

Collins

MATHS 2015

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Welcome to the 2015 Maths Catalogue.

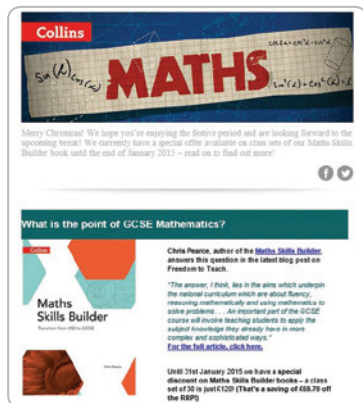
This year you'll find lots of useful information on our brand new resources for GCSE Maths, as well as textbooks and revision guides that comprehensively support KS3 and A-level students.

Want to take a closer look? For more information on any of our series, please don't hesitate to contact one of our sales consultants – they'll be happy to answer your questions or come and visit your school. Find your local representative's details on the back page.



What's new?

Find out how we can support you in delivering the 2015 AQA and Edexcel specifications for GCSE Maths. Turn to page 6 for more information.



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Find out more

Visit www.collins.co.uk for information on all our series, curriculum change advice and free content to support your teaching

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Key icons in the catalogue

- NEW** New titles
- Age 14-16** Age range
- KS3** For Key Stage...
- GCSE** For GCSE
- AS/A** For AS and A-level
- Generic** Suitable for all exam boards
- APP** For Assessing Pupils' Progress
- FS** For Functional Skills

Current Specification

For the current GCSE specification. Use for 2015 & 2016 examinations.

Digital resource available on Collins Connect online learning platform:

Collins Connect

Exam board specific:

OCR AQA Edexcel Cambridge

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Collins Connect

Collins Connect is available for Collins Maths Frameworking and Collins GCSE Maths 4th edition.

Collins Connect is an innovative online learning platform designed to support teachers and students by providing a wealth of content and interactive activities – ideal as a front-of-class teaching and learning tool and to support independent learning and home/school links.

Collins Connect has been developed in consultation with schools as well as tested extensively to ensure it:

- delivers what you need
- is intuitive and easy to use
- is straightforward to set-up

Collins Connect is designed to:

Enable you to teach flexibly - use the suite of digital resources to engage your students

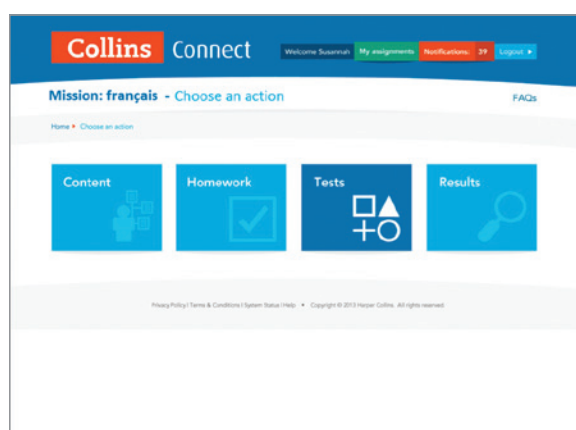
Be straightforward to set-up – get Collins Connect up and running quickly with no complicated installations or difficult passwords to remember

Make testing and reporting easy – Collins Connect syncs directly to Capita's SIMS so accounts are generated automatically for teachers and students and changes are updated daily

Work beautifully across all devices – Collins Connect works on all screen sizes from smart phones to whiteboards

Provide ongoing support – training videos and FAQs are available online for all customers. There's also a dedicated customer support team for set-up support, troubleshooting help and to ensure any issues can be quickly resolved

Provide course content and assessment all in one place – it's simple to set activities and homework directly from the platform. Assessments can also be set and completed and student data collated



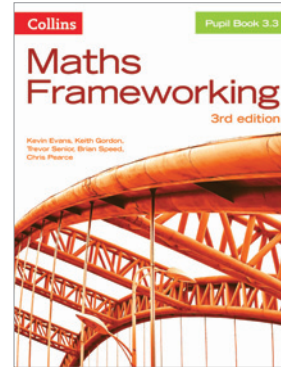
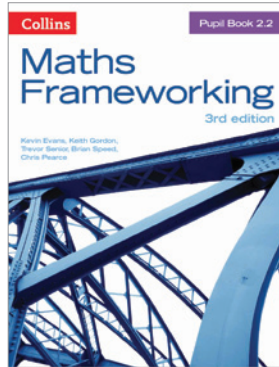
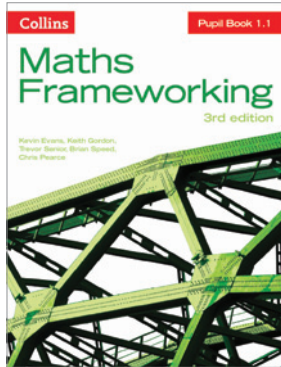
We know how important it is to you to ensure you have the right digital materials. All Collins Connect resources are available free of charge for a 14 day trial. Just go to education.support@harpercollins.co.uk for more information. You can also view sample chapters completely free online <http://connect.collins.co.uk/secondary-teaching-resources>

Looking for more digital resources?

iBooks Textbooks for GCSE Maths Revision and GCSE Maths Apps are available via the iBook Store. See page 19 for more details.

