 **j** 53 **k** 75 **l** 155

m 51 **n** 72 **o** 81 **p** 94

2 a 53 **b** 82 **c** 101 **d** 75

e 54 **f** 565 **g** 153 **h** 131

i 160 **j** 176 **k** 75 **l** 158

m 765 **n** 1103

3 a 58 km **b** 59 teddy bears

4 a 782 **b** 923 **c** 656 **d** 1230

e 5301 **f** 7881

5 a 178 **b** 184 **c** 174 **d** 196

e 552 **f** 538 **g** 350 **h** 1043

i 5849 **j** 8824 **k** 1509 **l** 1452

m 41 370 **n** 80 507 **o** 85 601

p 39 719 **q** 2118 **r** 22 378

6 a 225 marbles **b** 742 km

7 a 10 303 **b** 16 082

c 7059 **d** 21 586

8 $224

9 a 1 **b** 2 **c** 4

2C WHOLE CLASS

1 Answers will vary.

2 a 13 **b** 21 **c** 103 **d** 17

e 38 **f** 88

3 a 15 **b** 34 **c** 38 **d** 107

e 389 **f** 887

4 a 371 **b** 642 **c** 693 **d** 523

e 95 **f** 873

5 a 4 **b** 118 **c** 431 **d** 548

e 789 **f** 901

6 a 9 **b** 19 **c** 49 **d** 29

e 57 **f** 46

2C INDIVIDUAL

1 a 26 **b** 43 **c** 15 **d** 38

2 a 26 **b** 33 **c** 36 **d** 216

e 39 **f** 145

3 a 13 **b** 19 **c** 22 **d** 28

e 47 **f** 23 **g** 58 **h** 79

i 89 **j** 47 **k** 138 **l** 188

4 a 14 **b** 15 **c** 31 **d** 96

e 994 **f** 1987

5 a 47 **b** 88 **c** 651

d 819 **e** 998

6 a 21 **b** 46 **c** 55 **d** 70

e 585 **f** 964

7 a 77 **b** 145 **c** 149 **d** 147

8 See **BLM 4** answers in Interactive Textbook

9 a 29 boys **b** 87 men

c 158 stamps **d** 278 petunias

e $56.65 **f** 385 children

10 a 91 **b** 216 **c** 982

d 3822 **e** 427 **f** 3579

11 a 8 + 4 – 6 + 7 = 13

b 27 – 13 – 8 – 3 = 3

c 49 + 121 + 642 – 777 = 35

d 264 + 391 – 227 + 443 = 871

2C HOMEWORK

2 a 15 **b** 45 **c** 91 **d** 190

e (1 + last number) × last number ÷ 2

2D WHOLE CLASS

1 a 75 **b** 888 **c** 3315 **b** 244

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2D INDIVIDUAL

1 **a** 22 **b** 13 **c** 31 **d** 211
e 327 **f** 119 **g** 1042 **h** 2921
2 **a** 19 **b** 25 **c** 37 **d** 61
e 19 **f** 409 **g** 109 **h** 92
3 6 cm
4 **a** 366 **b** 277 **c** 643 **d** 275
5 35 seats
6 186 seats
7 **a** 5737 **b** 2659
c 2694 **d** 2889
8 577 girls
9 $1385
10 $1428
11 **a** 23 156 **b** 19 483 **c** 21 247

2E REVIEW QUESTIONS

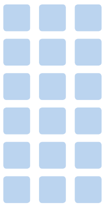
1 **a** 33 **b** 27 **c** 18 **d** 5
e 21 **f** 43
2 **a** 15 **b** 35 **c** 21
d 32 **e** 44 **f** 60
g 95 **h** 105 **i** 85
3 **a** 65 **b** 135 **c** 75
d 165 **e** 617 **f** 176
g 1367 **h** 3925 **i** 255
j 5673 **k** 36 725
4 **a** 94 **b** 99 **c** 148
d 180 **e** 519 **f** 1900
5 **a** 16 **b** 68 **c** 62
6 **a** 43 **b** 23 **c** 66
d 193 **e** 150 **f** 56
7 **a** 3618 **b** 56 756
8 **a** $3864 **b** $136
9 **a** 6 **b** 3 **c** 2

Chapter 3: Multiplication

Show what you know

1 **a** $7 + 7 + 7 + 7 = 28$
b $4 \times 7 = 28,\ 7 \times 4 = 28$

2

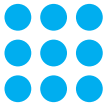


3 0, 3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42

3A WHOLE CLASS

1 See **BLM 5** answers in the Interactive Textbook.

2 **a**

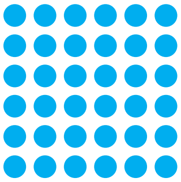


b The array is square.

c because it has the same number of rows as columns

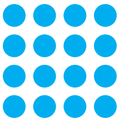
3 **a** a square

b

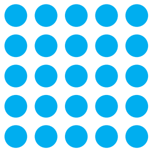


4 **a**

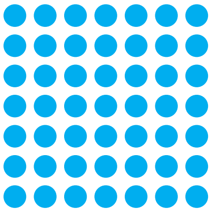
b



c



d



5 **a** 1, 4, 9, 16, 25, 36, 49
b 64, 81, 100, 121, 144

3A INDIVIDUAL

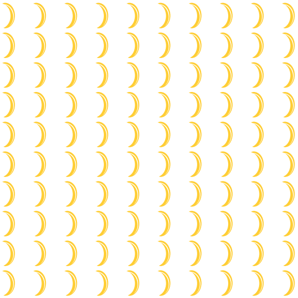
1 **a**

12 apples $6 \times 2 = \mathbf{12}$ $2 \times \mathbf{6} = \mathbf{12}$

b

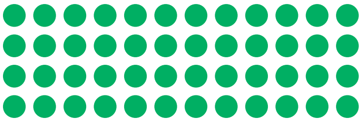
12 oranges 3 × 4 = **12** 4 × **3** = **12**

c



100 bananas 10 × 10 = **100**

d



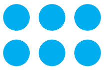
48 watermelons 4 × 12 = **48** 12 × **4** = **48**

2 **a** 4; 2 × **4** = 8; 4 × **2** = **8**

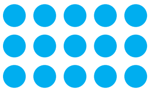
b 1; **1** × 5 – 5; 1 × **5** = **5**

c **4** rows of **7** stars; **4** × **7** = **28**

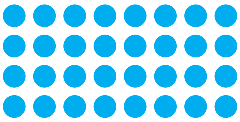
3 **a**



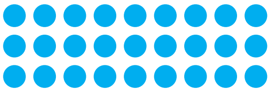
b



c

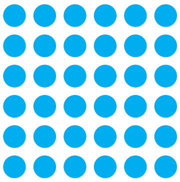


d



e

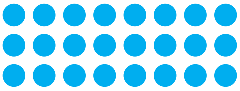
f



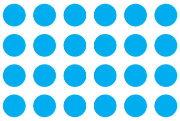
4

1 × 24 = 24 or 24 × 1 = 24

2 × 12 = 24 or 12 × 2 = 24

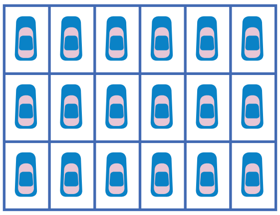


3 × 8 = 24 or 8 × 3 = 24



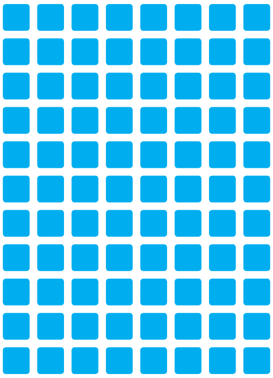
4 × 6 = 24 or 6 × 4 = 24

5



18; 3 × 6 = 18 or 6 × 3 = 18

6



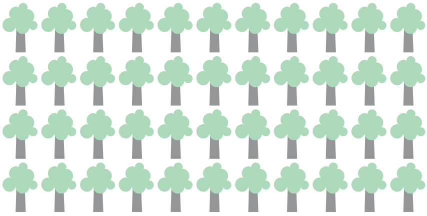
88; 8 × 11 = 88 or 11 × 8 = 88

7 12 tiles

3A HOMEWORK

1 **a**

b



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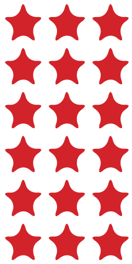
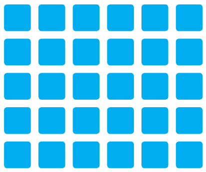
c



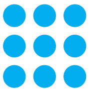
d



2 **a** 4 × 5 = 20 or 5 × 4 = 20
b 7 × 4 = 28 or 4 × 7 = 28
c 2 × 4 = 8 or 4 × 2 = 8

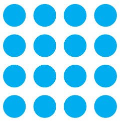
3 **a**

b



c

d



e

f

3B WHOLE CLASS

1–6 For discussion

3B INDIVIDUAL

1 **a** 30 **b** 45 **c** 55
d 50 **e** 40 **f** 35
2 **a** 12 **b** 15 **c** 24
d 36 **e** 21 **f** 27
3 **a** 22 **b** 0 **c** 66
d 110 **e** 99 **f** 132
4 **a** 36 **b** 28
5 **a** 15 **b** 12 **c** 35
d 48 **e** 48 **f** 42
g 56 **h** 72 **i** 56
j 54 **k** 96 **l** 132
m 108 **n** 72 **o** 104
6 **b** 10 × 8 = 80, so 9 × 8 = 80 – 8 = 72
c 10 × 9 = 90, so 9 × 9 = 90 – 9 = 81
7 **b** 10 × 12 = 120, so 5 × 12 = 120 ÷ 2 = 60
c 10 × 7 = 70, so 5 × 7 = 70 ÷ 2 = 35

3B HOMEWORK

1 **a** 1 **b** 4 **c** 9
d 16 **e** 25 **f** 36
g 49 **h** 64 **i** 81
j 100 **k** 121 **l** 144
2 **a** 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144
b diagonally from top left to bottom right

3C WHOLE CLASS

2 **a** 3, 6, 9, 12, 15 **b** 12
c 4, 8, 16 **d** 3, 6, 9, 15
3 **Multiple of 2 but not 7:**
2, 4, 6, 8, 10, 12, 16, 18, 20, 22, 24, 26
Multiple of 2 and 7: 14, 28
Multiple of 7 but not 2: 7, 21
Not a multiple of 2 or 7:
1, 3, 5, 9, 11, 13, 15, 17, 19, 23, 25, 27
4 **a** 6 **b** 12 **c** 21
d 20 **e** 60
5 **a** False. It is 8 **b** False
c True

3C INDIVIDUAL

1 **a** 2, 4, 6, 8, 10 **b** 5, 10, 15, 20, 25
c 8, 16, 24, 32, 40 **d** 12, 24, 36, 48, 60
e 10, 20, 30, 40, 50 **f** 9, 18, 27, 36, 45
g 7, 14, 21, 28, 35 **h** 11, 22, 33, 44, 55
i 100, 200, 300, 400, 500
j 50, 100, 150, 200, 250
2 **a** 4, 8, 12, 16, 20, 24, 28, 32, 36, 40
b 7, 14, 21, 28, 35, 42, 49, 56, 63, 70
c 13, 26, 39, 52, 65, 78, 91, 104, 117, 130
d 15, 30, 45, 60, 75, 90, 105, 120, 135, 150
e 20, 40, 60, 80, 100, 120, 140, 160, 180, 200
f 25, 50, 75, 100, 125, 150, 175, 200, 225, 250
g 75, 150, 225, 300, 375, 450, 525, 600, 675, 750
h 21, 42, 63, 84, 105, 126, 147, 168, 189, 210
i 60, 120, 180, 240, 300, 360, 420, 480, 540, 600
j 125, 250, 375, 500, 625, 750, 875, 1000, 1125, 1250
3 **a** 12, 6, 18, 21, 33 **b** 10, 45, 25, 100, 105
4 **a** 21, 24, 27, 30 **b** 32, 36, 40, 44
5 **a** 10 **b** 63

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6 **Multiple of 2 but not 3:**
2, 4, 8, 10, 14, 16, 20, 22, 26, 28, 32, 34
Multiple of 2 and 3: 6, 12, 18, 24, 30, 36
Multiple of 3 but not 2: 3, 9, 15, 21, 27, 33
Not a multiple of 2 or 3:
1, 5, 7, 11, 13, 17, 19, 23, 25, 29, 31, 35

3D INDIVIDUAL

1 **a** 180 **b** 560 **c** 7890
d 2000 **e** 48 000

2 **a** 160 **b** 180 **c** 220
d 300 **e** 320 **f** 1000
g 420

3 **a** 28 **b** 32 **c** 36
d 44 **e** 200 **f** 100
g 300

4 **a** 117 **b** 135 **c** 153
d 144 **e** 126 **f** 189
g 225

5 **a** 132 **c** 165 **e** 286
b 154 **d** 231 **f** 341
g 319

6 **a** 54 **c** 90 **e** 78
b 60 **d** 150 **f** 126
g 330

7 **a** 140 **b** 234

8 **a** 176 **b** 319 **c** 1331

9 **a** Multiply by 3, then by 10.
b Multiply by 3, then by 100.

3D REFLECTION

1 3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42, 45, 48, 51, 54, 57, 60

2 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 52, 56, 60, 64, 68, 72, 76, 80

3 12, 24, 36, 48, 60

4 12

3D HOMEWORK

1 **a** 150 **b** 170 **c** 210
d 1000 **e** 117 **f** 198
g 216 **h** 369 **i** 198
j 242 **k** 682 **l** 803
m 240 **n** 260 **o** 280
p 420 **q** 2820 **r** 36 000

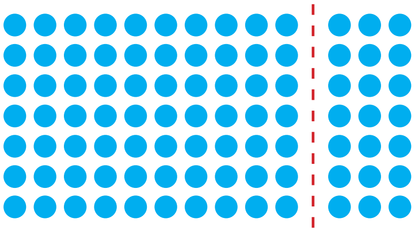
2 **a** 360 **b** 390 **c** 420
d 630 **e** 1500 **f** 3600
g Multiply by 3, then by 10.

4 **a** 171 **b** 261 **c** 351
d 441 **e** 711
f 981 Various strategies could be used.

