SAMPLE MATERIAL

BOOK 1

KEY STAGE 3

Mastering Mathematics

Second Edition

- Updated, second edition Textbooks (pp.3–18)
- New 'Develop and Secure' and 'Extend' Practice Books (pp.19–22)
- Boost – a new digital learning platform (p.23)

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Series Editor:
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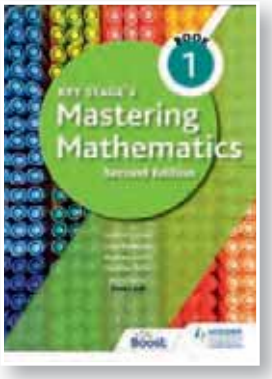
KEY STAGE 3

Mastering Mathematics

Second Edition

Textbooks

Second Edition



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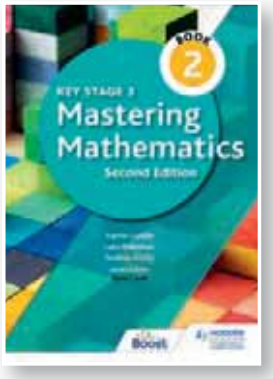

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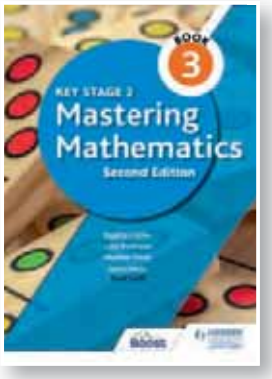

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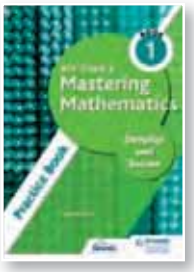

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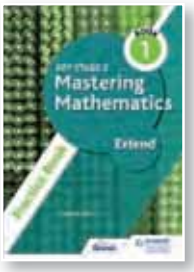

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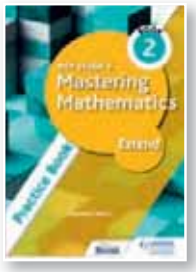

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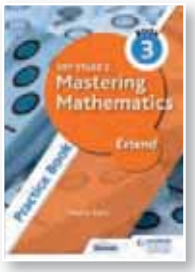

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How to use this book

How to get the most from this book

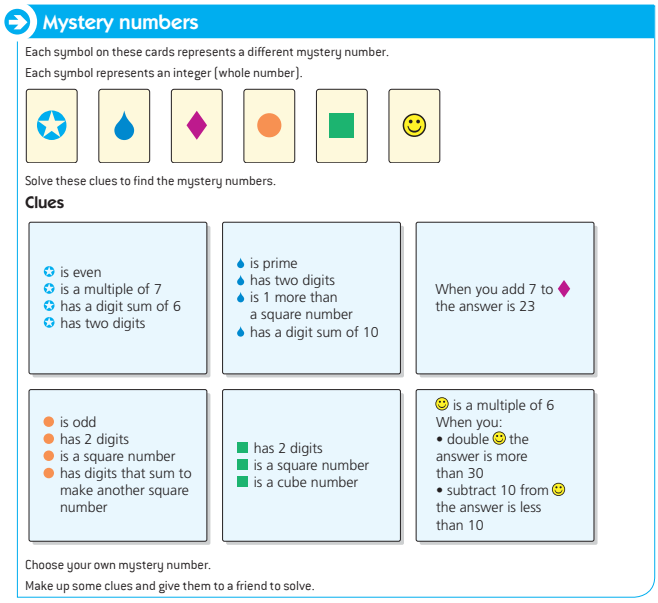
Hodder Education's Key Stage 3 Maths resources cover all you need to know for years 7–9 and are comprised of:

- three textbooks covering the entire Key Stage 3 National Curriculum
- three intervention and three extension practice books, designed to complement the textbooks for those that need more support or more challenging maths
- Boost online content.

Our year 7 material is split into 17 chapters, and each chapter comprises two, three or four units. In total there are 49 units in the book.

Each **chapter** includes:

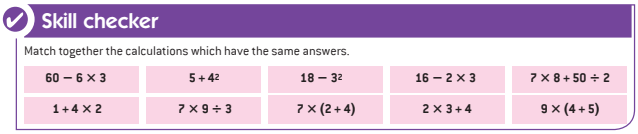
- *Coming up* – a list of learning objectives that will be tackled in the chapter
- a *Starter* problem – either an activity or a puzzle – to engage the students with a new topic and designed to be used before the first lesson, or at the start of the first lesson in that topic



- a Review exercise at the end of the chapter; this encompasses all of the units covered in the chapter.

Each of the **individual units** within the chapter includes:

- a *Skill checker* – simple diagnostic questions to test basic understanding in preparation for the unit



- clear and detailed explanation of the topic
- plenty of worked examples with solutions
- an activity for whole-class discussions and investigations in most units
- a Mastery-friendly approach throughout, including concrete-pictorial-abstract (CPA), manipulatives and bar-modelling
- a focus on fluency, with a carefully structured approach that takes into account cognitive load theory
- helpful hints and guidance on misconceptions and pitfalls to watch out for
- *Now try these* exercise questions:
  - Split up into three bands of difficulty: Band 1 questions are for those students who are working towards age-related expectations, Band 2 are for those at age-related expectations, and Band 3 are for those working beyond age-related expectations. Most students will engage with Band 2 questions and either Band 1 or Band 3, depending on which is most appropriate.
  - Defined as either Fluency (AO1), Reasoning (AO2) or Problem solving (AO3) and indicated as such.
  - All exercise questions are carefully calibrated to enable the whole class to understand each question and answer before moving on.
  - Non-calculator questions are indicated.
- a list of key words (highlighted in the text). These are fully explained in a glossary at the back of the book.

A full set of review questions (*Progress Review*) is included at the end of each group of chapters – that is, a sequence of two or three chapters that cover the same subject area (number, algebra, geometry, ratio/proportion, statistics, probability). These are designed to cover each half term's work. There are six of these in this book.

All answers are provided online at www.hoddereducation.co.uk/KS3MasteringMathematics and are freely accessible.

