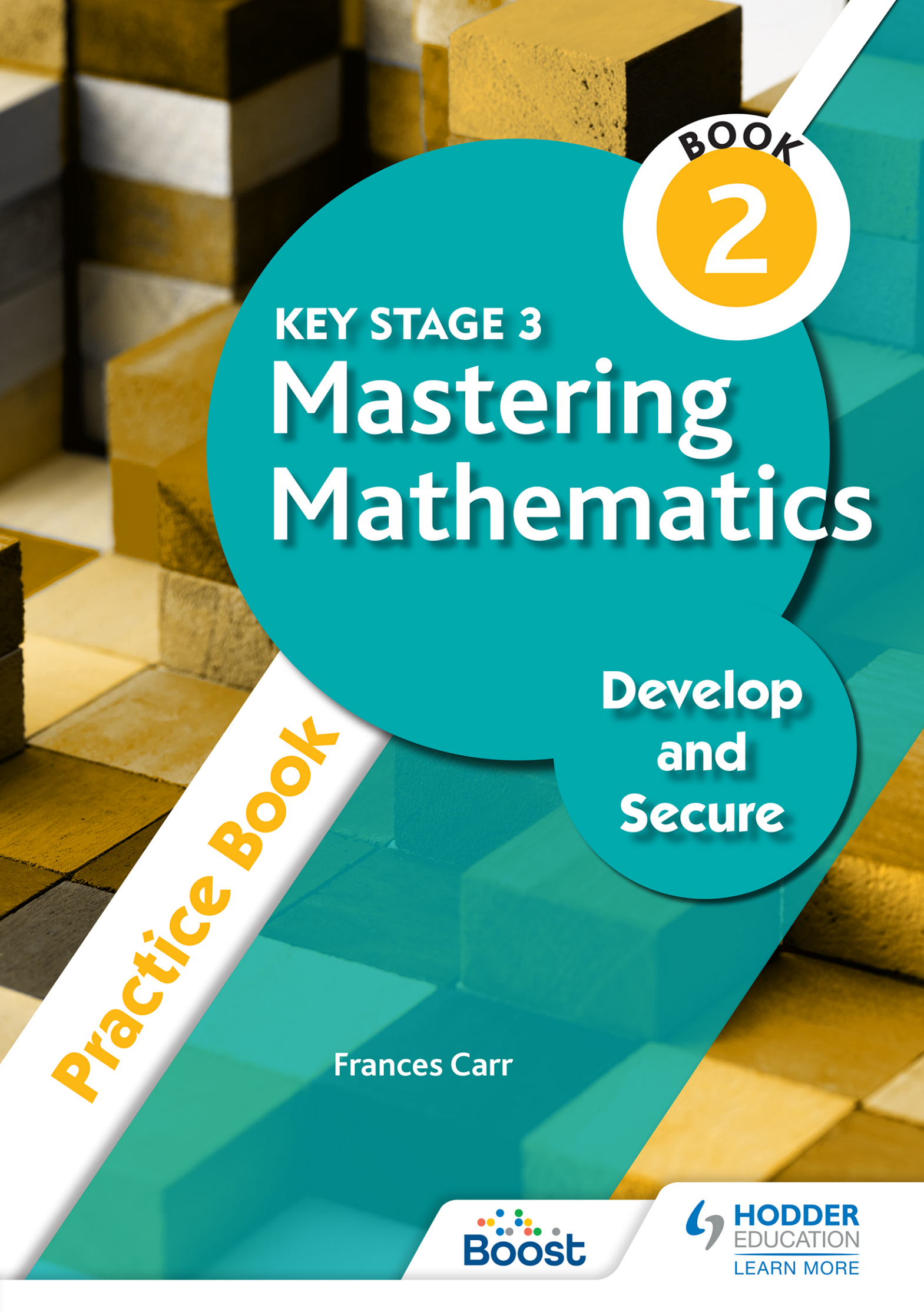

BOOK
2
KEY STAGE 3
Mastering Mathematics
Develop and Secure
Practice Book
Frances Carr
Boost
HODDER EDUCATION
LEARN MORE