3E WHOLE CLASS

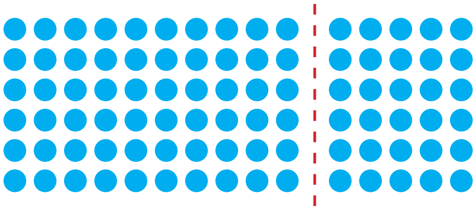
1 **a** $11 \times 12 = 10 \times 10 + 10 \times 2 + 1 \times 10 + 1 \times 2$
$= 100 + 20 + 10 + 2 = 132$

b



$13 \times 7 = 10 \times 7 + 3 \times 7 = 70 + 21 = 91$

c



$6 \times 15 = 6 \times 10 + 6 \times 5 = 60 + 30 = 90$

d 23×5 array split to show
$20 \times 5 + 3 \times 5 = 100 + 15 = 115$

e 34×21 array split to show
$30 \times 20 + 4 \times 20 + 30 \times 1 + 4 \times 1 = 600 + 80 + 30 + 4 = 714$

2 **a** $23 \times 13 = 20 \times 10 + 20 \times 3 + 3 \times 10 = 3 \times 3$
$= 200 + 60 + 30 + 9$
$= 299$

b $36 \times 19 = 30 \times 10 + 30 \times 9 + 6 \times 10 + 6 \times 9$
$= 300 + 270 + 60 + 54$
$= 684$

c $72 \times 28 = 70 \times 20 + 70 \times 8 + 2 \times 20 + 2 \times 8$
$= 1400 + 560 + 40 + 16$
$= 2016$

3E INDIVIDUAL

1 See **BLM 9** answers in the Interactive Textbook.

2 **a** $2 \times 13 = 2 \times \mathbf{10} + 2 \times 3$
$= \mathbf{20} + 6$
$= 26$

b $7 \times 15 = \mathbf{7} \times 10 + \mathbf{7} \times 5$
$= 70 + \mathbf{35}$
$= \mathbf{105}$

3 **b** 21×4 array split to show $20 \times 4 + 1 \times 4$
c $20 \times 4 + 1 \times 4 = 80 + 4$
$= 84$

4 **a** 32×12 array split to show

$30 \times 10 + 30 \times 2 + 2 \times 10 + 2 \times 2$

$30 \times 10 + 30 \times 2 + 2 \times 10 + 2 \times 2$

$= 300 + 60 + 20 + 4$

$= 384$

b 21×43 array split to show

$20 \times 40 + 20 \times 3 + 1 \times 40 + 1 \times 3$

$20 \times 40 + 20 \times 3 + 1 \times 40 + 1 \times 3$

$= 800 + 60 + 40 + 3 = 903$

c 38×41 array split to show

$30 \times 40 + 30 \times 1 + 8 \times 40 + 8 \times 1$

$30 \times 40 + 30 \times 1 + 8 \times 40 + 8 \times 1$

$= 1200 + 30 + 320 + 8$

$= 1558$

d 23×92 array split to show

$20 \times 90 + 20 \times 2 + 3 \times 90 + 3 \times 2$

$20 \times 90 + 20 \times 2 + 3 \times 90 + 3 \times 2$

$= 1800 + 40 + 270 + 6$

$= 2116$

5 34×26 array split to show

$30 \times 20 + 30 \times 6 + 4 \times 20 + 4 \times 6$

$$\begin{aligned} 34 \times 26 &= 30 \times 20 + 30 \times 6 + 4 \times 20 + 4 \times 6 \\ &= 600 + 180 + 80 + 24 \\ &= 884 \end{aligned}$$

3F WHOLE CLASS

1 **a** 52 **b** 105 **c** 702
2 **a** 42 **b** 85 **c** 124
d 322 **e** 180 **f** 784
g 366 **h** 480
3 104 slices
4 **a** 7894 **b** 148 929 **c** 631 952
d 3 561 444 **e** 1 403 970

3F INDIVIDUAL

1 **a** 28 **b** 39 **c** 84
d 93 **e** 64 **f** 92
g 72 **h** 102 **i** 183
j 369 **k** 288 **l** 249
m 288 **n** 476 **o** 468
p 756 **q** 350 **r** 480
s 520 **t** 4480 **u** 686
v 4804 **w** 17 079 **x** 62 118
2 **a** 91 **b** 196 **c** 371
d 609
3 256 cars **4** 153 tickets **5** 312 pavers

3G WHOLE CLASS

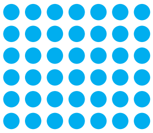
1 **a** 144 **b** 819 **c** 7098
2 **a** 168 **b** 672 **c** 517

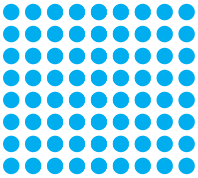
3G INDIVIDUAL

1 **a** 156 **b** 294 **c** 286
d 968 **e** 399 **f** 732
g 315 **h** 204
2 216 T-shirts **3** 224 **4** 432 trees
5 **a** 595 **b** 432 **c** 494
d 884 **e** 3071 **f** 1708
g 1920 **h** 1729
6 **a** 126 km **b** 504 km **c** 1638 km
7 **a** \$108 **b** \$612 **c** \$864
d \$2016 **e** \$8100
8 **a** 3634 **b** 2552 **c** 7065
9 **a** 508 **b** 9144 **c** 117 221
d 7620 **e** 38 100 **f** 56 261

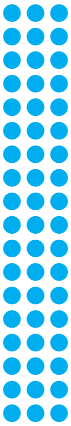
3H REVIEW QUESTIONS

1 **a** $4 \times 8 = 32$ **b** $5 \times 5 = 25$
c $6 \times 2 = 12$
2 **a** $6 \times 7 = 42$ **b** $8 \times 9 = 72$





c $18 \times 3 = 54$



3 1 × 36, 2 × 18, 3 × 12, 4 × 9, 6 × 6, 9 × 4, 12 × 3, 18 × 2, 36 × 1

4 32 cars in an 8 × 4 array

5 **a** 24 **b** 36 **c** 44
d 40 **e** 32

6 **a** 12 **b** 0 **c** 36
d 60 **e** 54

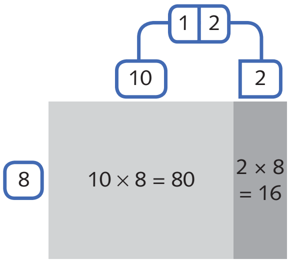
7 **a** 260 **b** 300 **c** 340
d 500 **e** 860

8 **a** 126 **b** 288 **c** 1296

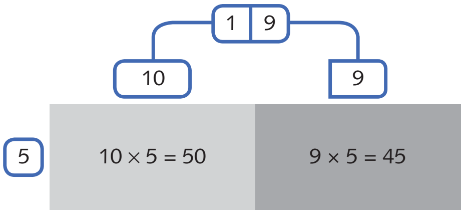
9 **a** 18 **b** 36 **c** 56
d 72 **e** 108 **f** 132

10 **a** 6, 12, 18, 24, 30
b 4, 8, 12, 16, 20
c 7, 14, 21, 28, 35
d 25, 50, 75, 100, 125
e 50, 100, 150, 200, 250

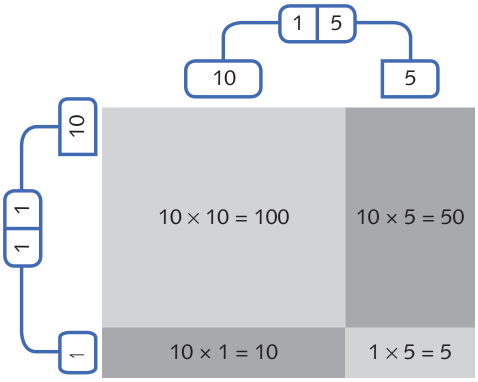
11 **a** 12 × 8 = 96



b 19 × 5 = 95



c 15 × 11 = 165



12 1161 (20 × 40 + 2 × 3 + 7 × 40 + 7 × 3)

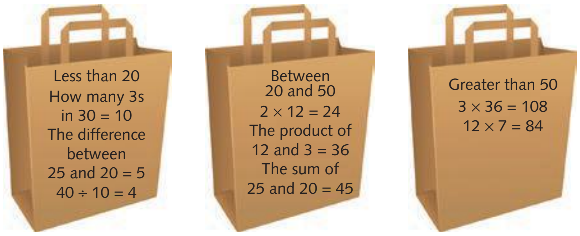
13 **a** 595 **b** 2160 **c** 3874
d 20 800 **e** 7656 **f** 1708
g 4800 **h** 819

14 1104 books **15** 14 256 pavers

Chapter 4: Division

Show what you know

1



4A WHOLE CLASS

1 Teacher to check

2 **a** 1 × 15, 3 × 5
b 1 × 12, 2 × 6, 3 × 4
c 1 × 30, 2 × 15, 3 × 10, 5 × 6
d 1 × 33, 3 × 11
e 1 × 72, 2 × 36, 3 × 24, 4 × 18, 6 × 12, 8 × 9

3 **a** factors:
2 (1, 2) 3 (1, 3)
4 (1, 2, 4) 5 (1, 5)
6 (1, 2, 3, 6) 7 (1, 7)
8 (1, 2, 4, 8) 9 (1, 3, 9)
10 (1, 2, 5, 10) 11 (1, 11)
12 (1, 2, 3, 4, 6, 12) 13 (1, 13)
14 (1, 2, 7, 14) 15 (1, 3, 5, 15)
16 (1, 2, 4, 8, 16) 17 (1, 17)
18 (1, 2, 3, 6, 9, 18) 19 (1, 19)
20 (1, 2, 4, 5, 10, 20)

b prime numbers: 2, 3, 5, 7, 11, 13, 17, 19
composite numbers:
4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 20

4 Teacher to check. Last line of factor tree reads (in any order):

a 45 = 3 × 3 × 5
b 72 = 2 × 2 × 2 × 3 × 3
c 1680 = 2 × 2 × 2 × 2 × 3 × 5 × 7
d 1000 = 2 × 2 × 2 × 5 × 5 × 5

5 Choose from 11, 12, 15, 22, 24, 33, 36, 44, 48, 55, 66, 77, 88 and 99.

6 The prime numbers less than 100 are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89 and 97.

4A INDIVIDUAL

1 **a** 2 **b** 3 **c** 9

d 3

2 **a** 1, 2, 3, 5, 6, 10, 15, 30

b 1, 2, 3, 4, 6, 9, 12, 18, 36

c

3 2, 3, 5, 6, 10, 15 or 30 children

4 groups of 2, 4, 7, 14 or 28 children

5 **a** 1 **b** 1 **c** 1

d 1

e 7, 1 and 7 17, 1 and 17 23, 1 and 23
29, 1 and 29

f The factors are itself and 1.

g These numbers are called prime numbers.

6 23, 29 **7** 41, 43, 47

8 **a** 41 **b** 53 or 47 **c** 61 or 59

9 47, 43, 41

10 It will always be a multiple of 5.

11 327 can be divided by 3.

12 113

13 Teacher to check factor trees. Final line should read as follows (in any order):

a $30 = 5 \times 2 \times 3$

b $84 = 7 \times 3 \times 2 \times 2$

c $63 = 7 \times 3 \times 3$

d $44 = 11 \times 2 \times 2$

e $120 = 5 \times 2 \times 3 \times 2 \times 2$

f $444 = 2 \times 2 \times 3 \times 37$

g $396 = 2 \times 2 \times 3 \times 11 \times 3$

h $176 = 2 \times 11 \times 2 \times 2 \times 2$

i $261 = 3 \times 3 \times 29$

j $7000 = 7 \times 5 \times 2 \times 5 \times 2 \times 5 \times 2$

14 **a** 30 **b** 140 **c** 99

d 256 **e** 2310

4A HOMEWORK

1 **a** 8 (1, 8, 2, 4)

b 7 (1, 7)

c 9 (1, 3, 9)

d 16 (1, 2, 4, 8, 16)

e 50 (1, 2, 5, 10, 25, 50)

2 Teacher to check. Last line of factor tree reads (in any order):

a $38 = 2 \times 19$

b $648 = 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 3$

c $2420 = 2 \times 2 \times 5 \times 11 \times 11$

4B WHOLE CLASS

1 Teacher to check

2 **a** 2 **b** 5 **c** 9

d 11 **e** 15 **f** 55

3 **a** 2 **b** 4 **c** 6

d 11 **e** 9 **f** 25

4 **a** 2 **b** 5 **c** 10

d 11 **e** 17 **f** 278

5 **a** $6 \times 3 = 18$ **b** $18 = 3 \times 6$

c $9 \times 2 = 18$ **d** $18 = 9 \times 2$

e $1 \times 18 = 18$ **f** $18 \div 2 = 9$

g $18 \div 1 = 18$ **h** $18 \div 9 = 2$

i $18 \div 6 = 3$ **j** $18 \div 18 = 1$

k $1 \times 18 = 18$ **l** $3 \times 3 \times 2 = 18$

6 **a** 1, 2, 3, 4, 6, 9, 12, 18, 36

b $6 \times 6 = 36$ **c** $36 = 3 \times 12$

d $36 = 9 \times 4$ **e** $4 \times 9 = 36$

f $2 \times 18 = 16$ **g** $36 \div 6 = 6$

h $36 \div 2 = 18$ **i** $36 \div 9 = 4$

j 36 ÷ 1 = 36 **k** 36 ÷ 9 = 4

l 1 × 36 = 36

m 36 = 2 × 3 × 2 × 3 OR 36 = 2 × 9 × 2 × 1

4B INDIVIDUAL

1 a If 3 × 5 = 15, then 15 ÷ 3 = 5 and 15 ÷ 5 = 3

b If 2 × 4 = 8, then 8 ÷ 4 = 2 and 8 ÷ 2 = 4

c If 6 × 3 = 18, then 18 ÷ 6 = 3 and 18 ÷ 3 = 6

d If 7 × 8 = 56, then 56 ÷ 8 = 7 and 56 ÷ 7 = 8

e If 313 × 279 = 87 327, then 87 327 ÷ 279 = 313 and 87 327 ÷ 313 = 279

2 a 2 × 6 = 12 **b** 12 ÷ 12 = 1

c 3 × 4 = 12 **d** 3 × 4 = 12

e 12 ÷ 3 = 4 **f** 12 ÷ 6 = 2

g 12 = 12 × 1 **h** 6 × 2 = 12

i 4 × 3 = 12 **j** 12 ÷ 2 = 6

k 12 ÷ 4 = 3 **l** 2 × 2 × 3 = 12

3 a Yes, 121 ÷ 11 = 11because 11 × 11 = 121

b No, 98 ÷ 8 does not equal 12 because 12 × 8 = 96

c Yes, 24 ÷ 8 = 3 because 3 × 8 = 24

d No, 37 ÷ 4 does not equal 9 because 4 × 9 = 36

e Yes, 54 ÷ 6 = 9 because 6 × 9 = 54

f Yes, 132 ÷ 12 = 11 because 11 × 12 = 132

g Yes, 72 ÷ 6 = 12 because 12 × 6 = 72

h No, 100 ÷ 9 does not equal 11 because 11 × 9 = 99

i Yes, 144 ÷ 12 = 12 because 12 × 12 = 144

j No, 43 ÷ 2 does not equal 22 because 2 × 22 = 44

k Yes, 42 ÷ 6 = 7 because 7 × 6 = 42

4 a No, 504 ÷ 63 does not equal 7 because 63 × 7 = 441.

$$\begin{array}{r} 6_{2}3 \\ \times\ \ 7 \\ \hline 4\,4\,1 \\ \hline \end{array}$$

b Yes, 243 ÷ 9 = 27 because 27 × 9 = 243.

$$\begin{array}{r} 2_{6}7 \\ \times\ \ 9 \\ \hline 2\,4\,3 \\ \hline \end{array}$$

c Yes, 72 ÷ 3 = 24 because 24 × 3 = 72.

$$\begin{array}{r} 2_{1}4 \\ \times\ \ 3 \\ \hline 7\,2 \\ \hline \end{array}$$

d Yes, 478 ÷ 239 = 2 because 2 × 239 = 478.

$$\begin{array}{r} 2\,3_{1}9 \\ \times\ \ 2 \\ \hline 4\,7\,8 \\ \hline \end{array}$$

e Yes, 161 ÷ 7 = 23 because 23 × 7 = 161.