CHAPTER 6

Using letter symbols

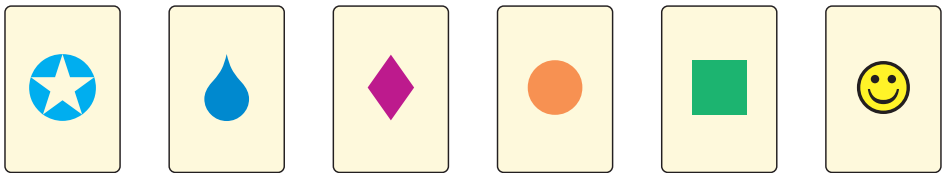
Coming up...

- Using word formulas
- Using letters in formulas and expressions
- Simplifying expressions
- Solving equations

The 'Coming up' section summarises the key learning points covered in each chapter

Mystery numbers

Each symbol on these cards represents a different mystery number.
Each symbol represents an integer (whole number).



Solve these clues to find the mystery numbers.

Clues

✪ is even ✪ is a multiple of 7 ✪ has a digit sum of 6 ✪ has two digits	♦ is prime ♦ has two digits ♦ is 1 more than a square number ♦ has a digit sum of 10	When you add 7 to ◆ the answer is 23
● is odd ● has 2 digits ● is a square number ● has digits that sum to make another square number	■ has 2 digits ■ is a square number ■ is a cube number	☺ is a multiple of 6 When you: • double ☺ the answer is more than 30 • subtract 10 from ☺ the answer is less than 10

Choose your own mystery number.
Make up some clues and give them to a friend to solve.

Build confidence and engagement with fun starter activities and warm-up questions to introduce each concept

6.1 Word formulas

Skill checker

Match together the calculations which have the same answers.

$60 - 6 \times 3$	$5 + 4^2$	$18 - 3^2$	$16 - 2 \times 3$	$7 \times 8 + 50 \div 2$
$1 + 4 \times 2$	$7 \times 9 \div 3$	$7 \times (2 + 4)$	$2 \times 3 + 4$	$9 \times (4 + 5)$

Assess pupils' prior knowledge at the beginning of each chapter using the 'Skill checker' questions

What is a formula?

A **formula** is a rule for working something out. It can be written in words or symbols.

For example, the time needed to roast a turkey is 50 minutes plus an extra 30 minutes per kilogram.

You can write this using the formula:

Cooking time in minutes = 50 + 30 × mass in kg

The words in a formula can be replaced with numbers that you know.

This is called substituting.

Worked example

Jamie is cooking a 5 kg turkey.

His recipe book has the formula

Cooking time in minutes = 50 + 30 × mass in kg

Jamie wants dinner to be ready for 1 pm.

At what time should he put the turkey in the oven?

Solution

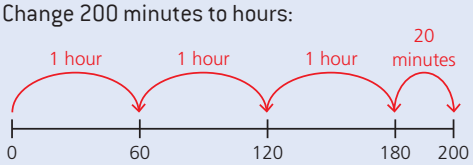
Cooking time in minutes = 50 + 30 × mass in kg

= 50 + 30 × 5 ← Substitute 5 into the formula.

= 50 + 150

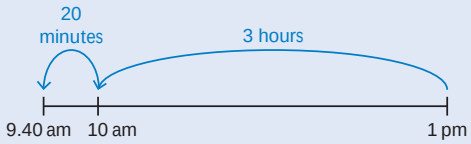
= 200 minutes

Change 200 minutes to hours:



So 200 minutes = 3 hours 20 minutes

Count back from 1 pm:



Jamie should put the turkey in the oven at 9.40 am.

Clear explanations and worked examples develop pupils' understanding

Secure and deepen understanding by working through the Band 1, 2 and 3 questions for every topic - following the 'do it, secure it, deepen it' Mastery structure

Easily target key skills using the fluency, reasoning and problem-solving markers in the margin

6.1 Now try these

Band 1 questions

Fluency

1. To convert metres to centimetres you use the formula:

   Length in centimetres = 100 × length in metres

   Convert the following measurements to centimetres:

   a Tallest giraffe: 6 m
   b Largest big cat (Siberian tiger): 3 m
   c Longest python: 14.85 m
   d Tallest man: 2.72 m
   e Length of smallest dog: 0.15 m
   f Length of a stag beetle: 0.05 m

2. Eve sees this sign at the supermarket.

   Apples only 45p each

   a Work out the cost of
   i 2 apples ii 10 apples iii 20 apples.
   b Copy and complete this formula.

   Cost in pence = ☐ × number of apples

Problem solving

3. A fitness trainer uses the formula:

   Maximum safe heart rate (beats per minute) = 220 – age (in years)

   to work out if her clients are exercising safely.

   a Work out the maximum safe heart rate of the following people:
   i Jim, aged 65 years ii Bev, aged 40 years iii Grace, aged 77 years.
   b The fitness trainer works out that Dani has a maximum heart rate of 190 beats per minute.
   How old is Dani?

Reasoning

4. Robert is two years older than Ella. Which of these rules is correct?

   A Robert's age in years + 2 = Ella's age in years
   B Ella's age in years + 2 = Robert's age in years

Band 2 questions

Fluency

5. A railway company works out its fares using this formula:

   Fare (£) = Length of journey in kilometres ÷ 10 + 5

   Calculate the fare for a journey of:

   a 50 km b 100 km c 200 km d 5 km.

6. A bowling alley uses the following formula to work out how much to charge customers:

   Cost (in pounds) = 6 × number of games + 5

   Ten Pin Bowling
   £6 per game
   £5 for shoe hire

   a Work out how much it costs for:
   i 1 game ii 2 games iii 3 games.
   b Sayeed has £40. He wants to play as many games as possible.
   How many games can he play?

Problem solving

7 Aliyah has £40 which she uses to buy some magazines for the school library.

She works out how much change she should have from £40 using the following formula:

Change (in pounds) = 40 – 3 × number of magazines

a Work out how much change Isobel has if she buys:

i 2 magazines **ii** 3 magazines **iii** 5 magazines.

b Aliyah has exactly £40.

i What is the maximum number of magazines that she can buy?

ii How much money does she have left?