Contents

How to use this book

1 Sequences 1
- 1.1 Arithmetic sequences 1
- 1.2 Other sequences 2

2 Graphs 4
- 2.1 Straight line graphs 4
- 2.2 Real life graphs 6

3 Angles 9
- 3.1 Parallel lines 9
- 3.2 Polygons 10

4 Constructions 13
- 4.1 Bearings 13
- 4.2 Scale drawing 15
- 4.3 Constructions 16

5 Calculations 18
- 5.1 Calculations review 18
- 5.2 Multiplying decimals 20
- 5.3 Dividing decimals 21

6 Negative numbers 23
- 6.1 Negative numbers 23
- 6.2 Adding and subtracting negative numbers 24
- 6.3 Multiplying and dividing negative numbers 25

7 Fractions 27
- 7.1 Fractions review 27
- 7.2 Multiplying fractions 29
- 7.3 Dividing fractions 30

8 Expressions and formulas 32
- 8.1 Working with letter symbols review 32
- 8.2 Expanding brackets 33
- 8.3 Factorising expressions 34
- 8.4 Rearranging formulas 35

9 Equations 37
- 9.1 Solving equations 37
- 9.2 Solving equations with an unknown on both sides 38
- 9.3 Solving equations with brackets 39

10 **Working with 2D shapes** 41
- 10.1 Types of quadrilateral 41
- 10.2 Area 43

11 **Properties of 3D shapes** 46
- 11.1 Properties of 3D shapes 46
- 11.2 Nets 48
- 11.3 Surface area and volume of a cuboid 51

12 **Percentages** 54
- 12.1 Working with percentages 54
- 12.2 Percentage increase and decrease 55
- 12.3 Percentage change 56

13 **Multiplicative reasoning** 58
- 13.1 Ratio and proportion review 58
- 13.2 Conversions graphs 59
- 13.3 Best buys 62

14 **Working with data** 63
- 14.1 Frequency tables 63
- 14.2 Pie charts 64

15 **Circles** 67
- 15.1 Circumference 67
- 15.2 Area of a circle 68

16 **Pythagoras' theorem** 71
- 16.1 Investigating triangles 71
- 16.2 Using Pythagoras' theorem 73

CHAPTER 1

Sequences

Fluency Reasoning Problem solving

1.1 Arithmetic sequences

1 Find the next three terms in these sequences.

a 4, 8, 12, 16, …
b 15, 18, 21, 24, …
c 8, 13, 18, 23, …

2 Substitute $n = 10$ into these expressions.

a $n + 3$
b $2n$
c $4n - 1$
d $5n + 6$

Look at this sequence of numbers: 5, 10, 15, 20, …
This sequence is based on the five times table.

The 1st term is $5 \times 1 = 5$.

The 2nd term is $5 \times 2 = 10$.

The 10th term is $5 \times 10 = 50$.

The nth term is $5 \times n = 5n$.

$5n$ is called the **formula** or the **position-to-term formula** for the sequence.

It is also called the **formula for the nth term** or the **nth term rule**.

A sequence in which you add or subtract the same amount to move from one term to the next is called an **arithmetic sequence**. In the arithmetic sequence above the term-to-term rule is 'add 5'.

3 Find the next three terms in these arithmetic sequences.

a 8, 9, 10, 11, …
b 11, 22, 33, 44, …
c 60, 50, 40, 30, …
d 4, 7, 10, 13, …
e 9, 7, 5, 3, …
f 12, 19, 26, 33, …

4 Find the missing numbers in these arithmetic sequences.

a 11, 13, 15, ☐, 19, …
b 20, 17, 14, ☐, 8, …
c −1, 4, 9, ☐, 19, …
d 6, 14, ☐, 30, 38, …
e 7, 3, ☐, −5, −9, …
f ☐, 8, 15, ☐, 29, …

Remember: The difference between the terms shows the times table on which the sequence is based. Compare the times table to the sequence and work out how to adjust it.