$$\begin{array}{r} 2_{2}3 \\ \times\ \ 7 \\ \hline 1\,6\,1 \\ \hline \end{array}$$

f Yes, 612 ÷ 9 = 68 because 9 × 68 = 612.

$$\begin{array}{r} 6_{7}8 \\ \times\ \ 9 \\ \hline 6\,1\,2 \\ \hline \end{array}$$

g No, 181 ÷ 16 does not equal 12 because 16 × 12 = 192.

$$\begin{array}{r} 1_{7}6 \\ \times 1\,2 \\ \hline 1\,9\,2 \\ \hline \end{array}$$

h No, 200 ÷ 23 does not equal 9 because 9 × 23 = 207.

$$\begin{array}{r} 2_{2}3 \\ \times\ \ 9 \\ \hline 2\,0\,7 \\ \hline \end{array}$$

i Yes, 343 ÷ 49 = 7 because 7 × 49 = 343.

$$\begin{array}{r} 4_{6}9 \\ \times\ \ 7 \\ \hline 3\,4\,3 \\ \hline \end{array}$$

j Yes, 1836 ÷ 68 = 27 because 27 × 68 = 1836.

$$\begin{array}{r} {}_{5}6_{1}8 \\ \times 2\,7 \\ \hline 4\,7\,6 \\ 1\,3\,6\,0 \\ \hline 1\,8\,3\,6 \\ \hline \end{array}$$

4C WHOLE CLASS

1 a 84 ÷ 3 = 28 **b** 1000 ÷ 5 = 200

c 725 ÷ 4 = 181 r1 **d** 799 ÷ 17 = 47

4C INDIVIDUAL

Teacher to check all answers for the correct setting out of long division algorithm

1 a 432, 432 × 2 = 864

b 25, 25 × 5 = 125

c 38, 38 × 8 = 304

d 52, 52 × 7 = 364

e 58 r2, 58 × 3 = 174 and 174 + 2 = 176

f 256 r2, 256 × 4 = 1024 and 1024 + 2 = 1026

g 21 r1, 21 × 9 = 189 and 189 + 1 = 190

h 80 r2, 80 × 6 = 480 and 480 + 2 = 482

2 a 72, 72 × 11 = 792

b 18, 18 × 13 = 234

c 12, 12 × 21 = 252

d 247, 247 × 36 = 8892

3 a 98 **b** 56 **c** 49

d 43 r5 **e** 30 r2

4 143 chocolate buttons

5 37 hours

6 27 days

7

	Full flush	Quick flush	Remainder
24-litre tank	1 × 8	3 × 5	1 litre
	2 × 8	1 × 5	3 litres
	3 × 8	0 × 5	0 litres
33-litre tank	1 × 8	5 × 5	0 litres
	2 × 8	3 × 5	2 litres
	3 × 8	1 × 5	4 litres
	4 × 8	0 × 5	1 litre
40-litre tank	1 × 8	6 × 5	2 litres
	2 × 8	4 × 5	4 litres
	3 × 8	3 × 5	1 litre
	4 × 8	1 × 5	3 litres
	5 × 8	0 × 5	0 litres

4D INDIVIDUAL

1 **a** 134 **b** 37 **c** 82

d 247 **e** 89 r1 **f** 30 r5

g 71 r6 **h** 109 r7

2 12, 36, 81, 999, 1008

3 24, 28, 100, 396

4 No. All numbers that have 5 as a factor will end in 5 or 0. So they are 100 and 395.

5 **a** 11 bags **b** 14 bags r1

c 65 bags r8 **d** 114 bags

6 **a** 111 boxes **b** 50 boxes r2

c 148 boxes **d** 166 boxes r4

7 **a** 223 **b** 65 **c** 587

d 2036

e 223 × 9 = 2007, 65 × 9 = 585, 587 × 9 = 5283, 2036 × 9 = 18 324

4E REVIEW QUESTIONS

1 **a** 1,8 2,4

b 1,10 5,2

c 1,42 3,14 2,21 6,7

d 1,36 2,18 3,12 4,9 6

e 1,144 2,72 3,48 4,36 6,24 8,18 9,16 12

2 **a** 1,50 2,25 5,10

b 1,54 2,27 3,18 6,9

3 **a** 5, 7

b 3, 6

c 7, 9, 10, 11

4 **a** If 9 × 8 = 72, then 72 ÷ 9 = 8 and 72 ÷ 8 = 9

b If 12 × 8 = 96, then 96 ÷ 12 = 8 and 96 ÷ 8 = 12

c If 87 × 93 = 8091, then 8091 ÷ 87 = 93 and 8091 ÷ 93 = 87

5 **a** 3 × 26 = 78 **b** 13 × 16 = 208

c 59 × 8 = 472 **d** 480 ÷ 15 = 32

e 2604 ÷ 84 = 31 **f** 1196 ÷ 23 = 52

6 **a** B, D, F, H **b** A, C, D, E, G, H

c A, D, G

7 **a** 13 × 9 = 117 **b** 7 × 18 = 126

c 17 × 34 = 578 **d** 278 × 8 = 2224

8 **a** 945 **b** 630 **c** 378

d 315 **e** 210

9 **a** 1152 **b** 768 **c** 576

d 384 **e** 192

10 105, 119, 602, 6174

11 Number grid reveals the word ME.

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12 **a** $157 \times 3 = 471$
b $326 \times 4 = 1304$
c $891 \times 7 = 6237$
d $506 \times 5 = 2530$
e $834 \times 7 = 5838$
f $827 \times 6 = 4962$
g $2103 \times 8 = 16\,824$
h $2307 \times 9 = 20\,763$
i $251 \times 13 = 3263$
j $128 \times 22 = 2816$
k $196 \times 51 = 9996$
l $698\,103 \times 43 = 30\,018\,386$

13 **a** 66 **b** 110
c 30 **d** 165

14 **a** 1512 **b** 756
c 864 **d** 672

15 Prime: 17, 19, 23, 29, 31

Composite: 15, 16, 18, 20, 21, 22, 24, 25, 26, 27, 28, 30, 32, 33, 34, 35

16 **a** 11 **b** 29 **c** 101

17 Factor trees should have these numbers in the final line.

a $2 \times 3 \times 3$ **b** $2 \times 2 \times 5$
c $2 \times 2 \times 2 \times 3$ **d** $2 \times 2 \times 2 \times 2 \times 2$

18 Factor trees should have these numbers in the final line

a 7, 2, 2 **b** 2, 2, 2, 3, 3
c 2, 5, 5 **d** 2, 11, 11
e 2, 2, 2, 2, 3, 7

19 **a** 16 **b** 105 **c** 28 **d** 104

Chapter 5: Length and perimeter

Show what you know

1 **a** 10 cm **b** 7 cm

2 Answers will vary.

3 **a** metres **b** millimetres
c centimetres

5A WHOLE CLASS

1–8 All measurements should be checked by a teacher.

9 Answers will vary.

5A INDIVIDUAL

1 **a** 3 cm **b** 12 cm
2 **a** 35 mm **b** 98 mm
3 **a** 10 cm **b** 43 mm
4 **a** 50 cm **b** 20 cm **c** 95 cm
d 3 cm **e** 47 cm **f** 38 cm

5 28 cm

6 7 pieces

7 **a** 75 cm **b** larger
8 **a** 1 m **b** 16 cm
9 15 cm

10 width 480 cm; length 660 cm; height 360 cm

11 **a** 6 m 60 cm **b** 5 m 95 cm **c** subtract

5B WHOLE CLASS

1 **a** 1 m 30 cm **b** 1 m 68 cm
c 132 cm **d** 4 cm 3 mm
e 620 mm **f** 1270 mm
2–4 Answers will vary.

5B INDIVIDUAL

1 **a** 2 m **b** 5 m
c 8 m **d** 11 m
2 **a** 1 m 25 cm **b** 3 m 87 cm
c 5 m 14 cm **d** 6 m 44 cm
3 **a** 600 cm **b** 900 cm
c 1000 cm **d** 185 cm
e 237 cm **f** 444 cm
g 310 cm **h** 708 cm
4 **a** 4 cm **b** 7 cm
c 8 cm **d** 30 cm
e 60 cm **f** 100 cm
g 12 cm **h** 18 cm
5 **a** 1 cm 2 mm **b** 2 cm 6 mm
c 8 cm 7 mm **d** 12 cm 5 mm
e 21 cm 5 mm **f** 77 cm 5 mm
6 **a** 40 mm **b** 70 mm **c** 120 mm
d 800 mm **e** 1300 mm **f** 2000 mm
g 65 mm **h** 78 mm **i** 99 mm
j 103 mm **k** 152 mm **l** 1359 mm
7 width 3400 mm; height = 1800 mm

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8 **a** 1 m **b** 2 m 50 cm
c 1 m 50 cm **d** 20 cm
e 1 m 12 cm **f** 1 m 26 cm
9 80 mm
10 1500 mm
11 45 pieces of wool.
12 8 cm
13 22 cm 5 mm
14 20 mm
15 10 tiles
16 215 cm or 2 m 15 cm

5C INDIVIDUAL

1 **a** 2 km **b** 7 km
c 10 km **d** 8 km
e 12 km **f** 280 km
g 3 km 450 m **h** 6 km 270 m
i 1 km 9 m **j** 7 km 750 m
k 2 km 680 m **l** 23 km 780 m
2 **a** 3000 m **b** 7000 m
c 11 000 m **d** 10 000 m
e 100 000 m **f** 1 000 000 m
g 4825 m **h** 5123 m
i 8462 m **j** 2038 m
k 6090 m **l** 7003 m
3 2 km 304 m
4 **a** 2 km **b** 2 km 500 m
c 3 km 200 m **d** 2 km 700 m
e 2 km 660 m
5 **a** 3 km **b** 1 km 200 m
c 3 km 300 m **d** 3 km 400 m
e 4 km 667 m
6 28 km
7 2 kilometres 800 metres
8 4 kilometres 500 metres
9 1200 m
10 450 m
11 1 hour
12 2 km 250 m
13 1400 m or 1 km 400 m
14 **a** 300 metres **b** Brock; 400 metres

5D WHOLE CLASS

Answers will vary. Teacher to check.

5D INDIVIDUAL

1 **a** 10 cm **b** 14 cm **c** 14 cm
d 14 cm **e** 28 cm
2 **a** 15 cm **b** 24 cm **c** 24 cm
d 40 cm **e** 27 cm **f** 32 cm
g 48 cm **h** 44 cm **i** 47 cm
3 Answers will vary.
4 **a** 22 m **b** 22 m **c** 16 m
5 **a** 28 cm **b** 24 cm **c** 32 cm
d 48 m **e** 50 cm **f** 30 m
6 **a** 26 cm **b** 26 cm **c** 62 cm
7 **a** 24 cm **b** 36 cm **c** 48 cm
8 **a** 14 m **b** 18 m **c** 24 m
d 36 m
9 **a** **A** 10 cm **B** 10 cm **C** 18 cm
D 18 cm
b They are the same
c They are the same

5E REVIEW QUESTIONS

1 **a** 10 cm **b** 8 cm **c** 68 mm
2 **a** 25 cm **b** 88 cm **c** 12 cm
3 **a** 4 m **b** 11 m **c** 56 m
4 **a** 6 m 48 cm **b** 1 m 93 cm
c 19 m 3 cm
5 **a** 800 cm **b** 934 cm **c** 1881 cm
6 **a** 3 cm **b** 9 cm **c** 80 cm
d 12 cm **e** 66 cm **f** 101 cm
7 **a** 1 cm 7 mm **b** 4 cm 8 mm **c** 23 cm 6 mm
8 **a** 50 mm **b** 800 mm **c** 670 mm
d 835 mm **e** 1473 mm **f** 2099 mm
9 **a** 4 km **b** 1 km 893 m **c** 42 km 670 m
10 **a** 4000 m **b** 6038 m **c** 98 103 m
11 11 km 600 m **12** 254 cm
13 **a** 3 km **b** 4 km 200 m
c 2773 m, or 2 km 773 m
14 **a** 12 cm **b** 9 m **c** 15 m
d 40 m **e** 28 cm **f** 44 m

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15

	Length	Width	Perimeter
a	12 mm	3 mm	30 mm
b	15 cm	4 cm	38 cm
c	21 m	8 m	58 m
d	5 cm	100 cm	210 cm
e	43 m	17 m	120 m

Chapter 6: Area

6A WHOLE CLASS

1 **a** 14 cm^2 **b** 25 cm^2

2–3 Answers will vary.

6A INDIVIDUAL

1 **a** 15 cm^2 **b** 7 cm^2 **c** 36 cm^2

2 **a** 1 cm^2 **b** 4 cm^2 **c** 9 cm^2

3 **a** 16 cm^2 **b** 25 cm^2 **c** 36 cm^2

d 49 cm^2

6B WHOLE CLASS

1 **a** 15 cm^2 **b** 18 cm^2 **c** 60 cm^2

d 125 cm^2

2 No

3 See **BLM 12** answers in the Interactive Textbook.

6B INDIVIDUAL

1 **a** 10 cm^2 **b** 18 cm^2 **c** 22 cm^2

d 30 cm^2 **e** 24 cm^2 **f** 12 cm^2

g 21 cm^2 **h** 16 cm^2 **i** 22 cm^2

j c and i

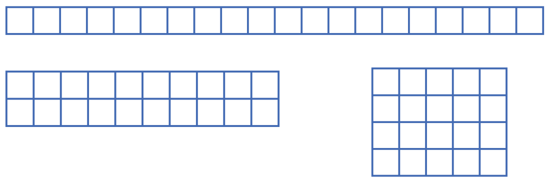
2 **a** 32 cm^2 **b** 40 cm^2 **c** 33 cm^2

d 100 cm^2 **e** 120 cm^2

3 **a** 64 cm^2 **b** 100 cm^2 **c** 49 cm^2

d 81 cm^2

4



5 **a** A = 27 cm^2, P = 24 cm

b A = 88 cm^2, P = 38 cm,

c A = 250 cm^2, P = 70 cm

d A = 1500 cm^2, P = 230 cm

e A = 270 cm^2, P = 78 cm

6C WHOLE CLASS

1 Answer will vary.

2 **a** L = 3 cm, W = 4 cm, A = 12 cm^2

b W = 10 cm, L = 2 cm, P = 24 cm, A = 20 cm^2

c P = 28 cm, A = 49 cm^2, L = 7 cm, W = 7 cm

3 **a** They have the same area.

b Yes. Answers will vary.

6C INDIVIDUAL

1 **a** 24 m^2 **b** 49 m^2 **c** 55 m^2

2 **a** A = 12 m^2, P = 14 m

b A = 40 m^2, P = 26 m

c A = 50 m^2, P = 54 m

d A = 120 m^2, P = 44 m

e A = 72 m^2, P = 34 m

3 Lounge room 80 m^2, Dining room 20 m^2, Kitchen 16 m^2, Bathroom 15 m^2, Bedroom 35 m^2, Hall 14 m^2

4 **a** **i** 1 m^2 **ii** 9 m^2 **iii** 1 km^2

iv 9 cm^2 **v** 144 mm^2 **vi** 16 m^2

vii 36 km^2 **viii** 100 m^2

b These are the square numbers. They appear on the diagonal in the multiplication table.