Reasoning

8 A paperback book costs twice as much as an eBook. Which of these rules is correct?

A Cost (£) of paperback × 2 = cost (£) of eBook

B Cost (£) of eBook ÷ 2 = cost (£) of paperback

C Cost (£) of eBook × 2 = cost (£) of paperback

Fluency

9 Here is part of a price list for hiring tools:

Item	Fixed cost	Daily charge
Extension ladder	£10	£20
Wheelbarrow	£8	£20
Concrete mixer	£12	£30
Chainsaw	£15	£30

The total cost is made up of a fixed cost and a charge for each day the item is hired for.

The hire shop uses this formula to work out the cost of hiring an extension ladder:

Total cost (in £) of hiring ladder = $\square$ + $\square$ × number of days hired

a Copy and complete the formula for the cost of hiring a ladder.

b Write down a formula for hiring each of the other tools.

c Use your formulas to work out the cost of hiring:

i a ladder for four days **ii** a wheelbarrow for two days

iii a concrete mixer for one day **iv** a chainsaw for two days.

d Dan is giving his garden a make-over at the weekend. He needs a chainsaw, a concrete mixer and a wheelbarrow.

How much does it cost him to hire them all for two days?

Band 3 questions

Fluency

10 A car hire company uses the following formula to work out the hire cost:

Hire cost (in £) = 30 × number of hire days + 0.1 × number of miles driven

a Work out how much each of the following customers are charged for hiring a car:

i Peter hires a car for 4 days and drives 100 miles.

ii Tilly hires a car for 7 days and drives 500 miles.

iii Hayden hires a car for 10 days and drives 1040 miles.

b Find how much the company charges for:

i each day of car hire

ii each mile driven.

Develop a greater depth of knowledge and understanding with more challenging 'Band 3' questions

Using letters to write an expression

Here are some bags of counters.

The red bag has x counters in it.

The blue bag has y counters in it.

The total number of counters in the bags is $x + y$.

$x + y$ is called an **expression**. It has no = sign.

You can substitute values into the expression to **evaluate** it. ← Work it out.

For example, when $x = 12$ and $y = 15$ then

$$x + y$$
$$= 12 + 15$$
$$= 27$$

When you use letter symbols you are using **algebra**. Make sure you know the rules for using algebra.

Worked example

Tosin has some counters.

Bags all come with x counters and boxes all come with y counters.

He removes 4 counters from one of the bags.

a i Write an expression for the total number of counters Tosin has left.

ii Work out how many counters Tosin has if $x = 7$ and $y = 5$.

b Tosin empties out half of the counters from a red bag with x counters in it.

i Write down an expression for the number of counters Tosin has left in the bag.

ii Work out how many counters are in the bag if $x = 10$.

Solution

a i Total number of counters is:

$$3 \times x + 2 \times y - 4$$
$$= 3x + 2y - 4$$

ii Substitute $x = 7$ and $y = 5$ into $3x + 2y - 4$

$$3 \times x + 2 \times y - 4$$
$$= 3 \times 7 + 2 \times 5 - 4$$
$$= 21 + 10 - 4$$
$$= 27$$

Tosin has 27 counters.

b i Tosin has $\frac{x}{2}$ counters.

ii Substitute $x = 10$ into $\frac{x}{2}$

$$\frac{x}{2} = \frac{10}{2}$$
$$= 5$$

Tosin has 5 counters left in the bag.

Don't forget the rules!

1 Don't use a × symbol or a ÷ symbol. (6 lots of n / n divided by 2)
- $6n$ ✓ $6 \times n$ ✗
- $\frac{n}{2}$ ✓ $n \div 2$ ✗

2 Write numbers first, then letters.
- $6a$ ✓ $a6$ ✗

3 Write letters in alphabetical order.
- xyz ✓ zxy ✗

4 x^2 means $x \times x$ ← Say x squared.

5 y^3 means $y \times y \times y$ ← Say y cubed.

6 Don't use decimals.
- $\frac{1}{2}x$ ✓ $0.5x$ ✗

Adopt a flexible teaching approach with opportunities to introduce Mastery elements such as manipulatives into classroom activities

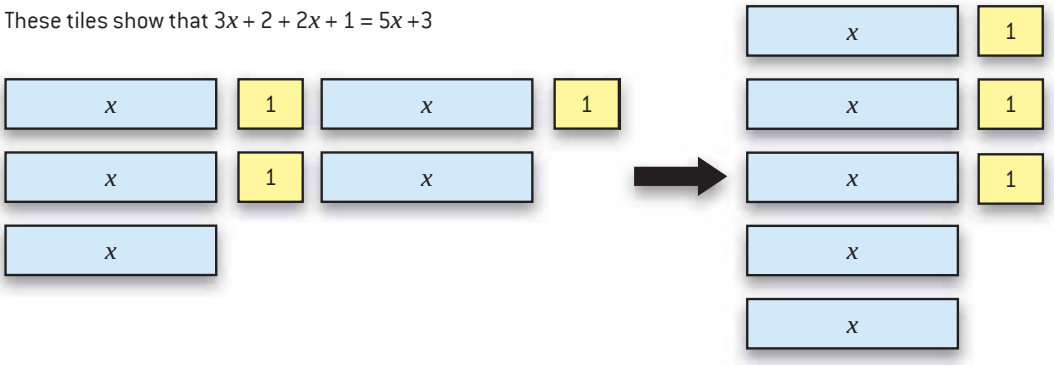
Activity

You can use algebra tiles to help you simplify expressions.

Group like tiles together.