For example, in the sequence 5, 9, 13, 17, … there is a difference of four between each term, so $4n$ will appear in the position-to-term formula. Every term in the sequence is one more than the four times table, so the nth term rule will be $4n + 1$.

5 Find the formula for the nth term of these sequences.

In each case the formula is ☐ n.

a 3, 6, 9, 12, 15, …
b 10, 20, 30, 40, 50, …
c 9, 18, 27, 36, 45, …
d 7, 14, 21, 28, 35, …

6 Find the formula for the nth term of these sequences.

In each case the formula is ☐ $n + 1$.

a 3, 5, 7, 9, 11, …
b 10, 19, 28, 37, 46, …
c 4, 7, 10, 13, 16, …
d 2, 3, 4, 5, 6, …

7 Find the formula for the nth term of these sequences.

In each case the formula is ☐ $n - 1$.

a 1, 3, 5, 7, 9, …
b 2, 5, 8, 11, 14, …
c 3, 7, 11, 15, 19, …
d 10, 21, 32, 43, 54, …

8 Find the formula for the nth term of these sequences.

a 2, 4, 6, 8, 10, …
b 7, 9, 11, 13, 15, …
c −1, 1, 3, 5, 7, …

9 Find the formula for the nth term of these sequences.

a 5, 10, 15, 20, 25, …
b 1, 6, 11, 16, 21, …
c 7, 12, 17, 22, 27, …

10 Find the formula for the nth term of these sequences.

a 7, 14, 21, 28, 35, …

b 10, 17, 24, 31, 38, …

c −1, 6, 13, 20, 27, …

11 Find the position-to-term formulas for these sequences:

a 8, 11, 14, 17, 20, …

b 1, 5, 9, 13, 17, …

c 8, 14, 20, 26, 32, …

d 2, 11, 20, 29, 38, …

e What type of sequence are these?

12 Cayleigh says the nth term of the sequence: 7, 11, 15, 19, 23, … is $3n + 4$.

Cayleigh is wrong. Explain why.

13 Find the position-to-term formulas for these sequences. The first has been done for you.

a −2, −4, −6, −8, −10, … nth term $= -2n$

b −5, −10, −15, −20, −25, …

c −1, −4, −7, −10, −13, …

d 5, 4, 3, 2, 1, …

14 Match each position-to-term formula with the correct sequence.

$-n + 8$	**8, 16, 24, 32, …**
$2n + 3$	**9, 10, 11, 12, …**
$8n$	**5, 8, 11, 14, …**
$3n + 2$	**7, 6, 5, 4, …**
$n + 8$	**5, 7, 9, 11, …**

You can use the position-to-term formula to find any term of the sequence.

For example, the 20th term of a sequence with an nth term rule of $3n$ is 60 because $3 \times 20 = 60$.

15 Find the first five terms of these sequences, given their position-to-term formula.

a The sequence with position-to-term formula $n + 5$.

n	1	2	3	4	5
$n + 5$	1 + 5 = 6	2 + 5 =			

b The sequence with position-to-term formula $4n$.

n	1	2	3	4	5
$4n$	4 × 1 = 4	4 × 2 =			

c The sequence with position-to-term formula $5n - 3$.

n	1	2	3	4	5
$5n - 3$	5 × 1 − 3 = 2	5 × 2 − 3 =			

16 Find the first five terms of these sequences, given their nth term rules.

a $10n + 7$ **b** $4n + 1$

c $6n - 1$ **d** $3n - 5$

e $-3n + 10$

17 Look at this sequence: 8, 13, 18, 23, 28, …

a What is the term-to-term rule?