5 **a** $2700 **b** $3600

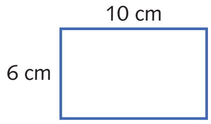
6D REVIEW QUESTIONS

1 **a** 24 m^2 **b** 60 cm^2 **c** 5244 mm^2

2 **a** 16 m^2 **b** 225 cm^2 **c** 441 mm^2

3 There is more than one possibility for each answer.

a



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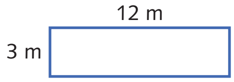
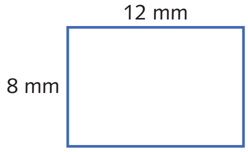
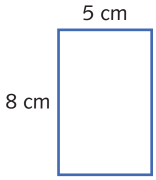


c

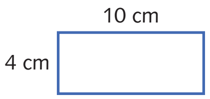


4 One example (there are others):

Area = 40 cm^2, Perimeter = 26 cm



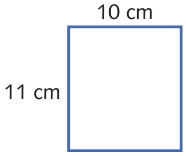
Area = 40 cm^2, Perimeter = 28 cm



5 One example (there are others):

Perimeter = 42 cm, Area = 54 cm^2

Perimeter = 42 cm, Area = 110 cm^2



6 a

Rectangle	Length	Width	Area	Perimeter
A	6 cm	8 cm	**48 cm^2**	28 cm
B	5 cm	10 cm	**50 cm^2**	**30 cm**
C	11 cm	**3 cm**	33 cm^2	**28 cm**
D	9 cm	**4 cm**	36 cm^2	**26 cm**
E	**7 cm**	5 cm	35 cm^2	**24 cm**
F	**3 cm**	9 cm	27 cm^2	**24 cm**

b F, C, E, D, A, B
c F, E, D, C, A, B
d C and D

7 a **A** 8 m^2 **B** 10 m^2 **C** 12 m^2
D 18 m^2 **E** 20 m^2 **F** 30 m^2
b E and F

Chapter 7: Volume

Kick off

1 a 32 **b** 16 **c** 64 **d** 96
2 a 15 **b** 30 **c** 180 **d** 300

7A WHOLE CLASS

1 a 6 cm^3 **b** 18 cm^3 **c** 12 cm^3
d 16 cm^3
2 a 24 cm^3
b 3 × 4 × 2 or 8 × 3 × 1 or 4 × 6 × 1 or 24 × 1 × 1
c 24 cm^3

7A INDIVIDUAL

1 a 10 cm^3 **b** 25 cm^3 **c** 60 cm^3
d 48 cm^3
2 b A = 6 cm^3, B = 36 cm^3, C = 16 cm^3
c ACB **d** same as part **b**
3 a 16 cm^3 **b** 24 cm^3 **c** 20 cm^3
d 12 cm^3

7B INDIVIDUAL

1 a 40 cm^3 **b** 24 cm^3 **c** 60 cm^3
d 144 cm^3
2 a 60 cm^3 **b** 80 cm^3 **c** 120 cm^3
d 180 cm^3
3 a 1 cm^3 **b** 8 cm^3 **c** 27 cm^3
d 64 cm^3 **e** 125 cm^3 **f** 216 cm^3
g 343 cm^3 **h** 512 cm^3
4 a 2730 cm^3 **b** 1820 cm^3

7C WHOLE CLASS

2 d 1 000 000 cm^3 = 1 m^3
(100 cm × 100 cm × 100 cm)
3 a 1 × 1 × 36, 1 × 2 × 18, 1 × 3 × 12,
1 × 4 × 9, 1 × 6 × 6, 2 × 2 × 9,
2 × 3 × 6, 3 × 3 × 4
b 1 m × 1 m × 36 m 1 m × 2 m × 18 m
1 m × 3 m × 12 m 1 m × 4 m × 9 m
1 m × 6 m × 6 m 2 m × 2 m × 9 m
2 m × 3 m × 6 m 3 m × 3 m × 4 m

7C INDIVIDUAL

1 Volume less than 1 m^3: schoolbag, shoe box

Volume greater than 1 m^3 but less than 10 m^3: telephone box

Volume greater than 10 m^3: swimming pool, classroom, bathroom

2 a 120 m^3 **b** 360 m^3
c 10 000 m^3 **d** 125 m^3
3 a 60 m^3 **b** 80 m^3 **c** 120 m^3
d 180 m^3 **e** 280 m^3
4 a 27 m^3 **b** 343 m^3 **c** 1000 m^3
5 a 1.2 m^3 **b** 12 m^3
c 0.225 m^3 **d** 0.024 cm^3
6 a 200 m^3 **b** 400 m^3, it doubles the volume
c 800 m^3, it is 4 × the volume **d** 1600 m^3, it is 8 × the volume

7D INDIVIDUAL

1 **a** 17 cubes **b** 10 cubes
2 **a** 13 cubes **b** 14 cubes
3 **a** 40 cubes **b** 24 cubes
4 **a** 11 cubes **b** 13 cubes
5 **a** 14 cubes **b** 36 cubes
c teacher

7E INDIVIDUAL

1 **a** L **b** mL **c** mL
d L **e** mL **f** L

2 **a** 400 mL **b** 85 mL
c $1\frac{1}{2}$ L or 1500 mL
3 **a** 1000 mL **b** 2000 mL
c 5200 mL **d** 27 000 mL
e 7100 mL **f** 13 100 mL
4 **a** 3 L **b** 5 L
c 10 L **d** 1 L 350 mL
e 4 L 444 mL **f** 10 L 505 mL

5 1750 mL
6 4500 mL 4.5 litres $\left(4\frac{1}{2}\text{ litres}\right)$
7 **a** = 200 mL,
b = 216 mL,
c = 189 mL,
d holds the most
8 **a** 39 000 cm^3 or 39 litres **b** 78 000 cm^3 or 78 litres
c 210 600 cm^3 or 210 litres 600 millilitres **d** 312 000 cm^3 or 312 litres

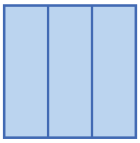
7F REVIEW QUESTIONS

1 **a** 96 cm^3 **b** 432 cm^3
c 288 cm^3 **d** 343 m^3
2 **a** 160 cm^3 **b** 105 m^3
c 81 cm^3 **d** 54 m^3
3 **a** 20 **b** 64
4 **a** 64 cm^3 **b** 343 cm^3
c 27 m^3 **d** 10 648 mm^3
5 **a** 96 m^3
b 288 m^3, 3 times the original volume
c 864 m^3, 9 times the original volume
d 2592 m^3, 27 times the original volume
6 Less than 1 litre: **a, c**
Between 1 and 3 litres: **d**
More than 3 litres: **b, e, f**
7 **a** 28 m^3 **b** 0.72 m^3 **c** 2.88 m^3
d 0.0108 m^3
8 **a** 15 mL **b** 1200 mL **c** 75 mL
d 155 mL
9 5 cm

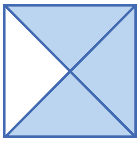
Chapter 8: Fractions

Kick off

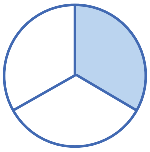
1 **a** $\frac{3}{3}=$



b $\frac{3}{4}=$

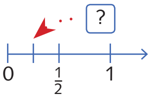


c $\frac{1}{3}=$



d $\frac{2}{3}=$

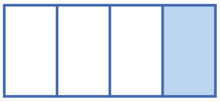
e $\frac{1}{4}=$



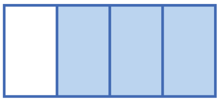
f $\frac{1}{2}=$

Show what you know

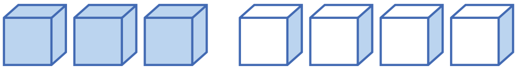
1 **a** one half **b** three quarters
c one fifth **d** three eighths
e two fifths
2 one quarter



3 three quarters



4



There are 7 blocks of equal size. Three of the 7 blocks are blue.
That means that three sevenths of the blocks are blue.

8A WHOLE CLASS

1 **a** $\frac{4}{5}$ **b** $\frac{2}{3}$ **c** $\frac{3}{4}$
2 **a** denominator **b** numerator
c numerator **d** denominator
e denominator

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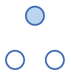
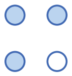
3 Blue counters show the numerator; total counters show the denominator.

Set 1

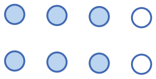
a



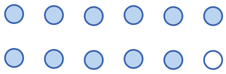
b



c

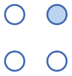


d

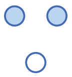


Set 2

a



b



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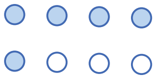

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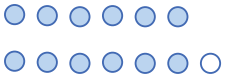


4 **Set 1**

a

b

c

d

Set 2

a

b

c

d

8A INDIVIDUAL

1 numerators: 1, 2, 3, 3, 7 denominators: 5, 4, 4, 8, 8

2 **a** denominator **b** denominator
c numerator **d** numerator
e denominator

3 **a** $\frac{4}{7}$ **b** $\frac{2}{5}$ **c** $\frac{2}{3}$ **d** $\frac{1}{7}$
e $\frac{2}{191}$

4 **a** $\frac{2}{5}$ **b** $\frac{1}{4}$ **c** $\frac{12}{13}$ **d** $\frac{4}{8}$
e $\frac{50}{100}$ **f** $\frac{99}{100}$

5 **a** $\frac{1}{4}$ **b** $\frac{2}{4}$ **c** $\frac{3}{8}$ **d** $\frac{1}{6}$

6 **a** $\frac{1}{5}$ **b** $\frac{2}{5}$ **c** $\frac{1}{6}$ **d** $\frac{3}{7}$
e $\frac{5}{6}$ **f** $\frac{2}{4}$

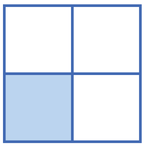
7 **a** $\frac{1}{6}$ **b** $\frac{5}{6}$

8 $\frac{2}{5}$

9 **a** $\frac{2}{3}$ **b** $\frac{3}{4}$ **c** $\frac{1}{5}$

10 **a** $\frac{3}{8}$ **b** $\frac{3}{16}$

11 **a**



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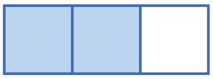

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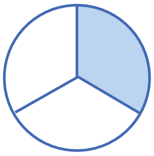

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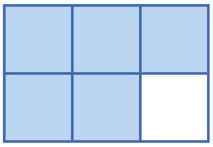
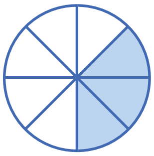
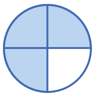


e

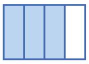


12 Teacher to check

a



b



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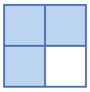

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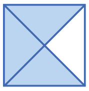


8B WHOLE CLASS

1 **a** two quarters **b** two fifths
c nine quarters **d** eight halves

2 **a** 2 and 3 **b** 3 **c** 3 and 4

3–5 Teacher to check

6 **a** multiples **b** 1
c 6 **d** 3

7–8 Teacher to check

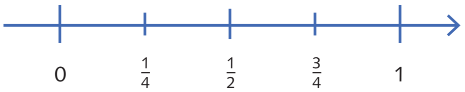
8B INDIVIDUAL

1 **a** one half **b** two quarters
c two thirds **d** three halves
e seven thirds

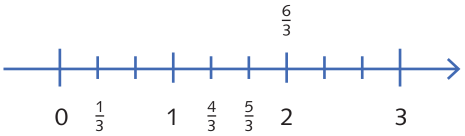
2 **a** $\frac{3}{4}$ **b** $\frac{1}{3}$ **c** $\frac{2}{3}$
d $\frac{7}{4}$ **e** $\frac{9}{2}$ **f** $\frac{72}{3}$

3 Teacher to check

4 **a**



b



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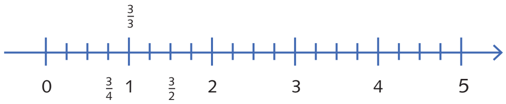

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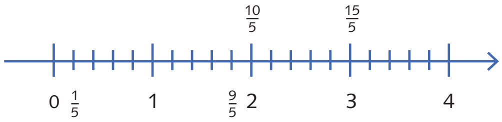
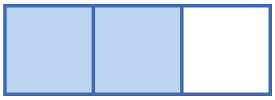


8C WHOLE CLASS

1 c i



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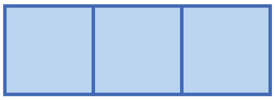
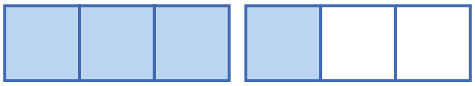


iii



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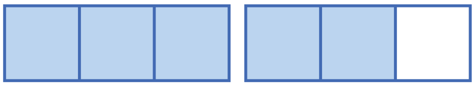
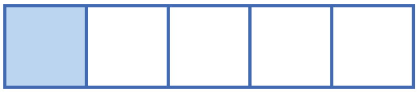


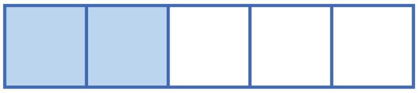
8C INDIVIDUAL

1 a



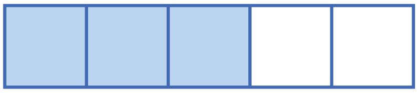
$\frac{1}{5}$

b



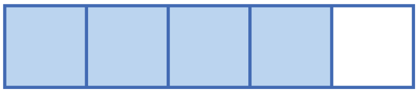
$\frac{2}{5}$

c



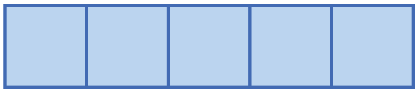
$\frac{3}{5}$

d



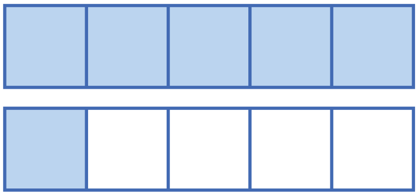
$\frac{4}{5}$

e



$\frac{5}{5}$

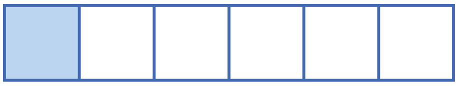
f



$\frac{6}{5}$

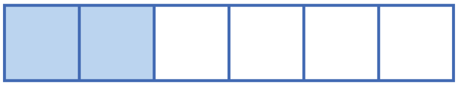
g 1

2 a



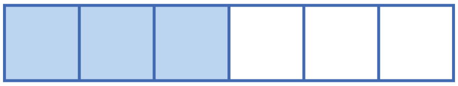
$\frac{1}{6}$

b



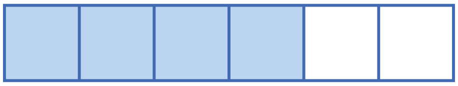
$\frac{2}{6}$

c



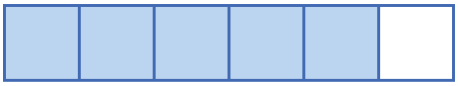
$\frac{3}{6}$

d



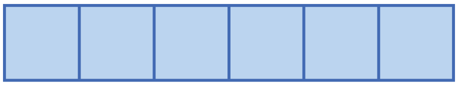
$\frac{4}{6}$

e



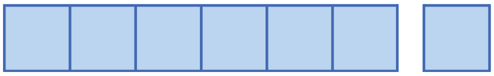
$\frac{5}{6}$

f



$\frac{6}{6}$

g



$\frac{7}{6}$

h

$\frac{9}{6}$

i $\frac{2}{6} = \frac{1}{3}$ $\frac{3}{6} = \frac{1}{2}$ $\frac{4}{6} = \frac{2}{3}$ $\frac{6}{6} = 1$

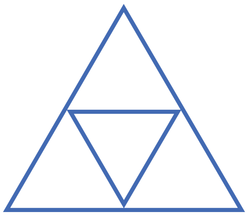
3 a $\frac{1}{3}$ **b** $\frac{1}{2}$ **c** $\frac{3}{6}$ **d** $\frac{5}{11}$ **e** $\frac{2}{5}$

4 a $\frac{2}{6}$ **b** $\frac{4}{6}$ **c** $\frac{2}{6}, \frac{4}{6}$

8D WHOLE CLASS

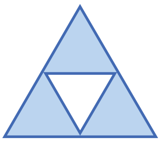
1 Answers will vary.