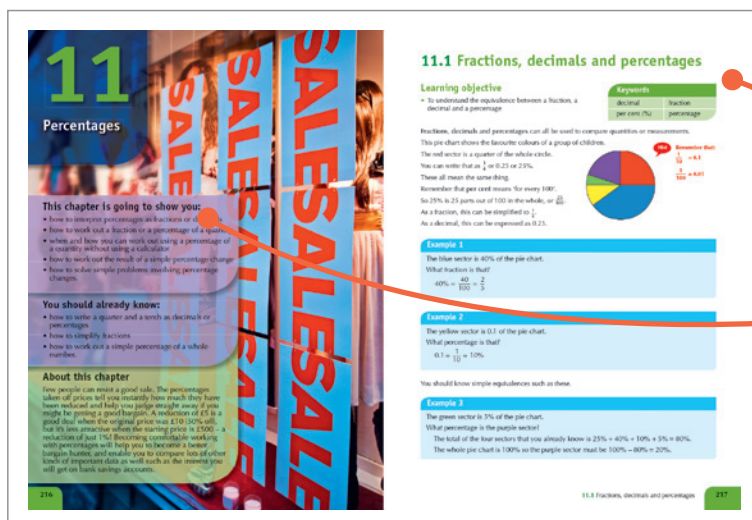
Maths Frameworking 3rd edition

Authors: Kevin Evans, Keith Gordon, Trevor Senior, Brian Speed and Chris Pearce



The right progression for all levels.

- Enable all students to progress with fully differentiated resources
- Teach flexibly with resources that work well for both a 2-year and 3-year Key Stage 3
- Allow students to consolidate and embed their learning with thousands of practice questions and worked examples
- Enable your students to develop their problem-solving and mathematical reasoning skills, with dedicated practice questions flagged throughout the books
- Break up lessons and maintain students' interest in mathematics with longer tasks which are relevant to real-life including investigations, challenges, practical activities, problem-solving, financial skills and mathematical reasoning tasks
- Encourage students to make links between different areas of mathematics with synoptic questions included at the end of every chapter
- Provide students with the practice they need with accessible Homework Books
- The dedicated Skills Booster Book will support your students in developing the skills they need for GCSE
- Take action when students are not making the required level of progress with one-to-one Intervention Workbooks that focus on basic skills and mathematical fluency
- Inspire and engage students with brand new digital resources to motivate and encourage independent learning. Our digital resources also include automarked homework and assessments to support teachers too!



Focus on literacy skills with key words for each topic and a glossary included

Inspire pupils with a chapter opener that puts maths in context



Collins Connect

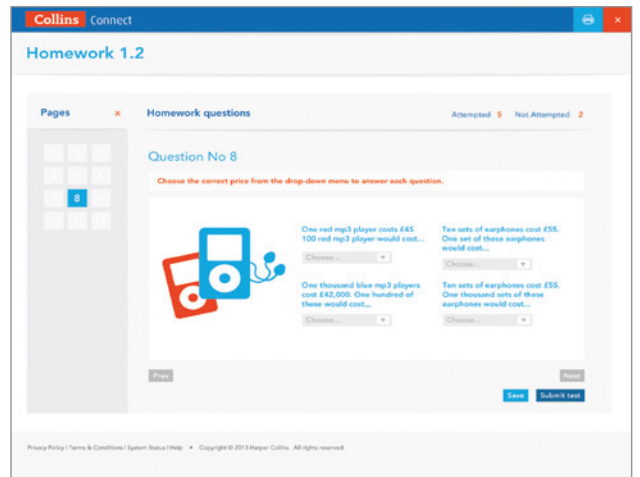
Maths Frameworking on Collins Connect

Teach Key Stage 3 Maths flexibly and in a way that suits your students, with a full suite of digital resources.

Digital resources for **Collins Maths Frameworking** have been carefully selected to improve and build on key skills in maths such as fluency, problem-solving, correcting common misconceptions, using the correct vocabulary, applying maths to real-life scenarios, and to encourage independent learning.