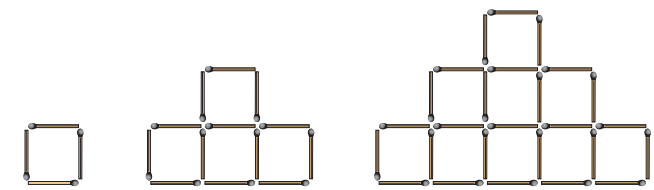
b Find the position-to-term formula for the sequence.

c What is the 100th term of the sequence?

d Which term of the sequence is 48?

e What type of sequence is this?

18 Manon is making patterns from matchsticks.



Pattern 1 Pattern 2 Pattern 3

a Copy and complete this table for the number of matchsticks used in each pattern.

Include the number of matchsticks Manon would use if she continued to Pattern 4.

Pattern number n	1	2	3	4
Number of matchsticks	4			

b If the pattern is continued, which pattern will use 25 matchsticks?

c Find the term-to-term rule for this sequence.

d Find the position-to-term formula for the number of matchsticks.

1.2 Other sequences

There are many other types of sequence.

In the sequence: 1, 10, 100, 1000, … the term-to-term rule is **multiply by 10**.

This is called a **geometric sequence**.

1 Are these sequences arithmetic or geometric? In each case, what is the term-to-term rule?

a 16, 8, 0, −8, … **b** 16, 8, 4, 2, 1, …

c 1, 8, 64, 512, … **d** 0, 8, 16, 24, …

2 Find the next three terms in these geometric sequences.

a 1, 2, 4, 8, …

b 0.03, 0.3, 3, 30, …

c 800, 400, 200, 100, …

d 0.2, 1, 5, 25, …

Look at this sequence: 1, 1, 2, 3, 5, 8, 13, …

Each term in this sequence is made by adding the two numbers before it.

This sequence is called the **Fibonacci Sequence**.

3 Find the next three terms in these Fibonacci-type sequences.

a 1, 2, 3, 5, …

b 1, 3, 4, 7, …

c 2, 4, 6, 10, …

d 5, 1, 6, 7, …

e 8, 2, 10, 12, …

4 Fill in the blanks in these Fibonacci-type sequences:

a 1, 5, ☐, 11, 17, 28, …

b 2, 5, 7, ☐, 19, 31, …

c 3, 1, 4, ☐, ☐, 14, …

d 1, ☐, 8, 15, ☐, 38, …

e ☐, 5, 10, ☐, 25, 40, …

f ☐, ☐, 9, 16, 25, 41, …

5 Lars says this is a Fibonacci-type sequence:
1, 1, 1, 3, 5, 9, 17, 31, …

Do you agree? Explain why.

6 A sequence starts 4, 8, …

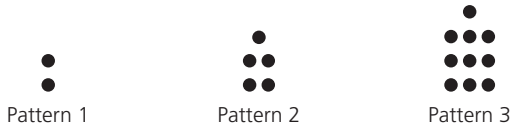
Jaydon says the term-to-term rule is add 4. Is he correct? Explain your answer.

7 Look at this special sequence: 1, 4, 9, 16, 25, …

a What is the name of this sequence of numbers?

b What is the position-to-term formula for this sequence?

8 Here is a pattern of dots.



a Draw pattern 4.

b How many dots will there be in pattern 5?

c Which pattern will contain 101 dots?

9 Find the next three terms in these sequences.

a 4, 6, 9, 13, …

b 1, 3, 7, 13, …

c 8, 18, 27, 35, …

d 2, 5, 10, 17, …

e 6, 5, 3, 0, …

10 Copy and complete these sequences by writing the missing numbers in the spaces.

a 5, 6, 8, ☐, 15, ☐, …

b 40, 38, 34, ☐, ☐, 10, …

c −5, −4, −2, ☐, 5, ☐, …

d 16, ☐, 21, 25, ☐, 36, …

11 Here is another pattern of dots.

a Draw pattern 4.

b How many dots will there be in pattern 5?

c Write down the number of dots in the first 8 patterns as a sequence.