2 b



c Cut the larger triangle into 4 smaller ones and place them on top of each other to make sure they are the same size.

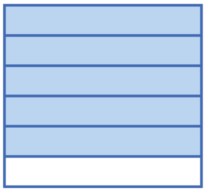
d Here is one example.



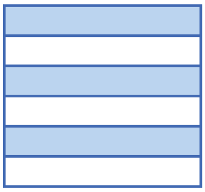
8D INDIVIDUAL

1 Answers will vary. Here are some examples.

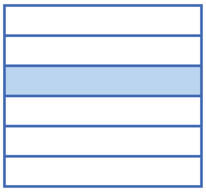
a



b

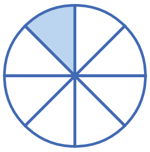


c

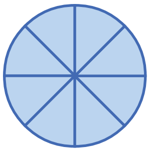


d

2 a



b



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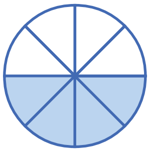

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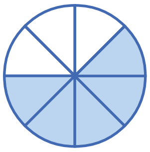


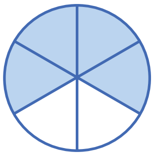
3 a $\frac{1}{3}$ **b** $\frac{1}{2}$ **c** $\frac{2}{6}$

4 a $\frac{1}{4}$ **b** $\frac{2}{3}$ **b** $\frac{4}{8}$

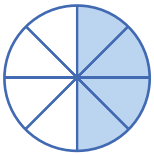
8E WHOLE CLASS

1 b $\frac{5}{10}$ **c** $\frac{5}{10}, \frac{2}{10}$

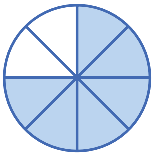
2 a



b



c



3 smaller than $\frac{1}{2}$: $\frac{1}{8}, \frac{1}{3}, \frac{2}{9}, \frac{1}{4}, \frac{1}{10}$; equivalent to $\frac{1}{2}$: $\frac{1}{2}, \frac{4}{8}, \frac{5}{10}$; larger than $\frac{1}{2}$: $\frac{3}{4}, \frac{5}{8}, \frac{2}{3}$

4 a Teacher to check **b** Yes, it is possible.

8E INDIVIDUAL

1 a $\frac{1}{4}$ **b** $\frac{1}{3}$

2 b $\times 4$ **c** $\times 2$ **d** $\times 4$

3 smaller than $\frac{1}{4}$: $\frac{1}{8}, \frac{2}{9}$; equivalent to $\frac{1}{4}$: $\frac{3}{12}, \frac{2}{8}, \frac{1}{4}$;
larger than $\frac{1}{4}$: $\frac{1}{2}, \frac{3}{4}, \frac{5}{8}, \frac{2}{3}, \frac{1}{3}, \frac{5}{10}, \frac{3}{10}$

4 $\frac{1}{2} = \frac{5}{10}$ $\frac{1}{10} = \frac{2}{20}$ $\frac{10}{12} = \frac{5}{6}$
$\frac{6}{8} = \frac{3}{4}$ $\frac{16}{24} = \frac{2}{3}$

5 a $\frac{3}{4}$ **b** $\frac{1}{4}$ **c** $\frac{2}{5}$ **d** $\frac{1}{4}$
e $\frac{2}{5}$ **f** $\frac{4}{7}$ **g** $\frac{3}{8}$ **h** $\frac{2}{5}$

8F INDIVIDUAL

1 a $\frac{3}{5}$ **b** $\frac{8}{7}$ **c** $\frac{7}{12}$

2 a $\frac{1}{8}, \frac{3}{8}, \frac{5}{8}, \frac{6}{8}, \frac{8}{8}$

b $\frac{2}{10}, \frac{3}{10}, \frac{5}{10}, \frac{9}{10}, \frac{10}{10}$

3 a $\frac{3}{8}, \frac{2}{8}, \frac{8}{8}$ **b** $\frac{5}{6}, \frac{3}{6}, \frac{4}{6}$
c $\frac{2}{20}, \frac{8}{20}, \frac{5}{20}$

4 a $\frac{3}{4}$ **b** $\frac{2}{3}$ **c** $\frac{1}{3}$ **d** $\frac{2}{3}$

5 a $\frac{7}{9}$ **b** $\frac{2}{3}$ **c** $\frac{7}{10}$

6 $\frac{1}{2}$ is larger; it is equivalent to $\frac{50}{100}$, which is larger than $\frac{48}{100}$.

7 Mrs Tee's class

8G WHOLE CLASS

1 proper fractions: $\frac{3}{4}$ $\frac{2}{3}$ $\frac{999}{1000}$

mixed numbers: $10\frac{9}{8}$ $2\frac{1}{2}$ $18\frac{2}{3}$ $10\frac{1}{1000}$

improper fractions: $\frac{4}{2}$ $\frac{3}{2}$ $\frac{999}{998}$ $\frac{5}{5}$ $\frac{77}{77}$

2 **a** $\frac{3}{4}$, proper **b** $\frac{5}{2}$, improper

c $\frac{6}{6}$, improper **d** $\frac{6}{4}$, improper

3 Teacher to check

8G INDIVIDUAL

1 **a** 2 **b** 1 **c** 3 **d** 4

e 6 **f** 10 **g** 7 **h** 2

i 1 **j** 2

2 Teacher to Check

3 **a** $\frac{17}{4}$ **b** $\frac{17}{5}$ **c** $\frac{83}{10}$ **d** $\frac{926}{100}$

e $\frac{27}{2}$ **f** $\frac{17}{8}$ **g** $\frac{59}{12}$ **h** $\frac{199}{50}$

i $\frac{6111}{1000}$ **j** $\frac{138}{30}$

4 **a** $1\frac{1}{3}$ **b** $2\frac{2}{5}$ **c** $2\frac{2}{3}$ **d** $2\frac{2}{25}$

e $11\frac{1}{3}$ **f** $6\frac{2}{3}$ **g** $1\frac{3}{37}$ **h** $8\frac{1}{3}$

i $3\frac{1}{25}$ **j** $25\frac{1}{2}$

5 **a** $\frac{5}{2}, 2\frac{1}{2}$ **b** $\frac{15}{4}, 3\frac{3}{4}$ **c** $\frac{31}{8}, 3\frac{7}{8}$

8H INDIVIDUAL

Teacher to check number lines

1 **a** $\frac{4}{4}$ or 1 **b** $\frac{4}{5}$

c $\frac{5}{6}$ **d** $\frac{11}{10} = 1\frac{1}{10}$

2 **a** $\frac{5}{4}$ or $1\frac{1}{4}$ **b** $\frac{4}{9}$ **c** $\frac{5}{6}$

d $\frac{13}{20}$ **e** $\frac{11}{11}$ or 1 **f** $\frac{4}{5}$

g $\frac{7}{8}$ **h** $\frac{39}{20}$ or $1\frac{19}{20}$

3 **a** Thursday **b** $\frac{1}{3}$ of a tank

c $1\frac{1}{3}$ of a tank **d** $\frac{18}{6} = 3$ tanks

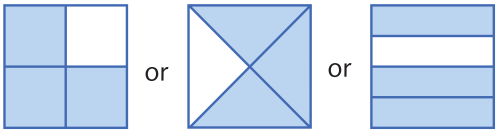
8I REVIEW QUESTIONS

1 **a** $\frac{1}{4}$ **b** $\frac{3}{5}$ **c** $\frac{3}{4}$ **d** $\frac{1}{7}$

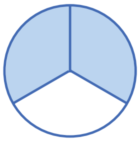
2 $\frac{6}{10}$

3 **a** $\frac{7}{14}$ **b** $\frac{1}{8}$ **c** $\frac{5}{18}$ **d** $\frac{11}{21}$

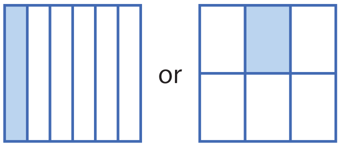
4 **a**



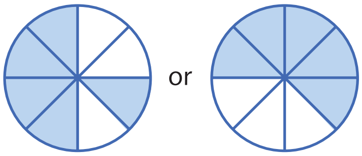
b



c

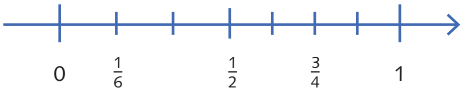


d



5 **a** $\frac{7}{8}$ **b** $\frac{2}{5}$ **c** $\frac{8}{10}$

6 **a**



b

7 **a** $\frac{1}{3}$ **b** $\frac{2}{4}$ **c** $\frac{2}{4}$

d $\frac{3}{4}$ **e** $\frac{4}{11}$ **f** $\frac{3}{11}$

g $\frac{4}{11}$

8 **a** $\frac{3}{5}$ **b** $\frac{5}{9}$ **c** $\frac{6}{10}$

9 **a** $\frac{1}{2} = \frac{3}{6} = \frac{12}{24}$ **b** $\frac{2}{6} = \frac{10}{30} = \frac{5}{15}$

c $\frac{6}{8} = \frac{3}{4} = \frac{12}{16}$

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10 Smaller than $\frac{2}{3}$: $\frac{1}{2}, \frac{3}{12}, \frac{1}{8}, \frac{1}{3}, \frac{2}{8}, \frac{2}{9}, \frac{5}{10}, \frac{1}{4}, \frac{3}{10}$

Equivalent to $\frac{2}{3}$: $\frac{4}{6}, \frac{10}{15}$

Larger than $\frac{2}{3}$: $\frac{3}{4}, \frac{3}{3}, \frac{6}{4}$

11 $\frac{1}{10}, \frac{1}{8}, \frac{1}{6}, \frac{1}{4}, \frac{1}{3}$

12 **a** $\frac{6}{8}$ **b** $\frac{1}{3}$ **c** $\frac{1}{4}$
d $\frac{7}{8}$ **e** $\frac{9}{10}$ **f** $\frac{2}{3}$

13 Stefan

14 **a** $\frac{2}{3}$ **b** $\frac{3}{5}$ **c** $\frac{6}{7}$
d $\frac{6}{9}$ or $\frac{2}{3}$ **e** $\frac{5}{6}$ **f** $\frac{11}{12}$

Chapter 9: Decimals

Show what you know

1

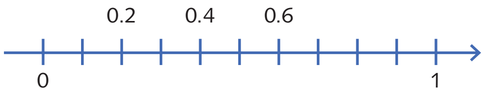
9A WHOLE CLASS

3 **a** $\frac{1}{10}$, 0.1 **b** $\frac{3}{10}$, 0.3 **c** $\frac{7}{10}$, 0.7

9A INDIVIDUAL

1 **a** 0.4 **b** 0.5 **c** 0.6
d 0.7 **e** 0.8 **f** 0.9

2



3 **a** 0.5 **b** 0.9 **c** 0.6

4 **a** 0.1 **b** 0.4 **c** 0.9

5 **a** $\frac{2}{10}$ **b** $\frac{3}{10}$ **c** $\frac{5}{10}$

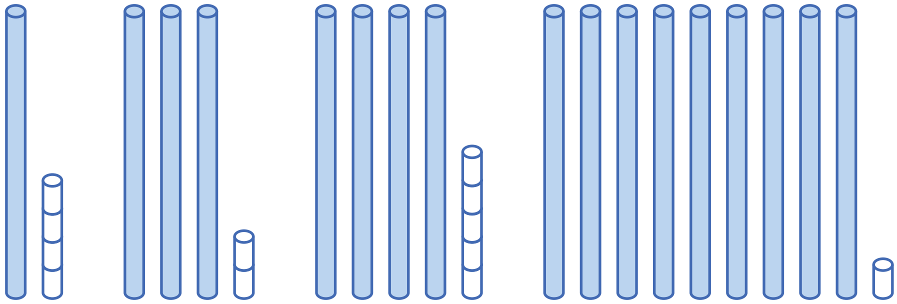
6 **a** 0.3, 0.4, 0.5, 0.8
b 0.1, 0.7, 0.9, 1.0

7 **a** 0.6
b 0.8
c 0.1

9B WHOLE CLASS

2 **b** 10 tenths is the same as 1.

c



9B INDIVIDUAL

1

		Hundreds	Tens	Ones		tenths
	45.7		**4**	**5**	•	**7**
a	45.6		4	5	•	6
b	8.2			8	•	2
c	60.8		6	0	•	8
d	2.3			2	•	3
e	32		3	2	•	
f	500.4	5	0	0	•	4