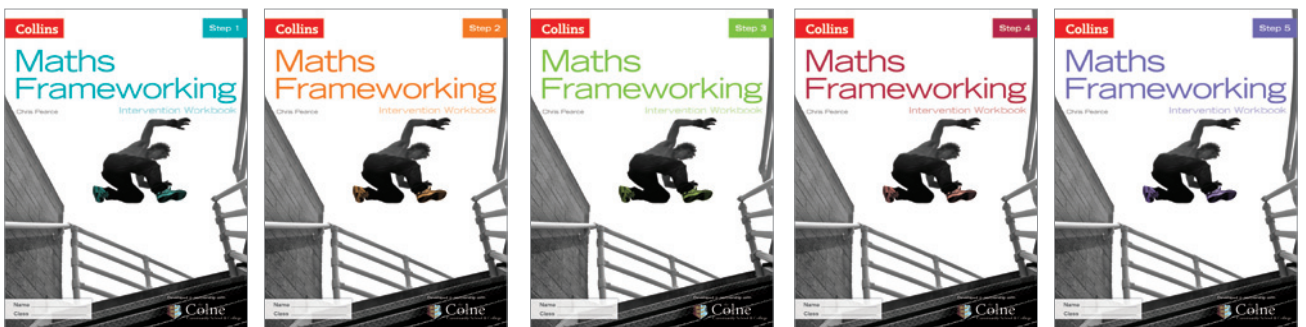
For more information on Collins Connect see page 2.

You can also view a free sample chapter online at connect.collins.co.uk.secondary-teaching-resources



One-to-one Intervention Programme – write-in workbooks for students that need extra support

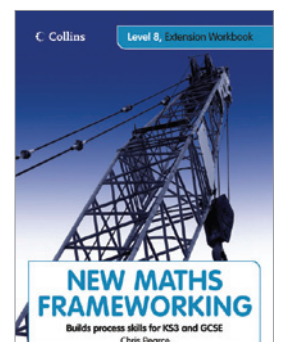
Support teaching staff and parents with resources designed to be used one-to-one to provide students with focused support to overcome identified weaknesses.



Level 8 Extension Workbooks

Brand new material written to support you in teaching and consolidating the skills needed to extend your gifted and talented pupils to achieve a Level 8.

- Build pupils' process skills with dedicated questions
- Consolidate pupils' learning and stretch your highest achievers with challenging questions
- Allow pupils to track their progress with colour-coded levels on the page