What is the name of this sequence?

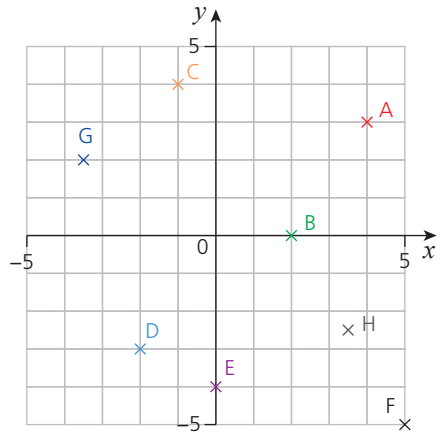
CHAPTER 2

Graphs

Fluency Reasoning Problem solving

2.1 Straight line graphs

1 Write the coordinate of each point A to H.



2 Find the value of $3x + 2$ when:

a $x = 1$ **b** $x = 2$

c $x = 3$ **d** $x = 4$

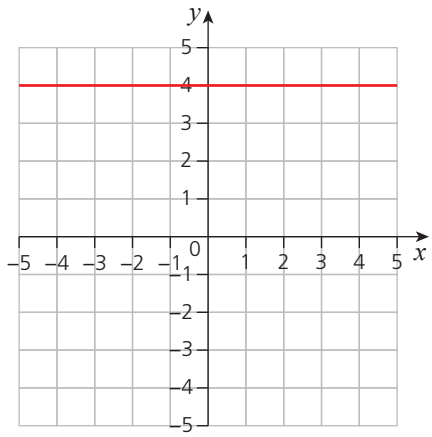
e $x = 5$

A graph with the equation $y =$ ☐ is a horizontal line.
Every point on the line has the same y-coordinate.
The x-axis has the equation $y = 0$.

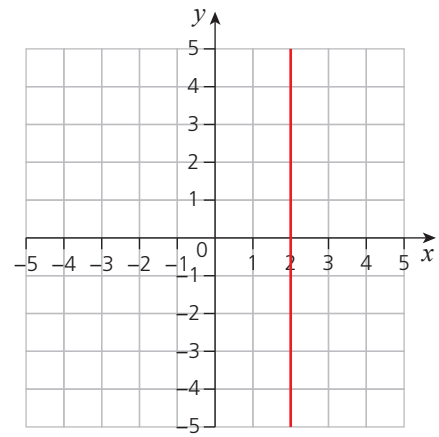
A graph with the equation $x =$ ☐ is a vertical line.
Every point on the line has the same x-coordinate.
The y-axis has the equation $x = 0$.

3 Give the equations of these straight lines.

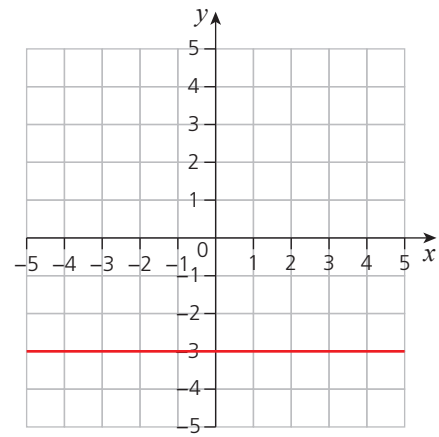
a



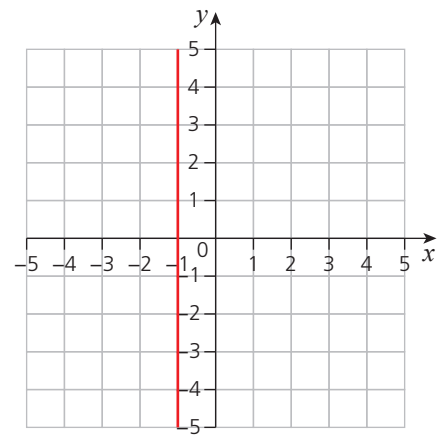
b



c



d



4 Write the equation of the line that goes through each set of coordinates.

a (3, 4) (3, 0) (3, −7)

b (2, 6) (0, 6) (−2, 6)

c (−3, −1) (1, −1) (5, −1)

d (−2, 0) (−2, 9) (−2, 5.5)

5 Sketch these straight lines, showing where they cross an axis.

a $y = 1$ **b** $x = 3$

c $y = -5$ **d** $x = -9$

Look at this equation: $y = 2x + 3$.