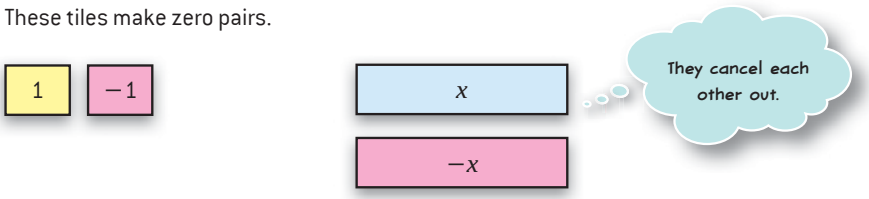
Example

These tiles show that $3x + 2 + 2x + 1 = 5x + 3$



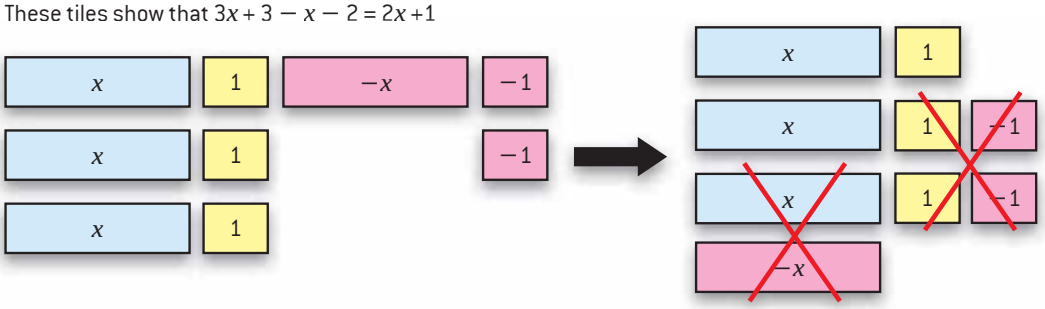
You can group together tiles which make a zero pair (cancel).

These tiles make zero pairs.



Example

These tiles show that $3x + 3 - x - 2 = 2x + 1$



① Use algebra tiles to help you simplify these expressions.

a $x + x + x + x + x + x$

b $x + 3 + x + 2$

c $2x + 4 + 4x + 2$

d $3x + 4 - x - 3x + 4x - 2$

e $5x - 3x + 7 - 2x - 6$

f $x - 1 - 2x + 2 + x - 3 - 4x + 4$

② Use algebra tiles to make your own expression to simplify.

Give your expression to a partner to simplify.

Do you both get the same answer?

If you disagree, how can you check who is right?

Hints help to guide pupils on how to approach each question

You can simplify more complicated expressions in the same way.

Worked example

Simplify these expressions.

a $6xy - 2x + 4xy + 5x$ ← Collect like terms.

b $7x + x^2 - 2x + 3x^2$

Solution

a $6xy - 2x + 4xy + 5x$

$= 6xy + 4xy - 2x + 5x$

$= 10xy + 3x$

You can't simplify this any further as xy and x are not like terms.

b $7x + x^2 - 2x + 3x^2$ ← x and x^2 are not like terms.

$= 7x - 2x + x^2 + 3x^2$

$= 5x + 4x^2$

6.3 Now try these

Band 1 questions

Fluency

1 Simplify these expressions:

a $a + a + a + a + a + a$ b + c $c + c + c + c + c + c + c$

d + + e + + + f + + + +

Reasoning

2 a Find the values of 2 , 3 and 5 when:

i = 2 ii = 3 iii = 4.

b For each value of , show that 2 + 3 is the same as 5 .

Fluency

3 Simplify these expressions:

a + 2 + 3 b 2 + 5 + 3 c $a + 3a + 5a + 7a + 9a$

d $x + 2x + 3x + 4x$ e 3 + 2 + 4 + f 5 + 2 + + 3

4 Simplify:

a 7 − 2 b 12 − 3 + 5 c 12 + 5t − 4

d 19 − 5 + 7 − 11 e 5 − 3 − + 2 f 8 − 5 − 4 + 3

Reasoning

5 a Work out the value of these expressions when $a = 3$, = 4 and = 5.

i $5a - 4a$ ii 6 − 5 iii 10 − 4 − 5

What do you notice?

b Simplify the expressions given in part **a**.

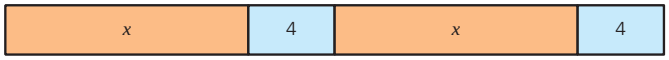
6 A box contains wooden building bricks of two different lengths: x cm and 4 cm as shown.

Molly puts some of the blocks together.

a Write down an expression for the total length of the bricks.

i

ii 

iii 

b Does changing the order that the bricks are placed in change the total length?

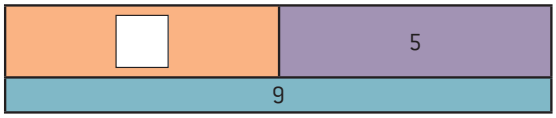
c Simplify each of your expressions in part **a**.

6.4 Equations

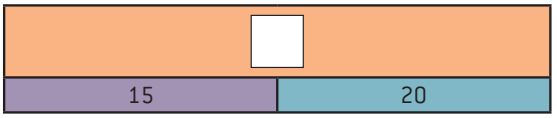
Skill checker

① Use the bar method to find the missing numbers.

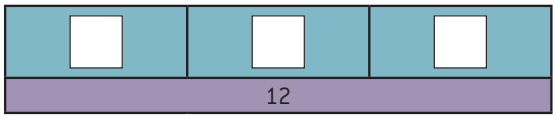
a 5 more than ☐ is 9.



b 20 less than ☐ is 15.



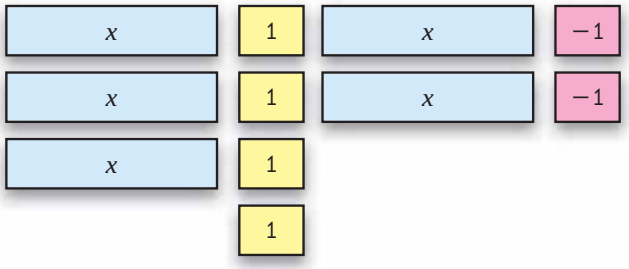
c 3 times ☐ is 12.



② Simplify these expressions:

a $x + x + x$

b $3x + 4 + 2x - 2$



c $2x + 4x - 3x$

d $4x - 2 + 3x + 7 - 10x$

③ When $x = 3$, find the value of:

a $3x$ **b** $5x + 2$ **c** $5 - 3x$

Solving equations

An **equation** says that one expression is equal to another. For example: $2x + 3 = 11$

Solving an equation means finding the value of x that makes the equation true.

x is called an unknown as you don't know its value until you solve the equation.