Collins Maths Frameworking: Available Resources

	Year 7	Year 8	Year 9		
Pupil Books	 <p>Pupil Book 1.1 978-0-00-753771-6 £15.99 Pupil Book 1.2 978-0-00-753772-3 £15.99 Pupil Book 1.3 978-0-00-753773-0 £15.99</p>	 <p>Pupil Book 2.1 978-0-00-753774-7 £15.99 Pupil Book 2.2 978-0-00-753775-4 £15.99 Pupil Book 2.3 978-0-00-753776-1 £15.99</p>	 <p>Pupil Book 3.1 978-0-00-753777-8 £15.99 Pupil Book 3.2 978-0-00-753778-5 £15.99 Pupil Book 3.3 978-0-00-753779-2 £15.99</p>		
Pupil Books (Print copy + online access to all 3 Pupil Books per year)*	<p>Pupil Book 1.1 978-0-00-753771-6 or Pupil Book 1.2 978-0-00-753772-3 or Pupil Book 1.3 978-0-00-753773-0 + 1 year subscription to Pupil Books 1.1, 1.2, 1.3 978-0-00-756376-0 • £17.99 + 3 year subscription to Pupil Books 1.1,1.2,1.3 978-0-00-756375-3 • £20.99</p> 	<p>Pupil Book 2.1 978-0-00-753774-7 or Pupil Book 2.2 978-0-00-753775-4 or Pupil Book 2.3 978-0-00-753776-1 + 1 year subscription to Pupil Books 2.1, 2.2, 2.3 978-0-00-756384-5 • £17.99 + 3 year subscription to Pupil Books 2.1, 2.2, 2.3 978-0-00-756383-8 • £20.99</p> 	<p>Pupil Book 3.1 978-0-00-753777-8 or Pupil Book 3.2 978-0-00-753778-5 or Pupil Book 3.3 978-0-00-753779-2 + 1 year subscription to Pupil Books 3.1, 3.2, 3.3 978-0-00-756392-0 • £17.99 + 3 year subscription to Pupil Books 3.1, 3.2, 3.3 978-0-00-756391-3 • £20.99</p> 		
Pupil Books (Online access only to all 3 Pupil Books per year)*	<p>1 year subscription to Pupil Books 1.1, 1.2, 1.3 978-0-00-756376-0 • £6.00 3 year subscription to Pupil Books 1.1,1.2,1.3 978-0-00-756375-3 • £15.99</p> 	<p>1 year subscription to Pupil Books 2.1, 2.2, 2.3 978-0-00-756384-5 • £6.00 3 year subscription to Pupil Books 2.1, 2.2, 2.3 978-0-00-756383-8 • £15.99</p> 	<p>1 year subscription to Pupil Books 3.1, 3.2, 3.3 978-0-00-756392-0 • £6.00 3 year subscription to Pupil Books 3.1, 3.2, 3.3 978-0-00-756391-3 • £15.99</p> 		
Teacher Packs	 <p>Teacher Pack 1.1 978-0-00-753781-5 £100.00 Teacher Pack 1.2 978-0-00-753782-2 £100.00 Teacher Pack 1.3 978-0-00-753783-9 £100.00</p>	 <p>Teacher Pack 2.1 978-0-00-753784-6 £100.00 Teacher Pack 2.2 978-0-00-753785-3 £100.00 Teacher Pack 2.3 978-0-00-753786-0 £100.00</p>	 <p>Teacher Pack 3.1 978-0-00-753787-7 £100.00 Teacher Pack 3.2 978-0-00-753788-4 £100.00 Teacher Pack 3.3 978-0-00-753789-1 £100.00</p>		
Online Teacher Resource Powered by Collins Connect – including Interactive Book – tests and reporting – homework	<p>3 year subscription 978-0-00-756373-9 • £700.00</p>  <p>1 year subscription 978-0-00-756374-6 • £250.00</p>	<p>3 year subscription 978-0-00-756381-4 • £700.00</p>  <p>1 year subscription 978-0-00-756382-1 • £250.00</p>	<p>3 year subscription 978-0-00-756389-0 • £700.00</p>  <p>1 year subscription 978-0-00-756390-6 • £250.00</p>		
Homework Books	 <p>Level 1 978-0-00-753763-1 £7.99</p>	 <p>Level 2 978-0-00-753764-8 £7.99</p>	 <p>Level 3 978-0-00-753765-5 £7.99</p>		
Maths Skills Builder	 <p>Maths Skills Builder 978-0-00-753780-8 £5.99</p>				
One-To-One Intervention Workbooks	 <p>Step 1 978-0-00-753766-2 £5.99</p>	 <p>Step 2 978-0-00-753767-9 £5.99</p>	 <p>Step 3 978-0-00-753768-6 £5.99</p>	 <p>Step 4 978-0-00-753769-3 £5.99</p>	 <p>Step 5 978-0-00-753770-0 £5.99</p>

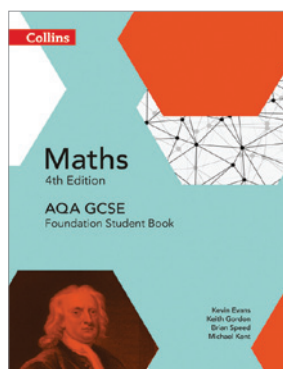
Subscriptions to the online Student Books are not available without a subscription to the Online Teacher Resource on Collins Connect. For full terms and conditions please visit www.connect.collins.co.uk

The Online Teacher Resource allows unlimited access for teachers and students to Collins Connect in school and enables the content to be used for front of class teaching, including whiteboard use. It does not allow access to the full reporting functionality or allow pupils to have individual log-ins. Individual pupil access must be purchased to access this.

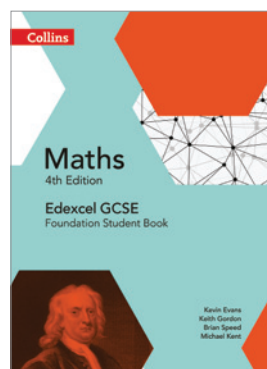
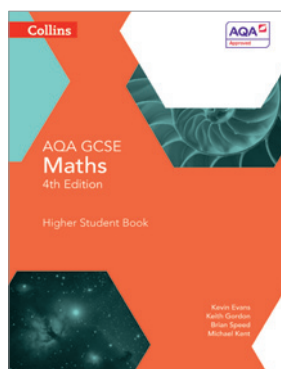


GCSE Maths, 4th edition for AQA and Edexcel

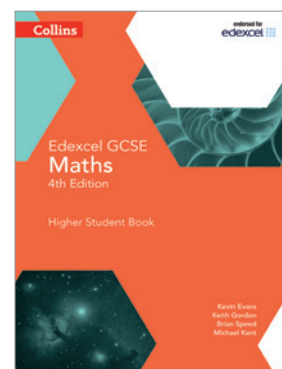
Authors: Kevin Evans, Keith Gordon, Brian Speed, Michael Kent



We have entered an approval process with AQA for endorsement of the Foundation Student Book.