For every value of x, there is a single value of y.

For example, when $x = 1$, $y = 2 \times 1 + 3$ so $y = 5$.

6 For each equation, find the value of y when $x = 2$.

a $y = 2x + 3$ **b** $y = 5x - 1$

c $y = 3x + 4$ **d** $y = 10x - 7$

There are several ways you can display this information. It can be shown in a table of values.

7 Copy and complete these tables:

a $y = 3x$

x	0	1	2	3	4
y			6		

b $y = 3x + 1$

x	0	1	2	3	4
y				10	

c $y = 3x - 2$

x	0	1	2	3	4
y	−2				

You can also plot this information on a **graph**.

Plot the points and join them with a straight line that goes through all the points and extends to the edges of the graph. Remember, when plotting a straight line, always use three or more points.

If a graph is a straight line, then y is a **linear** function of x.

8 **a** Draw a graph from this table of values:

x	0	1	2	3	4
y	3	5	7	9	11

b How can you tell from the graph that y is a linear function of x?

9 For each equation, copy and complete the table of values and then draw a graph of the results, using an x-axis from 0 to 6 and a y-axis from 0 to 8.

a $y = x + 2$

x	0	1	2	3
y			4	

b $y = 3x - 1$

x	0	1	2	3
y	−1			

c $y = 2x + 1$

x	0	1	2	3
y				

d $y = \frac{1}{2}x + 2$

x	0	2	4	6
y			4	

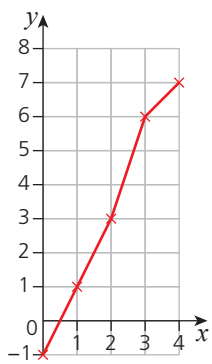
e $y = 6 - x$

x	0	1	2	3
y		5	4	

f $y = 4 - x$

x	0	1	2	3
y				

10 Kade draws the graph of the equation $y = 2x - 1$.

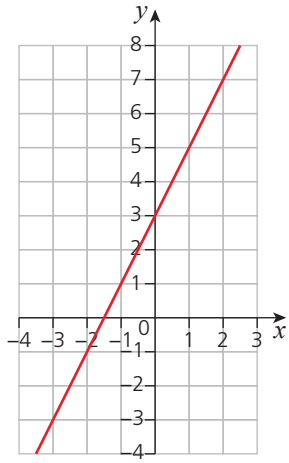


Kade has made a mistake. How can you tell?

Which point is incorrect?

You can use straight line graphs to find specific values of x or y.

11 Here is the graph of $y = 2x + 3$.



a Use the graph to find the value of y when:

i $x = 0$ **ii** $x = 2$

iii $x = -3$

b Use the graph to find the value of x when:

i $y = 5$ **ii** $y = -1$

iii $y = 0$

12 **a** Copy and complete this table using the equation $y = 2x$.

x	−3	−2	−1	0	1	2	3
y		−4				4	

b Draw a graph using the points from the table above.

c Using your graph, find the value of y when $x = 1.5$.

d Find the value of x when $y = -1$.

e If you continued the line, would the point (5, 10) lie on it?