2 **a** $2\frac{1}{10}$ **b** $3\frac{5}{10} = 3\frac{1}{2}$

c $\frac{8}{10} = \frac{4}{5}$ **d** $2\frac{6}{10} = 2\frac{3}{5}$

e $4\frac{4}{10} = 4\frac{2}{5}$ **f** $10\frac{2}{10} = 10\frac{1}{5}$

g $1\frac{7}{10}$ **h** $27\frac{3}{10}$

3 **a** 1.1 **b** 2.7 **c** 8.4 **d** 3.3

e 12.2 **f** 91.8 **g** 143.6 **h** 1.1

4 **a** 0.9, zero point nine

b 6.2, six point two

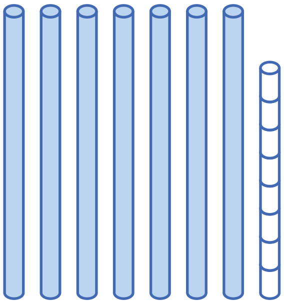
c 38.6, thirty-eight point six

d 19.4, nineteen point four

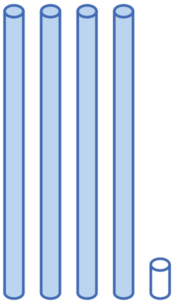
e 100.7, one hundred point seven

f 482.7, four hundred and eighty-two point seven

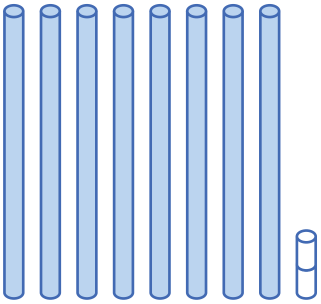
5 **a**



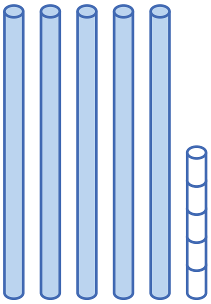
b



c



d



6 **b** 32.1 **c** 706.7

d 49.6 **e** 25.7

f 14.3

7 **a** 0.5 **b** 0.2 **c** 1.5

d 0.25 **e** 0.75 **f** 4.25

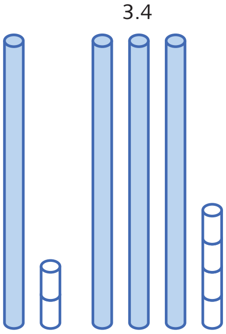
g 6.5 **h** 2.75 **i** 1.2

j 0.05 **k** 3.4 **l** 0.8

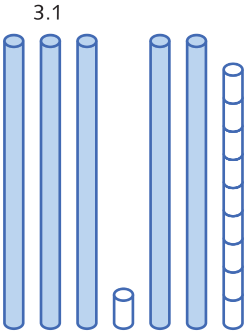
m 0.15 **n** 7.2

9C WHOLE CLASS

1 **a**



b



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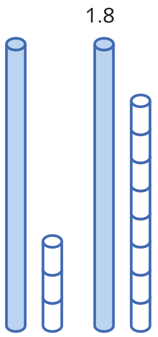
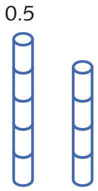
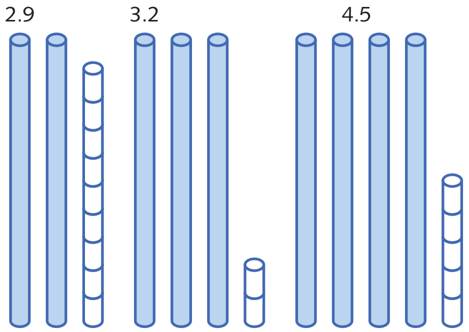
c



d



2 **a**



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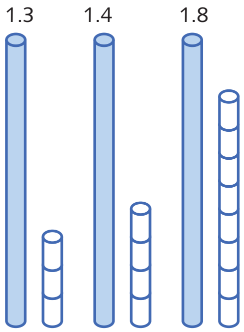

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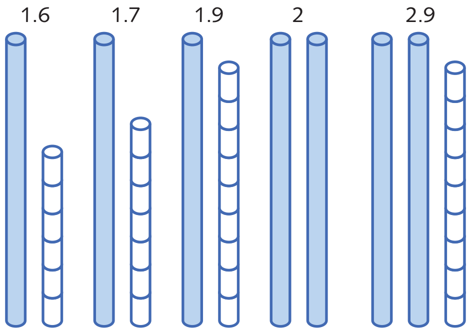
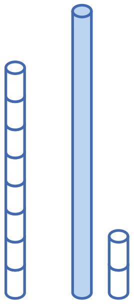


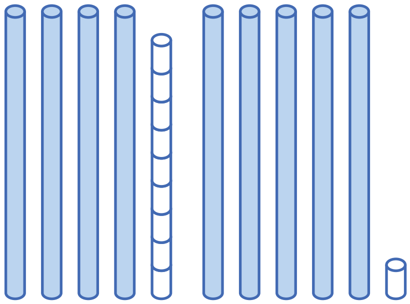
3 **b**

9C INDIVIDUAL

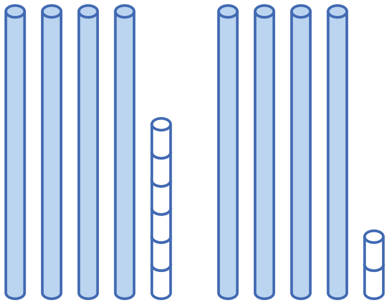
1 **a** 1.2 is larger.



b 5.1 is larger.



c 4.6 is larger.



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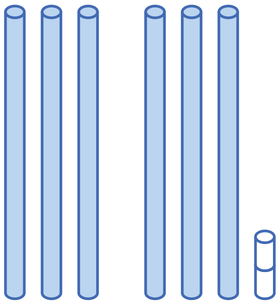
d 3.2 is larger.



2 **a** 1.1 1.2 1.3 1.4 1.5 1.7 1.8 1.9

b 0.0 0.1 0.2 0.7 1.2 2.1 7.0 12.1

c 1.8 4 4.3 4.7 5.0 9.1 12 12.1

3 **a** Jack is the tallest.

b Lin is the shortest.

c Jack is closest to being 2 metres tall.

4 **a** 3.1 3.3 3.4 3.6

b 0.6 1.4 7.1 8.2

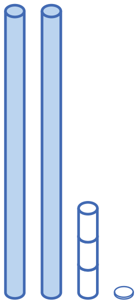
c 0.6 2.6 3.2 6.2

d 1.0 1.2 2.1 10.2

5 **a** 1.1 **b** 0.8 **c** 0.9 **d** 3.5

9D WHOLE CLASS

1 **a**



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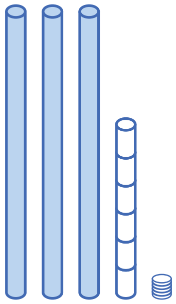
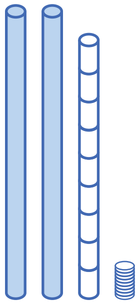


c



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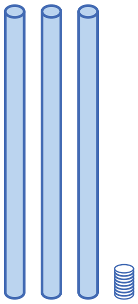


9D INDIVIDUAL

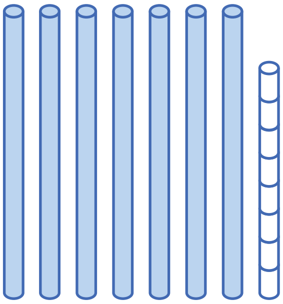
1

		Hundreds	Tens	Ones		tenths	hundredths
	1.05			**1**	•	**0**	**5**
a	2.33			2	•	3	3
b	10.82		1	0	•	8	2
c	153.18	1	5	3	•	1	8
d	49.02		4	9	•	0	2

2 **a** 23.45: twenty-three point four five

b 438.14: four hundred and thirty-eight point one four

3 **a**



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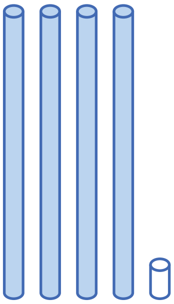

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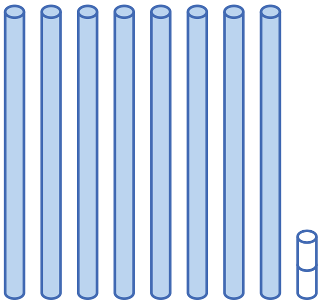

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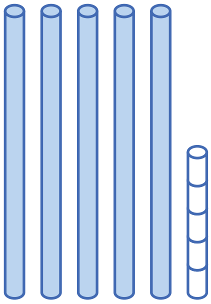

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4 **a** point zero six
b point two two
c point seven four

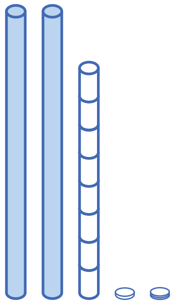
5 **a** 0.01 **b** 0.02 **c** 0.03
d 0.07 **e** 0.09 **f** 0.12
g 0.37

6 **a** $\frac{1}{100}$ **b** $\frac{8}{100}$
c $\frac{2}{100}$ **d** $\frac{23}{100}$
e $\frac{66}{100}$ **f** $\frac{99}{100}$

7 **b** 82.63 **c** 984.17
d 52.25 **e** 170.76

9E WHOLE CLASS

2 **a**



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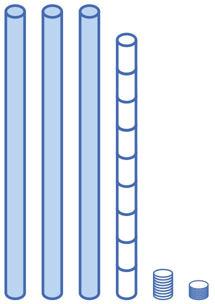

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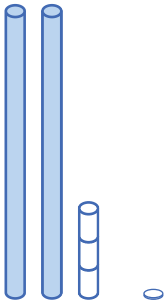

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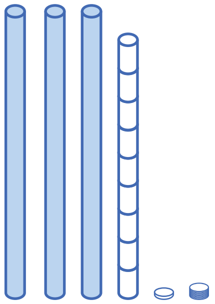


9E INDIVIDUAL

1 **a** 0.792: point seven nine two
b 1.294: one point two nine four
c 82.709: eighty-two point seven zero nine
d 121.048: one hundred and twenty-one point zero four eight

2

		Hundreds	Tens	Ones		tenths	hundredths	thousandths
	3.908			**3**	•	**9**	**0**	**8**
a	0.236			0	•	2	3	6
b	1.732			1	•	7	3	2
c	456.007	4	5	6	•	0	0	7
d	121.893	1	2	1	•	8	9	3
e	909.674	9	0	9	•	6	7	4

3 **a** 0.001 **b** 0.004 **c** 0.006
d 0.333 **e** 0.424 **f** 0.999
g 0.048 **h** 0.068 **i** 0.012
j 0.099

4 **a** $\frac{1}{1000}$ **b** $\frac{2}{1000}$ **c** $\frac{4}{1000}$

d $\frac{6893}{10\,000}$ **e** $\frac{6161}{10\,000}$ **f** $\frac{9999}{10\,000}$
g $\frac{21}{100}$ **h** $\frac{11}{100}$ **i** $\frac{38}{100}$
j $\frac{166}{1000}$ **k** $\frac{499}{1000}$ **l** $\frac{500}{1000}$

9E HOMEWORK

1 **a** 0.1 **b** 0.1 **c** 0.2
d 0.1 **e** 0.3 **f** 0.2

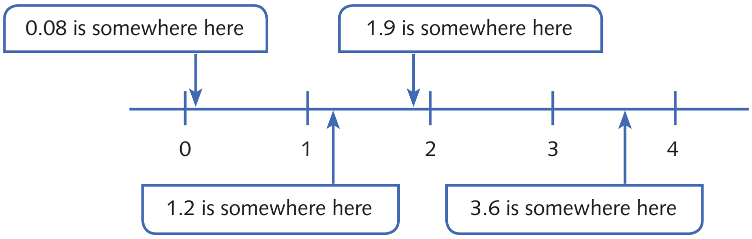
9F WHOLE CLASS

2 **a** 1.1 **b** 2.77 **c** 0.91 **d** 0.3

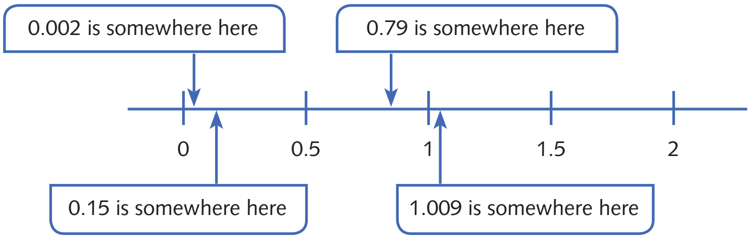
3 952.1 is the largest, 1.259 is the smallest.

9F INDIVIDUAL

1 **a**



b



2 **a** 0.8 **b** 4.92
c 4.8 **d** 0.3
e 8.983 **f** 4.8
g 38.3 **h** 2.1231

3 **a** 0.9 0.6161 0.21 0.001
b 1.499 1.424 1.402 1.4
c 0.166 0.11 0.01 0.004
d 0.6893 0.38 0.3 0.099

4 **a** 0.5 **b** $\frac{1}{8}$ **c** $3\frac{999}{1000}$

5 **a** 0.7 **b** 0.3 **c** 0.999

6 **a** $\frac{11}{10}$, 1.2, $2\frac{1}{10}$, 2.11, 2.18

b $\frac{2}{10}$, $\frac{11}{10}$, 1.6, $\frac{21}{10}$, 2.4, 2.7

9G REVIEW QUESTIONS

1

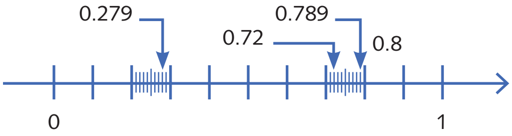
		Hundreds	Tens	Ones		tenths	hundredths	thousandths
b	23.803		2	3	•	8	0	3
c	999.876	9	9	9	•	8	7	6
d	20.07		2	0	•	0	7	
e	402.024	4	0	2	•	0	2	4

2 **a** 0.1 **b** 0.3 **c** 0.4
d 0.5 **e** 0.6 **f** 0.8
g 0.9

3 **a**

b

c



4 **a** 0.5 **b** 0.7 **c** 0.6
d 0.03 **e** 0.35 **f** 0.91

5 **a** 18.2305; eighteen point two three zero five
b 902.563; nine hundred and two point five six three

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6 Teacher to check

7 **a** 0.8 **b** 0.04 **c** 0.007

d 0.23 **e** 0.003 **f** 0.072

8 **a** $\frac{3}{1000}$ **b** $\frac{8}{100}$ **c** $\frac{104}{1000}$

d $\frac{43}{100}$ **e** $\frac{108}{1000}$ **f** $\frac{909}{10\,000}$

9 Martha is the tallest.

Joanne is the shortest.

10 Claude

11 **a** 7.6 **b** 4.9 **c** 1.4 **d** 1.932

12 **a** 5.6 3.4 1.2 0.8

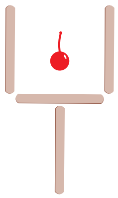
b 0.802 0.228 0.02 0.008

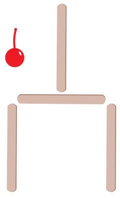
c 0.593 0.347 0.051 0.009

d 100.222 100.2 100.022 100.02

Chapter 10: Lines and angles

Kick off





10A INDIVIDUAL

1 **a** parallel lines and vertical lines

b horizontal line

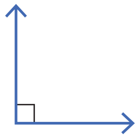
c vertical line

d parallel lines

10B WHOLE CLASS

2 **a** 360°

b Half a full revolution = 180° or a straight angle

c  A right angle or 90°

d Half a full turn is 180°. One-quarter of a full turn is 90°. This is also called a right angle.

3 Teacher to check

4 Teacher to check. The hands are at 90° to each other twice between any two times the hands cross over.

5 **a** the same

b half of a right angle = 45°

6 Teacher to check

10B INDIVIDUAL

1 **a** An acute angle is less than 90°.

b A straight angle is 180°.

c A right angle is $\frac{1}{4}$ of a complete turn.

d An obtuse angle is between 90° and 180°.

e A reflex angle is more than 180° but less than 360°.

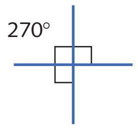
2 **a** straight **b** obtuse **c** reflex

d reflex **e** right **f** acute

g straight **h** reflex **i** straight

j reflex **k** right **l** obtuse

3 **b**



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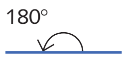

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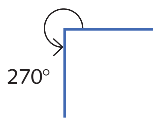
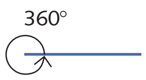


e



10C WHOLE CLASS

1 **a** 20° **b** 160°

2 Teacher to check

3 **a** Teacher to check

b Teacher to check

c 360°

4 Teacher to check

10C INDIVIDUAL

1 **a** 120° **b** 40°

c 240° **d** 30°

2 **a** 360°, $A = B = 135°$, $C = 90°$, $A + B + C = 360°$

b $P + Q + R + S = 360°$, $F + G + H = 360°$

c The sum of angles around a point is 360°.