We are working with Edexcel to gain endorsement of the Foundation Student Book.



Your whole class will need frequent practice in problem-solving and reasoning skills to succeed in the new, more demanding GCSE Maths exam.

Our resources provide exactly that, for students at every level. And we've done it in the most easily accessible way.

GCSE Maths is changing, and the Fourth Edition of GCSE Maths from Collins has been completely revised and updated to develop and embed the skills your students need, while providing a clear and supportive route through the new, more challenging GCSE content.

- **More opportunities for practice** – targeted support for your students with tailored, differentiated resources designed to provide extra practice where it is most needed. Choose from Skills Books which focus on reasoning and problem solving, Practice Books which focus on fluency and a Booster Workbook to provide additional practice for Foundation tier students, plus hundreds of differentiated questions in the Student Books.
- **Flexible routes through the curriculum** – however you want to teach it. The structured teacher resources provide options for covering the GCSE in two, three, or five years, plus support on how to tackle the new content that has moved from A-level to GCSE and from Higher tier to Foundation.
- **Easy for your students to get to grips with** - content is designed to be as clear and easy to understand as possible whilst covering all of the new, harder topics, featuring clear sign-posting of skills plus plenty of practice for fluency and consolidation.
- **On-going assessment opportunities** - track progress with auto-marked end of chapter, half term and end of year tests - which give you and your students regular knowledge checks before moving on, and prepare students for final assessment with exam-style question papers.

For full details please see the order form and component chart

GCSE Maths, 4th edition for AQA and Edexcel

Comprehensive materials support teachers and students through the substantial changes to the GCSE specification.

Student Books:

- Fully revised and updated for the new GCSE specifications for AQA and Edexcel
- Written by experienced teachers and expert authors
- Focused on fluency, mathematical reasoning and problem solving skills

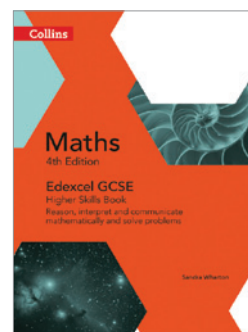
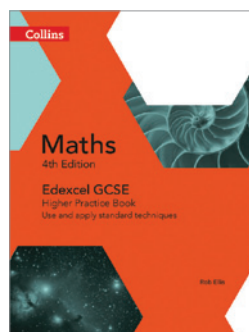
Teacher Packs:

- Help students achieve a smooth transition from KS3 to GCSE with carefully structured lessons and thorough explanations of the assessment objectives
- Plan ahead with detailed, practical schemes of work for 2,3 and 5 year teaching
- Extra teacher support on more challenging topics

Practice Books:

Available for both tiers, the Practice Books are designed to support students in mastering Assessment Objective AO1 - using and applying standard techniques. They are ideal for use both in the classroom or as a homework resource.

- Build students' confidence with hundreds of differentiated practice questions
- Easily identify topics for further practice, intervention, prior knowledge recall and revision
- Challenge your most able students with plenty of ambitious questions



Skills Books:

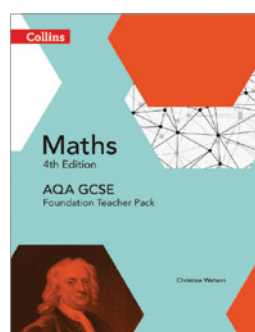
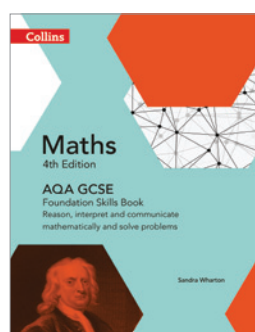
Available for both Foundation and Higher tier, the Skills Books support students in mastering Assessment Objectives AO2 and AO3: reason, interpret and communicate mathematically; and solve problems.

- Improve literacy, thinking skills and investigative strategies by providing opportunities for students to tackle problems within and outside mathematics
- Build confidence in tackling longer questions in class and allow further practice at home
- Encourage students to think and analyse their work with questions designed to encourage independence

Booster Workbooks:

Available for Foundation tier, this write-in Booster Workbook provides more practice for those students who require additional support.

- Ideal for revision, intervention groups and booster classes
- Improve students' confidence with plenty of practice questions targeted at the right level



GCSE Maths 4th edition sample pages

Focus on literacy skills with key words per topic

Bring awe and wonder with a chapter opener that puts the maths in context.

24 Algebra: Algebraic fractions and functions

24.1 Algebraic fractions

This section will show you how to:

- simplify algebraic fractions
- solve equations containing algebraic fractions.