13 **a** Draw the line $y = 2x - 3$ with x values from −3 to 3 and y values from −10 to 4.

b Do these points lie on the line?

i (2, 2) **ii** (−1, −5)

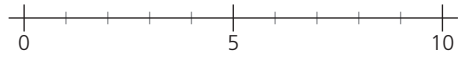
c If you extended the line, would these points lie on it?

i (4, 5) **ii** (−10, −17)

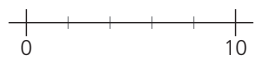
2.2 Real life graphs

1 Work out what each mark is worth on these axes:

a



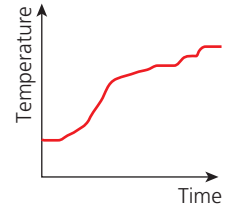
b



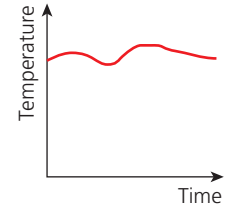
c

2 These graphs show the temperature for four different days.

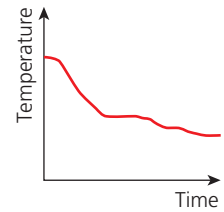
a



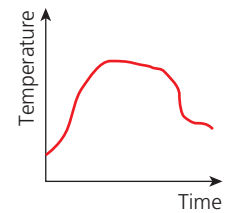
b



c



d



Match each description with one of the graphs.

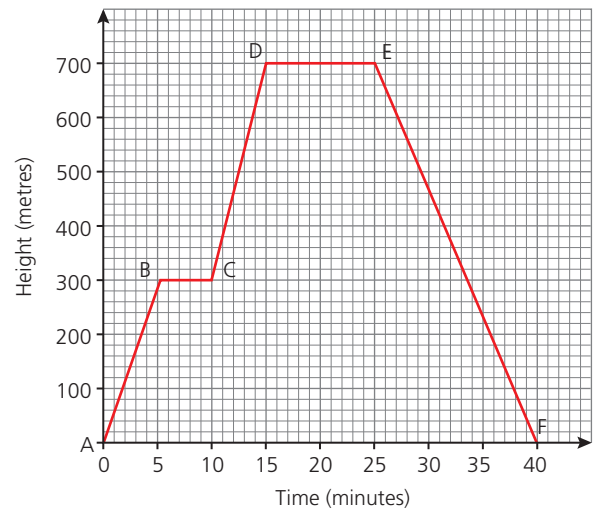
i The temperature stays warm all day.

ii The temperature starts cool, warms up and then cools down.

iii The temperature starts warm and then cools down.

iv The temperature starts cool and then warms up.

3 This graph shows the height of a hot air balloon during a trip.



a How high is the balloon when it stops rising for the first time?

b For how long does it stop?

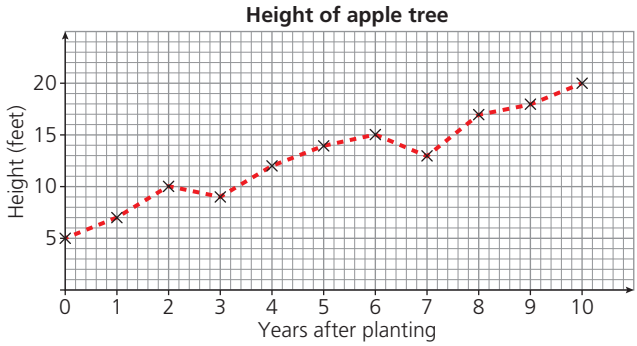
c What is the maximum height that the balloon reaches?

d How long does the balloon take to come down?

e When is the balloon at 600 m?