You can use a bar method to help you solve an equation.

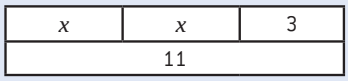
Worked example

Solve $2x + 3 = 11$.

Solution

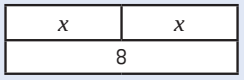
Draw a diagram for each stage of solving the equation.

$2x + 3 = 11$



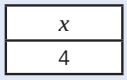
The top bar shows the left-hand side of the equation. Both bars are the same length as they are equal.

$2x = 8$



Take 3 from each bar.

$x = 4$

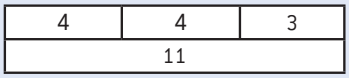


Halve each bar.

Check your answer:

Substitute $x = 4$ into $2x + 3 = 11$

so $2 \times 4 + 3 = 11$ ✓



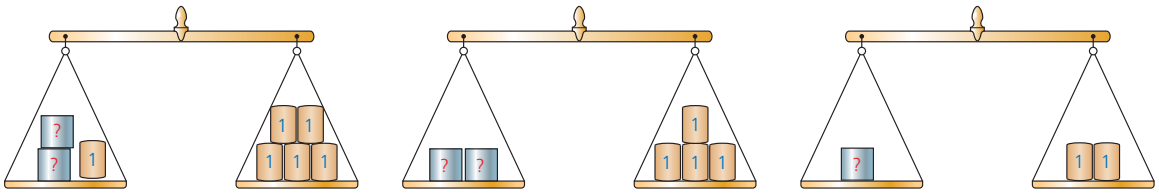
Always check your solution.

The balance method

Imagine a pair of scales. To keep them balanced you have to add or subtract the same amount to both sides.

The first set of scales show two identical parcels and 1 kg balancing with 5 kg.

To find the mass of the parcel:



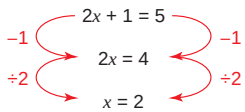
Subtract 1 from both sides.

Divide both sides by 2.

So the parcel is 2 kg.

In the same way, to keep an equation balanced, you must apply the same operation to both sides.

You can write this using algebra:



Key words

Here is a list of the key words you met in this chapter.

Equation	Formula	Solve	Unknown
Evaluate	Simplify	Substitute	Variable
Expression			

Use the glossary at the back of this book to check any you are unsure about.

Review exercise: using letter symbols

Reinforce learning with 'Review' exercises at the end of each chapter that can be used in class or set as homework

Band 1 questions

Reasoning

1 Ali has 20 fewer books than Tilly.

a Who has more books?

b Which of these rules is correct?

i Number of Ali's books + number of Tilly's books = 20

ii Number of Ali's books + 20 = number of Tilly's books

iii Number of Ali's books − 20 = number of Tilly's books

Fluency

2 Look at this advert.

Speedy Boats
£15 per hour

a Copy and complete this formula.

Cost of hire (£) = ☐ × number of hours

b Work out the cost of hiring a boat for:

i 2 hours **ii** 3 hours **iii** 12 hours.

3 Simplify these expressions.

a $4\ \ +2-3\ \ +5$ **b** $2\ \ +4+5\ \ +7+3$ **c** $4\ \ -2+4\ \ -3$

d $2x+3-x+2+4x$ **e** $3\ \ +2-2\ \ -1$ **f** $3y+5-y+3+2y-8$

4 Solve these equations.

a $\ \ -7=10$ **b** $5+\ \ =7$ **c** $\ \ -5=5$

d $\ \ +5=19$ **e** $\ \ -8=42$ **f** $\ \ +125=1125$

g $7n=42$ **h** $10x=70$ **i** $12y=132$

Reasoning

5 Jo has a pencils and Humza has b pencils.

Write in words the meaning of each of these equations.

a $a=8$ **b** $a+\ \ =12$ **c** $a=2$

Band 2 questions

Fluency

6 Simplify these expressions.

a $a+2\ \ +4+5a$ **b** $4x+5y-2x+y$ **c** $2x-3y+6y+7$

d $9x+6y-5x-4$ **e** $3\ \ -4\ \ +7-3$ **f** $4\ \ -5+3\ \ -4$

g $9\ \ -3\ \ -8\ \ +3s$ **h** $7\ \ -2\ \ -4\ \ +6$ **i** $5x+2y+3x-6y-8x$

7 Work out the value of $2a+4\ \ -5$ when:

a $a=2,\ \ =3$ and $=1$ **b** $a=9,\ \ =7$ and $=2$ **c** $a=1,\ \ =0$ and $=0$ **d** $a=4,\ \ =3$ and $=4$

Reasoning

8 Jon and Raj are co-pilots in a jet that flies from London to New York.

The journey is 3500 miles long.

They share the flying.

a Raj flies the first 2200 miles.
How far does Jon fly?

b On another trip, Jon flies 1800 miles.
How far does Raj fly?

c Copy and complete this formula.
Distance (in miles) flown by Raj = 3500 ☐

d Write another formula that gives the same information in a different way.

Band 3 questions

Fluency

9 Simplify these expressions.

a $x^2 + 3x^2$

b $x^2 + 2x^2 - 3x - 4x$

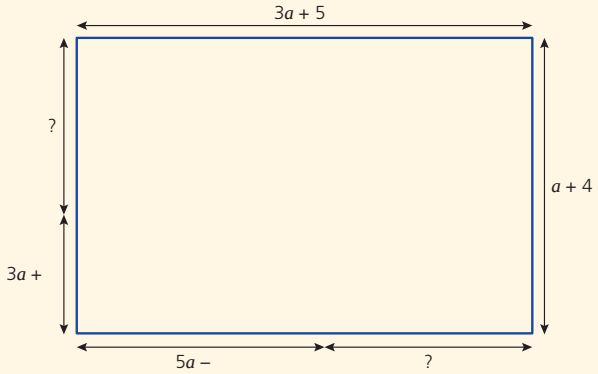
c $4x + 2xy - 3x - 4xy$

d $6xy + 2y - 3y - 4xy - xy + 5y$

Problem solving

10 All the lengths marked on this rectangle are in centimetres.

Find an expression for the missing lengths in this rectangle.