Key word
algebraic fraction

Algebraic fractions can be added, subtracted, multiplied or divided using the same rules that apply to numbers.

To add and subtract, find a common denominator and then find equivalent fractions with that denominator.

Addition: For $\frac{a}{b} + \frac{c}{d}$, the common denominator is bd , so $\frac{a}{b} + \frac{c}{d} = \frac{ad}{bd} + \frac{bc}{bd} = \frac{ad+bc}{bd}$

Subtraction: For $\frac{a}{b} - \frac{c}{d}$, the common denominator is bd , so $\frac{a}{b} - \frac{c}{d} = \frac{ad}{bd} - \frac{bc}{bd} = \frac{ad-bc}{bd}$

This method works for more than two terms.

For example, for $\frac{a}{b} + \frac{c}{d} - \frac{e}{f}$, the common denominator is bdf , so

$$\frac{a}{b} + \frac{c}{d} - \frac{e}{f} = \frac{adf}{bdf} + \frac{cdf}{bdf} - \frac{ebd}{bdf} = \frac{adf+cdf-ebd}{bdf}$$

To multiply, cancel any common factors, then multiply the numerators together and the denominators together.

Multiplication: $\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$

To divide, find the reciprocal of the fraction you are dividing by, then multiply.

Division: $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c} = \frac{ad}{bc}$

Note that a , b , c and d can be numbers, other letters or algebraic expressions. Remember to:

- use brackets, if necessary, to avoid problems with signs and help you expand expressions
- factorise if you can
- cancel if you can.

Example 1 Simplify these fractions. a $\frac{1}{x} + \frac{2}{x}$ b $\frac{3}{x} - \frac{5}{x}$

Solution a Common denominator is $2x$:
 $\frac{1}{x} + \frac{2}{x} = \frac{2}{2x} + \frac{4}{2x} = \frac{2+4}{2x} = \frac{6}{2x} = \frac{3}{x}$

b Common denominator is $2x$:
 $\frac{3}{x} - \frac{5}{x} = \frac{6}{2x} - \frac{10}{2x} = \frac{6-10}{2x} = \frac{-4}{2x} = -\frac{2}{x}$

Sample pages from Maths 4th Edition GCSE Higher Student Book

Longer questions can be tried in class to generate discussions

New questions require students to think and analyse their work encouraging independence

24 Algebraic fractions and functions

24.1 Algebraic fractions

Example 2 What number should you add to $x^2 + 3x$ to complete the square?

The general formula for completing the square is $x^2 + bx + \left(\frac{b}{2}\right)^2$. So in this case you will need to add $\left(\frac{3}{2}\right)^2 = \frac{9}{4}$.

Question 1 a What number should be added to $x^2 + 5x$ to complete the square?
b Solve the quadratic equation $2x^2 + 10x - 5 = 0$ by completing the square.
c Adam tried to solve a quadratic by completing the square but he made a number of mistakes. Look at his working below. What mistakes did he make?

$$x^2 + 5x + 5 = 0$$

$$\left(x + \frac{5}{2}\right)^2 - \left(\frac{5}{2}\right)^2 + 5 = 0$$

$$\left(x + \frac{5}{2}\right)^2 - \frac{25}{4} + 5 = 0$$

$$\left(x + \frac{5}{2}\right)^2 - \frac{25}{4} + \frac{20}{4} = 0$$

$$\left(x + \frac{5}{2}\right)^2 - \frac{5}{4} = 0$$

$$\left(x + \frac{5}{2}\right)^2 = \frac{5}{4}$$

$$x + \frac{5}{2} = \sqrt{\frac{5}{4}}$$

$$x = \sqrt{\frac{5}{4}} - \frac{5}{2}$$

Question 2 For each part of this question think of a quadratic equation of the type $ax^2 + bx + c = 0$. Give an example of a quadratic that fits the description. Remember to justify your example in each case, which means giving an explanation as well as an example.

- The turning point has a positive x -value.
- The turning point has a positive y -value.
- The y -intercept is positive.

Question 3 a Sketch the graph of $f(x) = x^2 - x + \frac{3}{4}$.
b Hence determine whether $f(x) + 3 = 0$ has any real roots. Give a clear justification for your answer.

Sample pages from Maths 4th Edition GCSE Higher Skills Book

Ensure your pupils feel confident and competent with hundreds of basic, differentiated practice questions

24 Algebraic fractions and functions

The questions below are differentiated with colours to show progression. Green is the most accessible, moving through blue to the pink questions, which are the most challenging.