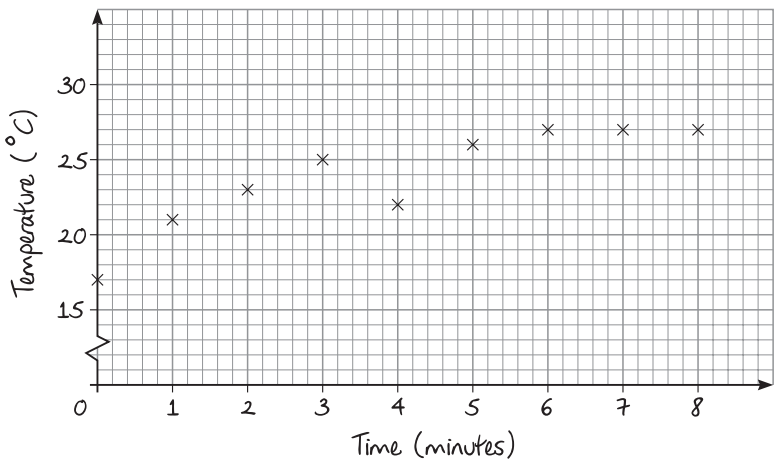
When measurements are taken over time, it is difficult to know exactly what happened between the times when the measurements were taken. This is shown on a graph by using a dotted line between the points.

4 Leroy plants an apple tree.
The graph shows its growth.



a How high is the tree when Leroy plants it?
b How high is it after 5 years?
c When is it 17 feet high?
d When does Leroy prune the tree?
e In which year does it grow the most?

5 Janine has made an electrical heater. She takes temperature readings over time and plots the data on a graph.



a Janine thinks one of her readings is wrong. Which one is this?
b What should she do about it?
c How should she join the data points?

6 The table gives the number of customers in a coffee shop during one week in May.

Month	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
Number of customers	34	22	28	27	36	52	63

a Show this data on a graph. Plot days on the horizontal axis and customers on the vertical axis.
b On which day were there the most customers?
c On which day were there the least customers?

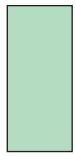
7 The table shows the hourly temperature in London on a particular day in September.

Time	6 a.m.	9 a.m.	12 noon	3 p.m.	6 p.m.	9 p.m.
Temperature (°C)	9	13	18	21	19	14

a Show this information on a graph.
b Between which times does the temperature rise most quickly?
c Between which times does the temperature fall most quickly?
d Estimate for how long the temperature remains above 20 °C.

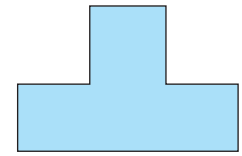
8 Water is poured at a constant rate into each of the three containers below.
For each container, a graph has been drawn of the water depth against time.

a



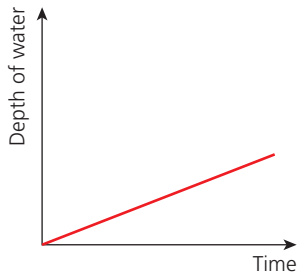
b

c

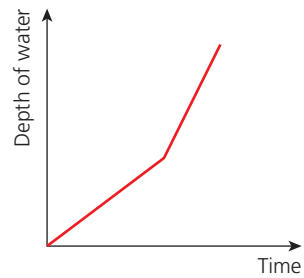


Match each container with one of the depth–time graphs below.

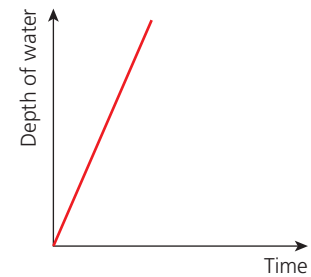
i



ii



iii



BOOK 2

KEY STAGE 3

Mastering Mathematics

Develop and Secure Practice Book

Build key fluency, reasoning and problem-solving skills with extra practice. This book is packed with questions that take small steps to enable sustained progress.

- Develop knowledge and understanding with practice questions that get progressively more difficult following a Mastery approach to learning
- Receive helpful reminders and explanations alongside hints for trickier questions
- Understand how maths is used outside of the classroom with questions based on real-life scenarios
- Easily learn at home with answers available online

HODDER EDUCATION
t: 01235 827827
e: education@hachette.co.uk
w: hoddereducation.co.uk

ISBN 978-1-3983-0845-9
9 781398 308459
FSC