Reasoning

11 The formula to convert a temperature in degrees Fahrenheit, F, to a temperature in degrees Celsius, C, is

$$C = \frac{5(F - 32)}{9}$$

Someone with a fever has a temperature above 37.8 °C.

Dan has a temperature of 99 °F.

Does Dan have a fever? Give a reason for your answer.

Problem solving

12 Three friends play a computer game.

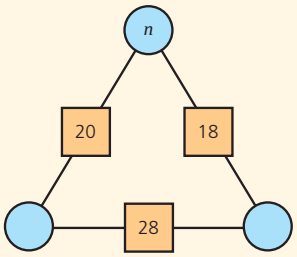
Between them they score 530 points.

Rob scores 30 more points than Beth.

Millie scores twice as many points as Rob.

How many points does each friend score?

13 **a** Copy this arithmagon.



The number in the square is the sum of those in the two circles on either side.

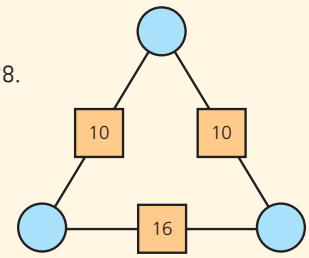
Fill in the bottom circles in terms of n.

b Use your answers to part **a** to write an equation in terms of n and the number 28.

c Solve your equation to find n.

Check your answer in the arithmagon.

d Copy and complete this arithmagon.



PROGRESS REVIEW 2

Chapters 4–7

Track progress, test understanding and encourage pupils to think synoptically across different sub-topics with 'Progress Review' questions at the end of each section, covering the last few chapters

Band 1 questions

Fluency

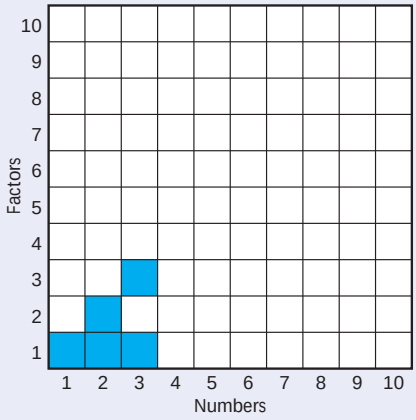
1 a Write down all the multiples of 5 between 34 and 61.

b Write down all the multiples of 4 between 27 and 45.

c Write down all the multiples of 9 between 35 and 82.

Reasoning

2 Copy this diagram. Extend your diagram to include all the whole numbers up to 30.



a For each number along the bottom, shade or colour the boxes to show the factors.

The first three numbers have been done for you.

b What do you notice about the bottom row? Why does this happen?

c What do you notice about the diagonal? Why does this happen?

d Which have more factors, odd numbers or even numbers? Comment on your answer.

e Which number(s) have exactly

i 1 factor ii 2 factors?

What is special about these numbers?

f What type of numbers have an odd number of factors? Why?

Problem solving

3 A gardener plants 13 rows of 25 tulip bulbs and 15 rows of 17 daffodil bulbs.

How many bulbs does he plant altogether?

Fluency

4 The rules show how to get from one term to the next in four sequences.

Write down the next three terms in each sequence.

Write down the name of each sequence.

Rule	1st term	2nd term	3rd term	4th term	5th term	Name of sequence
Add 2	2	4				
Add 2	1	3				
Add 5	5					Multiples of....
Add 7	7					

Reasoning

5 Samir has a rule for estimating the height of a person.

- Measure round your head.
- Multiply your answer by 3.
- This gives your height.

a Estimate the height of each of these people.

	Distance around head
Becky	50 cm
Harry	43 cm
George	64 cm

b Write down a formula for estimating a person's height using Samir's rule.

c Does Samir's rule work?

Measure yourself and some friends to find out.

Problem solving

6 The box shows the cost of tickets for visiting a theme park.

Family £105
Adult £37
Child £26

Two adults and two children visit the theme park.

They buy a family ticket.

How much more would it cost to buy two adult tickets and two child tickets?

7 A meal in restaurant costs the same for each person.

For a group of 14 people the cost is £364.

What is the price per person?

Fluency

8 Simplify these:

a $4a - 3a + 2a - a$

b $10 + 5 - 4$

c $7 - 3 - 3$

d $8 - 6 + 3 - 4$

Band 2 questions

9 Work out these:

a $3 + 4 \times 7$

b $(3 + 4) \times 7$

c $20 \div 5 - 3$

d $20 \div (5 - 3)$

e $9 + 3 \times 9 - 3$

f $(9 + 3) \times (9 - 3)$

Reasoning

10 Look at the numbers below.

5	7	25	6	40	1	64	36	8	19	2	21	24	125	48

Write down all the numbers from the boxes which are:

a a multiple of 5

b a square number

c both a multiple of 5 and a multiple of 10

d a prime number

e a cube number

f both a multiple of 4 and a multiple of 6

g a factor of 42

h both a square number and a cube number.