10D REVIEW QUESTIONS

1 Teacher to check

2 **a** right angle **b** reflex

c acute **d** straight

e reflex **f** obtuse

3 **a** and **b** Teacher to check

4 Teacher to check angles drawn

Chapter 11: Two-dimensional shapes

Kick off

1 **a** square, quadrilateral, 4 equal sides, rectangle, 2 equal sides, 3 equal sides
- **b** triangle
- **c** rectangle, quadrilateral, 2 equal sides
- **d** 2 equal sides, 3 equal sides, 4 equal sides
- **e** triangle, 2 equal sides
- **f** quadrilateral, 4 equal sides, 2 equal sides
- **g** triangle, 3 equal sides, 2 equal sides
- **h** quadrilateral, 4 equal sides, 2 equal sides

11A WHOLE CLASS

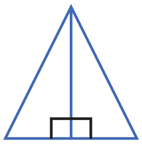
1 Teacher to check

11A INDIVIDUAL

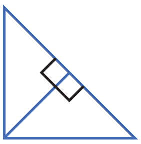
1–2 Teacher to check

3 **b** They are all 90°.
- **e** Angles are not all 90°.

4 **a**



b



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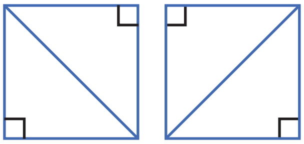


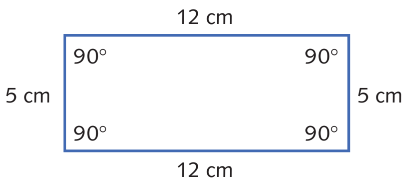
11B WHOLE CLASS

1–2 Teacher to check

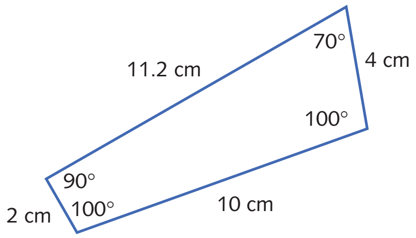
11B INDIVIDUAL

1–2 Teacher to check

3 **a**



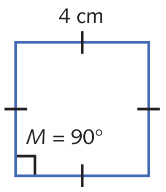
b



c 360°

d It is the same as the opposite side. The 90° angles make it a rectangle.

4 **b**



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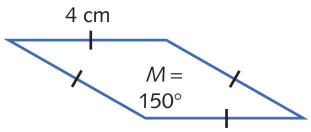
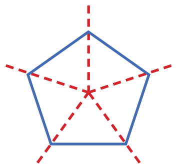


11C WHOLE CLASS

1 Teacher to check

a



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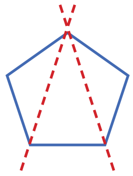

c All 3 triangles are isosceles.

11C INDIVIDUAL

1 **a** *AB* = 4 cm, *BC* = 7 cm, *AC* = 4 cm
A = 120°, *B* = 30°, *C* = 30°

b *DG* and *EF* = 5 cm, *DE* and *GF* = 3 cm
D, *E*, *F* and *G* = 90°

c All sides = 2.5 cm
H, *I*, *J*, *K*, *L* and *M* = 120°

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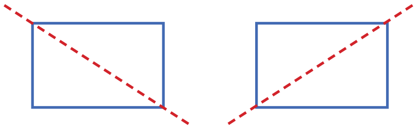
2 **a** regular hexagon **b** dodecagon
c octagon **d** pentagon
e decagon **f** pentadecagon

3 **a**



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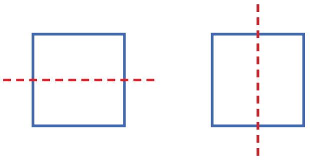

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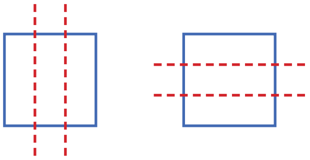

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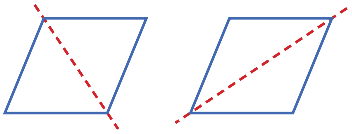

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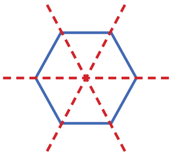

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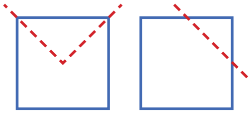

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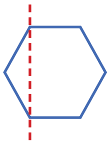


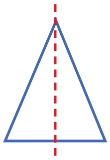
4 **c** 6

11D WHOLE CLASS

1–3 Teacher to check

11D INDIVIDUAL

1 **a**



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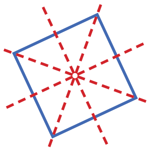

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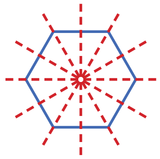
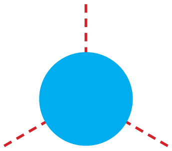


2 Teacher to check

3 **a**



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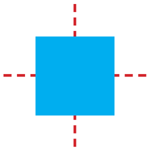

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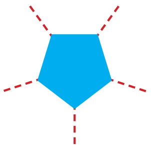

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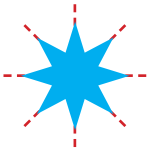


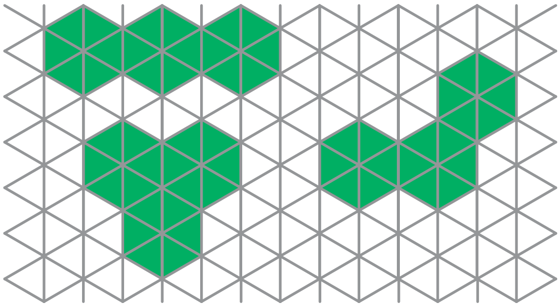
11E WHOLE CLASS

1–2 Teacher to check

11E INDIVIDUAL

1–2 Teacher to check

3 The three possible shapes that can be made are:

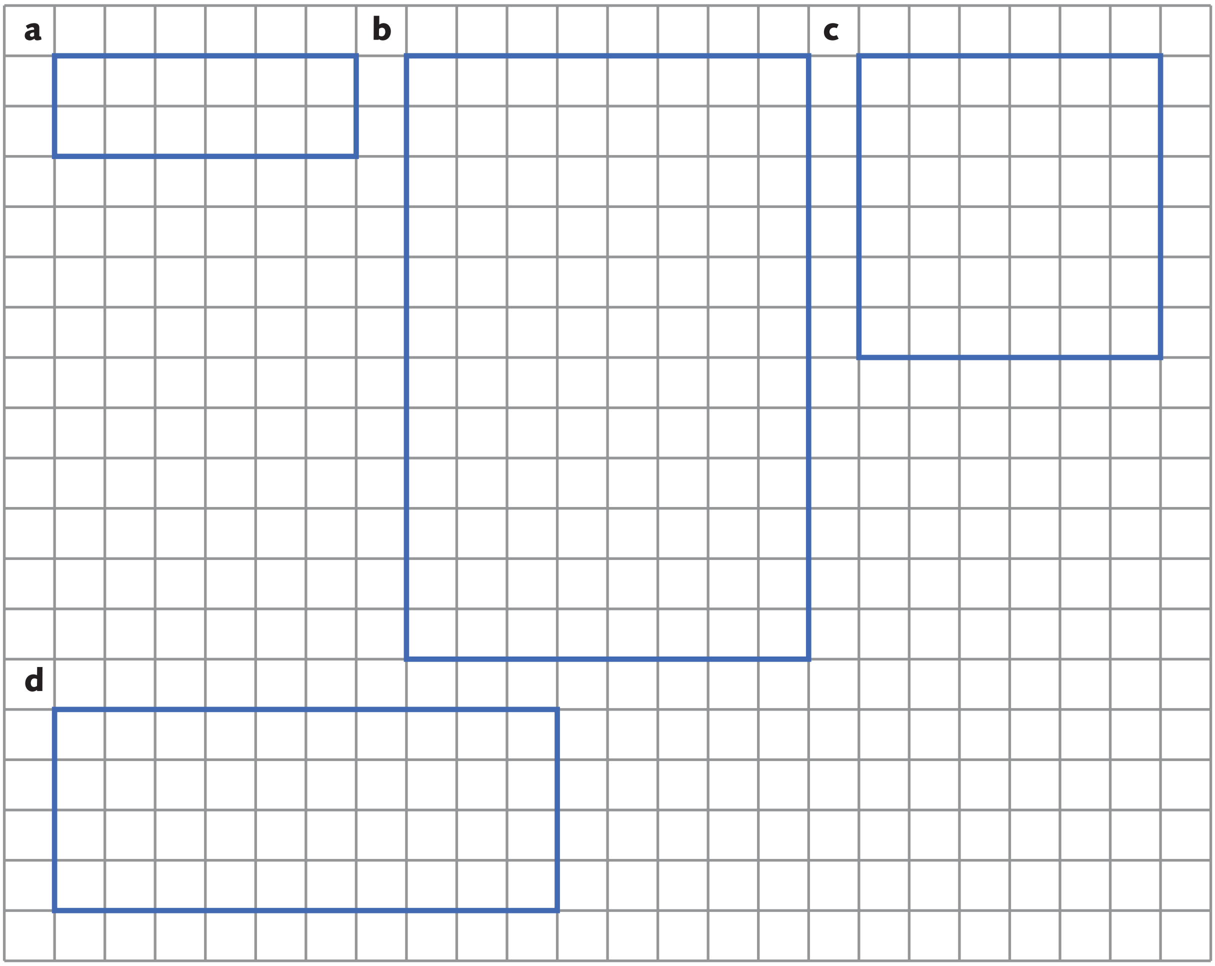


11F WHOLE CLASS

1 Teacher to check

11F INDIVIDUAL

1



2 **a** $P = 24\,\text{cm},\ A = 36\,\text{cm}^2$

b $P = 30\,\text{cm},\ A = 36\,\text{cm}^2$

c $P = 24\,\text{cm},\ A = 36\,\text{cm}^2$

d $P = 40\,\text{cm},\ A = 100\,\text{cm}^2$

11G REVIEW QUESTIONS

1–3 Teacher to check

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Chapter 12: Three-dimensional objects

Kick off

1 **a** equilateral triangle
  b cube
  c rectangle
  d regular tetrahedron

Show what you know

1 **a** cube
  b tetrahedron or triangular pyramid
  c cylinder
  d rectangular prism

12A WHOLE CLASS

1 Teacher to check sketches of cube, tetrahedron and pentahedron
  a A cube has 6 faces, 12 edges and 8 vertices.
  b A tetrahedron has 4 faces, 6 edges and 4 vertices.
  c A square pyramid has 5 faces, 8 edges and 5 vertices.
  d A triangular prism has 5 faces, 9 edges and 6 vertices.

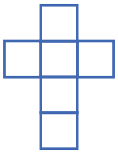
12A INDIVIDUAL

1 **a** tetrahedron **b** pentahedron
  c decahedron **d** hexahedron
2 **a** A hexahedron or cube has 6 faces, 12 edges and 8 vertices.
  b An octahedron has 8 faces, 12 edges and 6 vertices.
  c A nonahedron has 9 faces, 16 edges and 9 vertices.

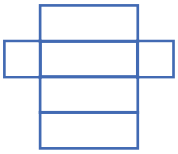
12B WHOLE CLASS

1–3 Teacher to check

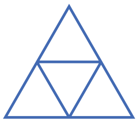
4 **a**



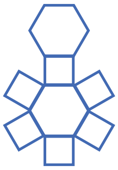
b



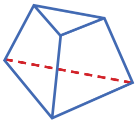
c



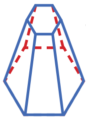
d



5 **a**



b



6 Teacher to check

12B INDIVIDUAL

1 **a** rectangle **b** pentagon
  c triangle **d** hexagon
2 **a** 2 **b** 1 **c** 4
  d 5 **e** 3

12C REVIEW QUESTIONS

1 Teacher to check
2 **a** This hexahedron or rectangular prism has 6 faces, 12 edges and 8 vertices.
  b This tetrahedron has 4 faces, 6 edges and 4 vertices.
  c This octahedron has 8 faces, 18 edges and 12 vertices.
3 **a** triangular pyramid or tetrahedron
  b triangular prism or pentahedron
  c cube
  d square pyramid or pentahedron
  e hexahedron or rectangular prism

Chapter 13: Maps and coordinates

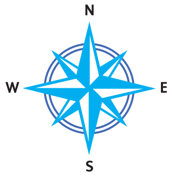
Kick off

Teacher to check

Show what you know

1 north, south, east, west
2 **a** west
  b east
3 south
4 north

5



13A WHOLE CLASS

1–2 Teacher to check

3 **a** 90°
b 180°
c 270°

4 **a** guinea pigs **b** silk worms
c lizards **d** dogs
e hermit crabs **f** snakes

5 **a** C4 **b** A6 **c** F1 **d** D3

13A INDIVIDUAL

1 Teacher to check

2 **a** Manly Golf Course
b North Steyne SLSC
c Cemetery
d Mackellar Girls HS
e Manly Wharf
f Manly West Primary

3 **a** A5, A6 **b** I2, J2 **c** F4, G4
d G9 **e** G9 **f** F10

4 Sydney Road

5 Teacher to check

6 **a** Melbourne **b** Brisbane
c Sydney **d** Canberra
e Adelaide

7 **a** Broken Hill
b Ararat, Horsham
c Orbost, Cann River
d Benalla, Wangaratta
e Bathurst, Lithgow, Orange
f Newcastle
g Kempsey, Port Macquarie
h Bourke
i Warrnambool
j Bega

8 **a** M2 **b** K9 **c** C11
d E10 **e** M4 **f** A6
g E8 **h** K3 **i** J5
j L1 **k** G11 **l** F6
m H13 **n** A3 **o** E13
p I7 **q** K8 **r** G3

13B REVIEW QUESTIONS

1 **a** shed **b** dining room
c swimming pool **d** Mr Blue's room
e kitchen **f** Mr Beige's room

2 Choose from one of:
a F10, G10, F11 or G11
b J8, J9, J10, J11, K8, K9, K10, K11, L8, L9, L10 or L11
c H10, H11, I10 or I11
d L2, L3, M2, M3
e P1, P2, P3, Q1, Q2 or Q3
f F8

3 **a** Ms Jade: D10, D11, E10 or E11,
Mrs Olive: F10, F11, G10 or G11 and
Ms Rose: H10, H11, I10 or I11
b Mrs Pink: D2, D3, E2 or E3
c Ms Rose: H10, H11, I10 or I11
d Mrs Pink: D2, D3, E2 or E3 and
Mr Blue: B2, B3, C2 or C3
e Mr Tan: L2, L3, M2, M3

Chapter 14: Measurement

Kick off

You always end up with 10 times your original number.