24.1 Algebraic fractions

- Simplify each of these:
 - $\frac{2x}{3} + \frac{5x}{3}$
 - $\frac{4x}{5} - \frac{2x}{5}$
 - $\frac{3x}{4} + \frac{7x}{4}$
 - $\frac{5x}{6} - \frac{2x}{6}$
- Solve the following equations:
 - $\frac{2x}{3} + \frac{5x}{3} = 11$
 - $\frac{4x}{5} - \frac{2x}{5} = 10$
 - $\frac{3x}{4} + \frac{7x}{4} = 1$
 - $\frac{5x}{6} - \frac{2x}{6} = 1$
- Show that $\frac{3x}{2} + \frac{5x}{2} = 2$ simplifies to $4x^2 - 5x - 11 = 0$.
- Solve the following equations:
 - $\frac{2x}{3} + \frac{5x}{3} = 5$
 - $\frac{4x}{5} - \frac{2x}{5} = 4$
 - $\frac{3x}{4} + \frac{7x}{4} = 4$
 - $\frac{5x}{6} - \frac{2x}{6} = 4$
- Simplify the expression $\frac{x^2 - 2x - 3}{2x^2 - 9x + 3}$.

24.2 Changing the subject of a formula

- Make the stated term the subject of each formula.
 - $4x - 2y = 3z - 10$ (1) $6x - 8y = 9z + 11$ (2) $A = 2ab^2 + ac$ (3)
 - $x(y + 1) = 2z + 3$ (4) $xy - 8z = 9z + 3$ (5) $x^2 = 2y^2 - 3z$ (6)

24.3 Functions

- Find the input for this function machine when the output is:
 - 12
 - 16
 - 8
- For which input do these function machines also have the same output?
 - Machine 1: $x \rightarrow x+2 \rightarrow \frac{1}{2}(x+2) \rightarrow x+1$
 - Machine 2: $x \rightarrow x-2 \rightarrow x+4 \rightarrow x+2$

Sample pages from Maths 4th Edition GCSE Higher Practice Book

GCSE Maths 4th edition on Collins Connect

Collins GCSE Maths 4th edition is supported by Collins Connect.

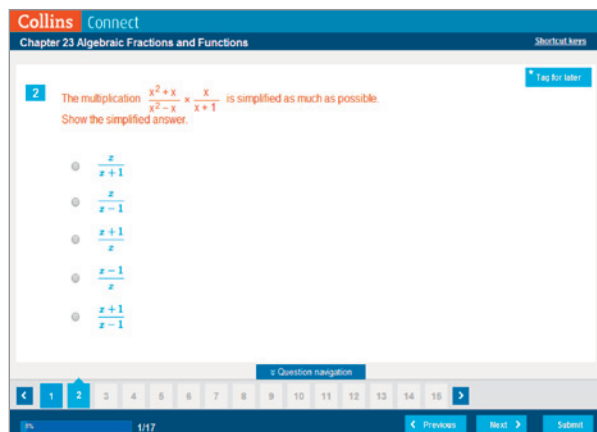
Teach GCSE Maths flexibly and in a way that suits your students with a full suite of digital resources.

Powered by an innovative online learning platform, Collins Connect makes GCSE Maths content available at home and at school, meaning it's ideal for use as a front-of-class teaching tool and as a way to set homework and tests.

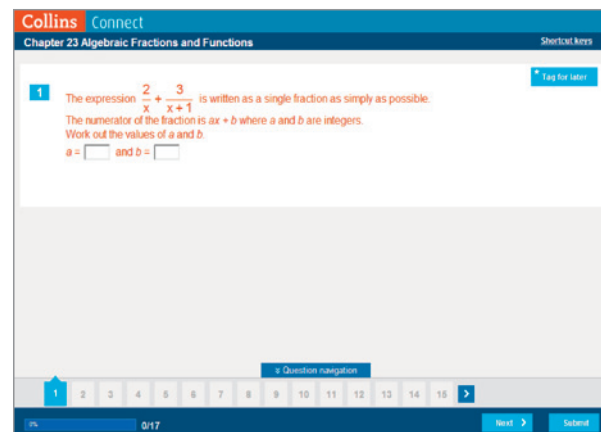


Digital resources for **Collins GCSE Maths** are designed to improve and build on key skills in maths such as fluency, problem-solving, correcting common misconceptions, using the correct vocabulary and applying maths to real-life scenarios.

Collins Connect also contains automarked questions to help students check their progress and understanding of topics.