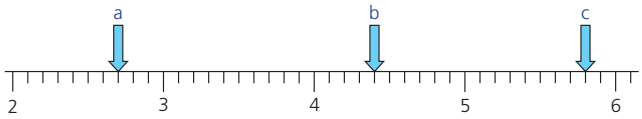
CHAPTER 3

Coordinates and transformations

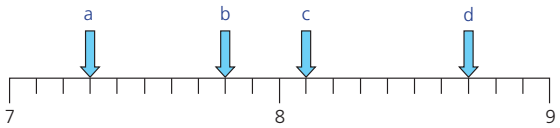
3.1 Coordinates

1 Look at these number lines. What numbers do the arrows point to?

a



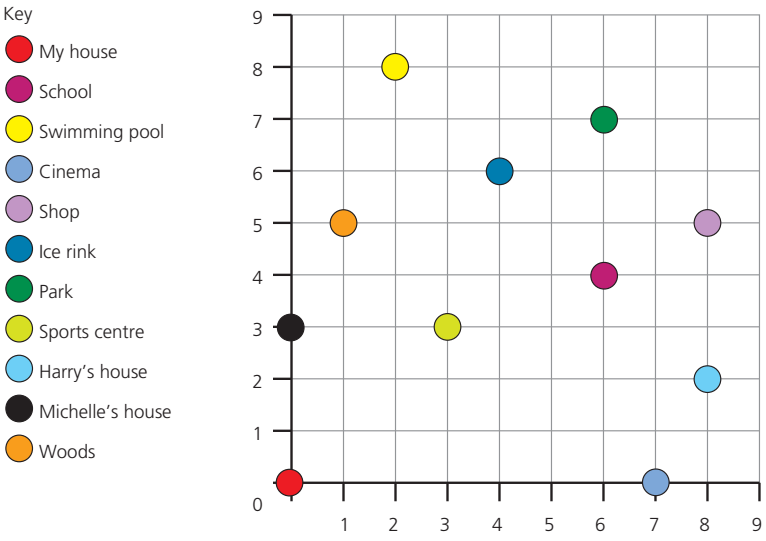
b



The position of a point on a grid can be given by its coordinates. In the coordinate (5, 4), 5 is the x-coordinate and 4 is the y-coordinate. The x-coordinate comes before the y-coordinate.

The x-axis is horizontal. The y-axis is vertical. The origin is labelled O and has coordinates (0, 0).

2 Here is a map of Tim's town.



a What is at these coordinates?

i (3, 3) **ii** (6, 4) **iii** (4, 6) **iv** (7, 0)

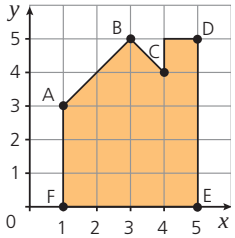
b Write down the coordinates of these places:

i Park **ii** Shop **iii** Woods **iv** Michelle's house

c Tim says the swimming pool is at (8, 2). Do you agree? Explain your answer.

3 **a** What are the coordinates of points A to F shown on the axes on the right?

b Which of the points (4, 1) or (1, 4) is inside the shape?



4 Draw a pair of axes from 0 to 5.

a Plot the points (1, 2), (4, 2), (4, 4) (1, 4) and (1, 2) and join them in order.

b What shape have you drawn?

5 Draw a pair of axes from 0 to 8.

a Plot these points and join them in order: (5, 6), (7, 4), (7, 2), (5, 0), (3, 0), (1, 2), (1, 4), (3, 6) and (5, 6)

b What shape have you drawn?

6 Draw a pair of axes from 0 to 6.

a Plot the points (3, 1), (3, 6) and (5, 1).

b Mark a fourth point to make a rectangle. What are the coordinates of this point?

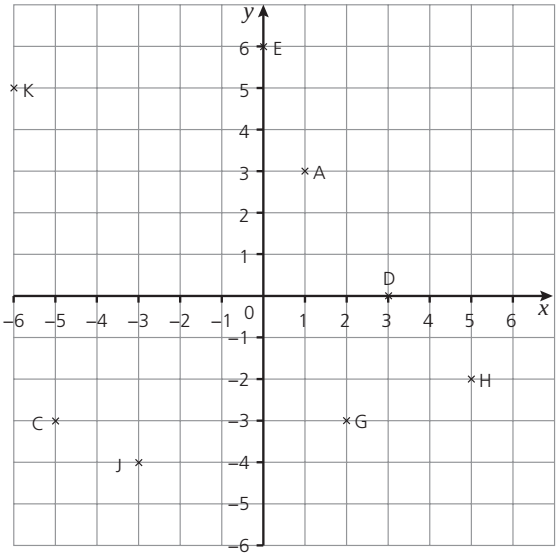
7 Point A has coordinates (3, 5).

a Write down the coordinates of three points with the same x-coordinate as A.

b Write down the coordinates of three points with the same y-coordinate as A.

You can extend the x- and y-axes to include negative numbers.
This makes four regions called **quadrants**.

8 The diagram below shows some points.



a Write down the coordinates of points A to K (there is no I).

b Which points are in the 2nd quadrant?

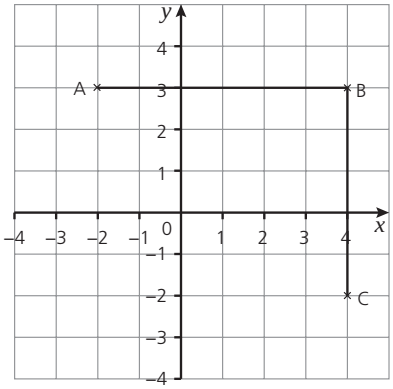
c Which quadrant is point C in?

9 Draw x- and y-axes, each from −5 to 5 using the same scale.

a Plot the points (3, 2), (2, −1), (−3, −1), (−2, 2) and (3, 2) and join them in order.

b What shape have you drawn?

10 On this grid, points A, B and C are three points of a rectangle.



a What are the coordinates of points A, B and C?

b What are the coordinates of the fourth point of the rectangle?

c How long is the rectangle?

d How wide is the rectangle?

11 Draw x- and y-axes, each from −5 to 5 using the same scale.

a Plot these points and join them in order: (−4, −1), (−2, 3), (2, 1)

b Mark a fourth point to make a square. What are the coordinates of this point?

3.2 Translations

When you slide a shape without turning it round or turning it over, you have **translated** the shape. You can **describe** a translation by saying how many squares **horizontally** (left/right) and **vertically** (up/down) you have moved a shape.
When a shape is translated, the shape and its image are exactly the same shape and size, they are **congruent**.
You can say the **object** is mapped onto its **image**.

1 For each diagram, describe the translation which

a maps shape A onto shape B

b maps shape B onto shape A.

CHAPTER 5

Calculations

Stretch and challenge pupils with extension questions designed to promote greater depth

5.1 Multiplying and dividing integers

1. Anouk calculates 387 × 416 several times and gets four different answers. They are:

   120 842 160 992 325 728 400 257

   a. Without doing the calculation, decide which is correct.

   b. For each of the other answers, explain how Anouk could tell they must be incorrect without doing the calculation.