Show what you know

1–2 Teacher to check

3 **a** kg **b** g **c** g
d g **e** kg **f** g
g g **h** kg or g **i** kg or tonne

4 **a** 5000 g **b** 7000 g **c** 12 000 g

14A WHOLE CLASS

1 Teacher to check

2 **a** $\frac{1}{2}$ **b** $\frac{1}{4}$

3 Teacher to check

4 **a** 1.25 g **b** 3.4 g
c 3.5 g **d** 0.275 g
e 3000 g **f** 12 000 g
g 30 g **h** 124 000 g

5 Teacher to check

14A INDIVIDUAL

1 **a** less **b** more **c** more
d less **e** more **f** less

2 **a** more **b** less
c more **d** more
e less **f** less
g more **h** more

3 **a** 1.5 g **b** 3.25 g
c 2.75 g **d** 400 g
e 1250 g **f** 3700 g
g 999 000 g **h** 10 000 000 g

4 **a** 4 kg **b** 3.5 kg
c 2.04 kg **d** 2.25 kg
e 5.25 kg **f** 0.6 kg
g 0.035 kg **h** 0.01 kg

5 **a** 4.25 t **b** 2.75 t
c 3.2 t **d** 1.7 t

6 **a** 3.56 kg **b** 700 g **c** 0.45 g
d 1250 kg **e** 2 t 500 kg **f** 4250 mg

7 **a** 0.75 kg of peas
b 13 680 g of bricks
c 125 g of butter

8 Yes, because the total is 23 600 kg or 23.6 tonnes

REFLECTION

1 **a** 10 apples
b 6 or 7 apples
c Teacher to check

14B WHOLE CLASS

1 **a** 0800 **b** 0630
c 0742 **d** 0940

2 Teacher to check

3 **a** 4 a.m. **b** 5:35 a.m.
c 2 p.m. **d** 3:10 p.m.

14B INDIVIDUAL

1 **a** 1100 **b** 0452
c 1500 **d** 1319

2 **a** 1 p.m. **b** 8 a.m.
c 7 p.m. **d** 9 p.m.
e 11 p.m. **f** 8:27 a.m.
g 12:10 a.m.

3 **a** 12:00 p.m. **b** 12:00 a.m.
c 11:59 p.m. **d** 0:03 a.m.
e 10:01 a.m.

4 **a** 2 p.m.,1400
b 10 a.m., 1000
c 11 p.m., 2300
d 5:23 a.m., 0523

5 midnight, 0450, 5:05 a.m., noon, 1310, 3:45 p.m., 7:15 p.m., 2055, 10:25 p.m., 2320

6 1830

7 7:45 p.m.

8 5:40 a.m., 5:40 p.m., 0540, 1740, 20 to 6 in the morning, 20 to 6 in the evening

14C WHOLE CLASS

1 **a** 1800 **b** 2250
c 3:05 p.m. **d** 9 a.m.
e 11:10 a.m.

2 **a–c** Teacher to check

3

Destination	**Train 1**	**Train 2**	**Train 3**	**Train 4**	**Train 5**
Central	1432	1442	1452	1502	1512
Scotsville	1436	1446	1456	1506	1516
Newcombe	1440	1450	1500	1510	1520
Harcourt	1444	1454	1504	1514	1524
Jackson	1448	1458	1508	1518	1528

4 4:05 p.m.

14C INDIVIDUAL

1 **a** Anton
b Sienna, 57 minutes
c 1 hour and 8 minutes

2 4:01 p.m.

3 **a** 1810 **b** 12:40 p.m.
c 0549 **d** 2208
e 0024

4 **a** 2:40 p.m. **b** 12:37 p.m.
c 11:52 p.m. **d** 1731
e 2336

5 **a** 5 hours and 15 minutes
b 1 hour and 3 minutes
c 2 hours and 47 minutes
d 7 hours and 31 minutes
e 56 minutes
f 4 hours and 29 minutes

6 9 hours 18 minutes

7 **a** 1 hour 19 minutes
  b 1340
  c 1 hour 5 minutes

8 1430

9 6:50 a.m.

10 0820 or 8:20 a.m.

11 **a** 10 a.m. Monday
  b 6:45 a.m. Tuesday
  c 0009 Saturday
  d 8:24 p.m. Saturday

14D WHOLE CLASS

1–2 Teacher to check

14D INDIVIDUAL

1 **a** 26°C **b** 15°C
  c 45°C **d** 37°C
  e 5°C

2 Teacher to check

3 Sydney, 11°C Hobart, 9°C
  Adelaide, 13°C Darwin, 13°C
  Brisbane, 10°C Perth, 12°C
  Melbourne, 10°C

14E REVIEW QUESTIONS

1 **a** 3 g **b** 1.5 g
  c 600 g **d** 1800 g
  e 4125 g **f** 150 000 g
  g 1 500 000 g **h** 15 000 000 g

2 **a** 8 kg **b** 1.2 kg
  c 0.07 kg **d** 0.128 kg

3 **a** 0.875 kg
  b 18 240 g

4 **a** 0600 **b** 1325
  c 1538 **d** 2359

5 **a** 2 p.m. **b** 4:32 a.m.
  c 1:58 p.m. **d** 6:45 p.m.
  e 9:27 p.m.

6 **a** 4 p.m., 1600
  b 5 a.m., 0500
  c 5:12 p.m., 1712
  d 5:33 a.m., 0533
  e 8:15 p.m., 2015

7 5 hours and 38 minutes

8 **a** 1950 **b** 11:20 p.m.
  c 0803 **d** 2148

9 **a** 9:10 a.m. **b** 9:55 p.m.
  c 12:42 a.m. **d** 1313

10 **a** 100°C **b** 35°C
  c 0°C **d** 120°C
  e –5°C

11

City	Minimum temperature	Maximum temperature	Difference between minimum and maximum temperature
Wagga Wagga	11°C	13°C	**2°C**
Kapunda	5°C	**17°C**	12°C
Meekatharra	**8°C**	25°C	17°C
Humpty Doo	17°C	31°C	**14°C**
Murgon	**0°C**	19°C	19°C
Tooborac	3°C	**15°C**	12°C
Wynyard	1°C	**12°C**	11°C
Tharwa	0°C	4°C	**4°C**

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Chapter 15: Decimal arithmetic

Kick off

a 0.5 **b** 0.25 **c** 0.1
d 0.75 **e** 0.6 **f** 0.9
g 0.99 **h** 0.47 **i** 0.01

15A WHOLE CLASS

1 Teacher to check
2 **a** and **b** 0.4 and 0.9, 0.5 and 0.8, 0.6 and 0.7
c 0.7

15A INDIVIDUAL

1 **a** 0.7 **b** 1.9
c 5.5 **d** 1.3
e 0.08 **f** 0.11
g 1.09 **h** 4.98
2 **a** 2.9 **b** 6.9 **c** 5.1
d 6.8 **e** 8.89 **f** 1.39
g 14.73 **h** 153.1 **i** 5.3
j 9.1 **k** 13.7 **l** 13.5
m 27.09 **n** 61.69 **o** 9.96
p 15.33 **q** 875.476 **r** 43.27
3 1.03 m
4 No. The total is 6.007 tonnes.

15B INDIVIDUAL

1 **a** 0.3 **b** 0.3 **c** 0.1 **d** 0.06
e 9.2 **f** 0.3 **g** 0.5 **h** 2.02
2 **a** 1.6 **b** 4.5
c 4.1 **d** 1.192
e 1.109 **f** 0.1229
g 0.684 **h** 17.1929
i 283.7621 **j** 38.765
k 2.142 **l** 1.599 05
3 **a** 1.7 **b** 4.6 **c** 13.49
d 28.36 **e** 60.282
4 **a** 16.441 **b** 82.106 **c** 0.3792
d 60.372 **e** 4.69
5 **a** 7.2 **b** 2.9
c 7.383 **d** 98.8
6 **a** 6.4 **b** 8.2
c 0.6155 **d** 9.996 142 8
7 **a** 1.356 metres **b** 135.6 cm
c 52.6 cm
8 **a** 3 kg
b one 5 kg bag for $6.25
c 2 kg
9 4.5 cm
10 3.87 cm
11 1.2 m
12 2 minutes 23.54 seconds

15C ADDITION WITH MONEY

1 **a** $16.40 **b** $16.15
c $14.95 **d** $10.75
e $35.80 **f** $46.15
g $98 **h** $101.60
2 **a** $755.55 **b** $938.50
c $867.35 **d** $1146.30
3 **a** $1829 **b** $1789
c $7540 **d** $19 102
4 $81.65
5 **a** $157.50 **b** $296.45
6 $518.80

15D SUBTRACTION WITH MONEY

1 **a** $4.55 **b** $2.85 **c** $2.25
d $4.55 **e** $15.50 **f** $52.25
2 **a** $2489 **b** $2365 **c** $2117
d $12 471 **e** $21 785 **f** $62 684
3 **a** $255 **b** $178
c $1052 **d** $3989
e $5355
4 $8.45
5

		Usual price	Sale price	Reduction
a	Jacket	$69.25	$55.99	**$13.26**
b	Pullover	$19.95	**$13.96**	$5.99
c	Printed top	$21.99	$17.59	**$4.40**
d	Jeans	$34.49	**$27.99**	$6.50
e	Cord pants	$87.45	$22.99	**$64.46**
f	Polo neck	$17.39	**$14.99**	$2.40
g	Waffle top	$18.19	$14.59	**$3.60**
h	Men's jeans	$139.45	**$131.99**	$7.46

15F REVIEW QUESTIONS

1 **a** 2.3 **b** 4.6
c 4.9 **d** 4.7
e 11.91 **f** 26.41
g 91.312 **h** 39.214

2 3.7 km

3 11.55 m

4 **a** 1.2 **b** 2.2
c 5.87 **d** 1.97
e 17.403 **f** 0.0438

5 **a** 0.6 **b** 0.9
c 45.013 **d** 102.96
e 98.9

6 **a** 0.3741 **b** 195.71
c 1.02 **d** 3.99
e 99.99

7 **a** 8.16 **b** 3.49
c 16.47 **d** 98.17
e 3.17

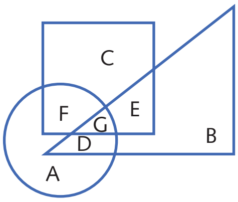
8 **a** $9.99 **b** $2.22
c $10.00 **d** $2.22
e $1515.15 **f** $1234.56

9 **a** $50.00 **b** $555.55
c $1010.10 **d** $8888.00

10 **a** $24.24 **b** $12.34

Chapter 16: Statistics and probability

Kick off



16A WHOLE CLASS

1 Teacher to check

2 **a**

	Boys	Girls
Netball	6	14
Volleyball	12	10
Basketball	13	11
Soccer	14	5

b basketball
c soccer
d 85
e netball
f soccer

3 **a**

	Tennis ball	Skipping rope	Football	Basketball
Boys	4	1	5	6
Girls	3	7	2	4

b 32

4 Teacher to check

5 Teacher to check

16A INDIVIDUAL

1 **a** 3 **b** 6 **c** 4 **d** 5 **e** 18

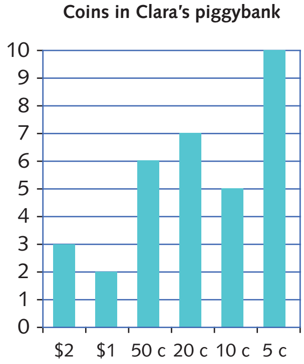
2

	Ice cream	No ice-cream
Peaches	Mia	Keilah
No peaches	Charlie	Marissa

16B WHOLE CLASS

1 Teacher to check

2 **a**



b $1
c $13.40

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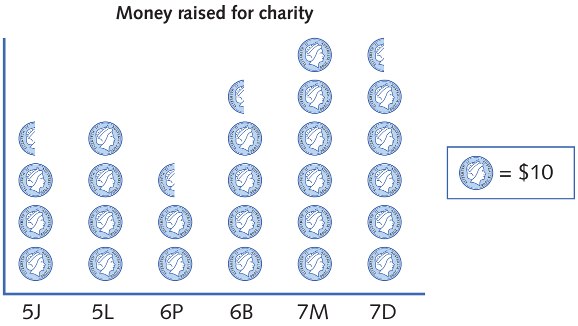
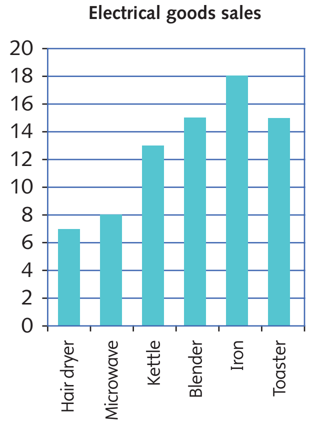
16B INDIVIDUAL

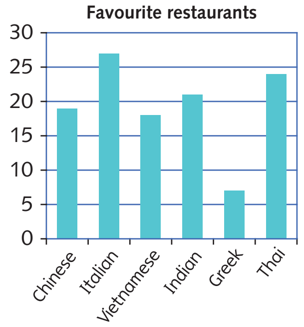
1 **a** Teacher to check pictograph
  b 7M
  c $70
  d Year 7
  e $260



2 **a** Teacher to check horizontal bar chart
  b iron
  c hair dryer
  d toaster and blender
  e 28
  f 76



3 **a** and **b** Teacher of check vertical bar chart and four questions

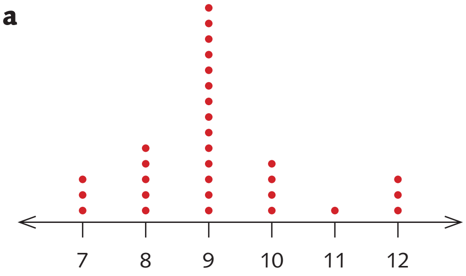


4 **a** 35
  b 20
  c station wagon and utility
  d 280

16C INDIVIDUAL

1 **a** 23 **b** 20 **c** 127

2 **a**



  b 9 minutes
  c 22

16D INDIVIDUAL

1 **a** 1, 2, 3, 4, 5, 6 **b** $\frac{1}{6}$

  c $\frac{1}{6}$ **d** 0 or $\frac{0}{6}$

  e $\frac{3}{6}$ or $\frac{1}{2}$ **f** $\frac{5}{6}$

  g $\frac{6}{6} = 1$

2 **a** $\frac{2}{10} = \frac{1}{5}$ **b** $\frac{3}{10}$ **c** $\frac{5}{10} = \frac{1}{2}$

3 **a** $\frac{1}{2}$

  b $\frac{1}{4}$

		Coin one	
		Head	**Tail**
Coin two	**Head**	Head, Head	Head, Tail
	Tail	Tail, Head	Tail, Tail

16E REVIEW QUESTIONS

1

	Likes kiwifruit	**Doesn't like kiwifruit**
Likes strawberries	Mum	Dad
Doesn't like strawberries	Jed	Anh

2 Teacher to check pictograph

3 **a** Teacher to check vertical bar chart

b 245 children

c green

4 **a** 495 **b** 190

c Wednesday and Thursday

d 115

5 **a** pies: 180, hot dogs: 290, sausage rolls: 120, dim sims: 280, pasties: 120, salad sandwiches: 110, soup: 180, chips: 500

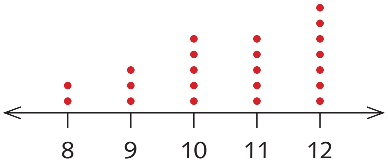
b hot chips

c salad sandwiches

d pies and soup, or sausage rolls and pasties

e 15 packets. 10 hot dogs left over

6 **a**



b 12