2. Binti calculates 243 314 ÷ 38 several times and gets four different answers. They are:

   668 6403 8094 8109

   a. Without doing the calculation, decide which is correct.

   b. For each of the other answers, explain how Binti could tell they must be incorrect without doing the calculation.

3. 1906 × 237 = 451 722. Without using a calculator, work out:

   a. 4 517 220 ÷ 23 700

   b. 3812 × 474

   c. 225 861 ÷ 953

4. 251 762 ÷ 343 = 734. Without using a calculator, work out:

   a. 686 × 734

   b. 251 762 ÷ 1468

   c. 49 × 734

5. Two consecutive numbers multiply to give 4032. What are the two numbers?

6. Three consecutive numbers multiply to give 388 944. What are the three numbers?

7. In these multiplications each letter represents a missing digit. Find the missing digits.

   a. $\begin{array}{r} A\,7\,B \\ \times\quad 3 \\ \hline C\,4\,D\,5 \end{array}$ b. $\begin{array}{r} E\,6\,4 \\ \times\quad F \\ \hline 6\,1\,G\,2 \end{array}$ c. $\begin{array}{r} H\,I\,J\,K \\ \times\quad 7 \\ \hline 3\,6\,7\,2\,9 \end{array}$

8. In these divisions, each letter represents a missing digit. Find the missing digits.

   a. $4\overline{)\,A\,5\,4\,B}$ $=\ 6\,C\,5$

   b. $7\overline{)\,A\,4\,D\,6}$ $=\ 6\,B\,C$

   c. $A\overline{)\,B\,2\,B\,1}$ $=\ 2\,C\,D\,E$

Splitting a number, so that it is written as the sum of smaller numbers, is called partitioning.

The product is the result from multiplying numbers.

9. 12 can be partitioned into 4 and 8. The product of 4 and 8 is 32. Find the partition of 12 using two numbers that give the largest product.

10. 12 can be partitioned into 1, 2 and 9. The product of 1, 2 and 9 is 18. Find the partition of 12 using three numbers that give the largest product.

11. 12 can be partitioned into 1, 2, 3 and 6. The product of 1, 2, 3 and 6 is 36. Find the partition of 12 using four numbers that give the largest product.

12. Use the digits 1, 2, 3, 4 and 5 to make two numbers. What two numbers give the largest product?

13. Use the digits 1, 2, 3, 4 and 5 to make two numbers. What two numbers give the number closest to 3 when you divide them?

14. ABCABC = ABC × ADDA for some values of A, B, C and D (A, B, C and D are all different).

    a. Find values for A, B, C and D.

    b. How many solutions are there?

15. Work out, stopping when you reach the decimal point:

    a. $7\overline{)\,1\,0\,0\,0\,0\,0\,0}$

    b. $7\overline{)\,2\,0\,0\,0\,0\,0\,0}$

    c. $7\overline{)\,3\,0\,0\,0\,0\,0\,0}$

    d. $7\overline{)\,4\,0\,0\,0\,0\,0\,0}$

    e. What do you notice?

5.2 Solving word problems

1. 16 children and 5 adults buy tickets for a theme park. An adult ticket costs £54 and a child's ticket costs £39. What is the total cost?
2. **a** A school plans to take 254 students and teachers on a trip to a theme park by coach. Each coach holds 45 passengers. How many coaches are needed?
   b The calculation 254 ÷ 45 has a remainder. What does the remainder represent?
3. 12 people share 36 cakes. 36 ÷ 12 = 3 is the calculation required to work out how many cakes each person gets. What problem does 3 × 12 give the answer to?
4. Alan spends £200 on 250 bottles of water. He sells each one for £1.50. How much profit does he make?
5. Nadya bakes 80 cakes. The ingredients cost her £24 altogether. How much does each cake cost to make?
6. Vince buys 48 sausages for a barbeque. They are shared equally between 15 people. How many sausages do they have each? What does the remainder represent?
7. Five friends go out for a meal and split the bill of £84 equally. 84 ÷ 5 = 16 with a remainder of 4. What should be done with the remainder in this context?
8. Anya has £60 to buy books for her book club. The books cost £8 each. 60 ÷ 8 = 7 with a remainder of 4. What does the remainder represent in this context?
9. A frog climbs up from the bottom of a well. Each day it climbs 3.5 m and each night it falls back 1 m. The well is 24 m deep. On which day does the frog reach the top of the well?
10. On what date in the year is it one thousand hours old?
11. Will you live to be 1 million hours old?
12. Bobby draws a bar diagram to help him solve a problem.

25	25	25	25	25	25
150					

Write down three different word problems he could solve using the diagram. The problems should involve £150 and buying shirts.

13. What date and time is it 1 million minutes into the New Year?
14. What date and time is it 1 million seconds into the New Year?
15. Write word problems for 45 ÷ 12 so that the answer:
    a is rounded down and the remainder ignored
    b is rounded up
    c is worked out with a decimal part to deal with the remainder
    d is worked out with a fractional part to deal with the remainder.

5.3 BIDMAS

BIDMAS tells us the order that operations should be carried out. The order is: **b**rackets, **i**ndices (this means powers and roots), **d**ivision, **m**ultiplication, **a**ddition and **s**ubtraction.

1. Work out:
   a $3(17-5)^2+6$
   b $18 \div 3 - 5 + 11$
   c $91 - 12 + 15 \times 6$
2. Work out:
   a $\dfrac{16-3\times 2}{5}+23$
   b $\sqrt{8^2+15^2}$
   c $\dfrac{24}{7^2-1}$
3. Insert brackets to make each statement true:
   a $3 \times 17 - 3 = 42$
   b $20 \div 2 + 3 = 3^2 - 5$
   c $25 - 3 \times 4 + 1 = 10$
4. Fill in the missing numbers to make each statement true:
   a $5 \times 6 - 4 + 3 - \square = 27$
   b $\square \div 7 + 6 \times 3 = 22$
   c $(\square - 4)^2 - 2^3 = 17$

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