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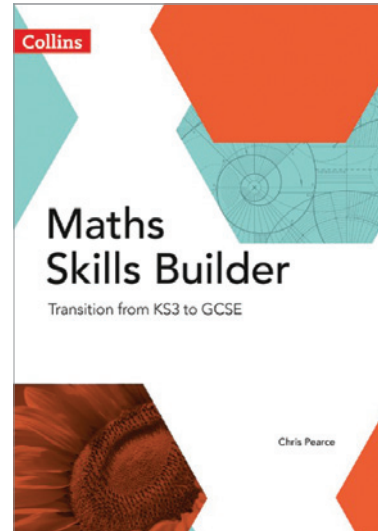
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Author: Chris Pearce

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Title	ISBN	Price
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Help pupils to make connections across maths with plenty of mixed questions

Probability

WORKED EXAMPLE

There are red, blue and black pens in a drawer. Tracy takes one pen from the drawer, without looking. The probability that she takes a red pen is $\frac{3}{5}$. The probability that she takes a black pen is $\frac{1}{10}$.

a. Work out the probability that her pen is:

- not red
- blue.

b. Denise says: 'There are now 15 pens left in the drawer.' Explain why this is false.

SOLUTION

The question says that Tracy takes the pen without looking. This means that she is equally likely to take a pen of any colour. You could also say that she takes a pen 'at random'.

a. i. The probability that the pen is **not** red = $1 - \text{the probability that it is red}$

$$= 1 - \frac{3}{5} = \frac{2}{5}$$

ii. The pen must be red, blue or black. The three probabilities must add up to one.

$$\text{The probability the pen is blue} = 1 - \left(\frac{3}{5} + \frac{1}{10} \right)$$

$$= 1 - \frac{9}{10} = \frac{1}{10}$$

b. If there are 15 pens left then originally there were 16 pens, since only one has been taken out. But originally $\frac{3}{5}$ of the pens were red – that is what the probability tells you. However, $\frac{3}{5}$ of 16 is not a whole number. Tracy must be wrong. You could also have used one of the other probabilities ($\frac{3}{10}$ or $\frac{1}{10}$) to justify your answer.

QUESTIONS

1. Graham has seven cards. Each card has a letter and a number on it.

A	B	C	D	E	F	G
1	2	3	4	5	6	7

Graham takes a card at random. Work out the probability that the card has on it:

- a multiple of 3
- a letter in the word GRAHAM
- an even number and a letter in the word CAMERA.

2. Weather each day is put in one of three categories:

sunny
cloudy and dry
wet.

The probability it is sunny today is 0.3.
The probability it is not cloudy and dry is 0.9.
What is the probability it is wet?

3. Lucy has a large jar that contains 80 coloured sweets. She says: 'If you take one without looking, the probability that you will **not** get a red sweet is $\frac{7}{8}$.' Lucy is correct. How many of the sweets in the jar are red? Give a reason for your answer.

4. Gurdeep has a 2p coin, a 10p coin and a 20p coin. He throws all three coins. Each coin can show a head (H) or a tail (T).

- Copy and complete this table to show all the possible outcomes. You will need to add more rows.

2p	10p	10p
H	H	H

- Work out the probability of his throwing at least one head.
- Work out the probability of his throwing more heads than tails.

Sample pages from Maths Skills Builder

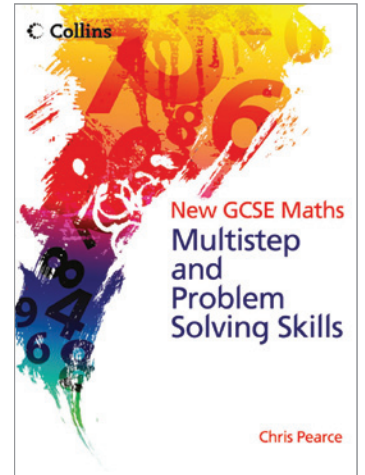
Age 14-16

Generic

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Why this chapter matters

Life is full of pairs: up and down, hot and cold, left and right, light and dark, rough and smooth, to name a few. One pairing that is particularly relevant to maths is positive and negative.

You are already familiar with positive numbers, including where they appear in real life and how to carry out calculations with them. However, sometimes we need to use a set of numbers in addition to the positive counting numbers. This set of numbers is known as the negative numbers. Here are some examples of where you might encounter negative numbers.

A negative number on a bank statement will show by how much you are overdrawn (or, how much money you have spent above what you have in your bank account). This person has withdrawn £36.42 more than what they had saved in their account and will have to pay this money back to the bank.

On the temperature scale of degrees Celsius zero is known as 'freezing point'. In many places – even in the UK – temperatures fall below freezing point. At this stage we need negative numbers to represent the temperature.

Jet pilots experience g-forces when their aircraft accelerates or decelerates quickly. Negative g-forces can be felt when an object accelerates downwards very quickly and they are represented by negative numbers. These negative forces are responsible for the feeling of weightlessness that you have on rollercoasters!

When a bigger number is taken from a smaller one, the result is a negative number.

$5 - 9 = 4$

In lifts, negative numbers are used to represent floors below ground level. These are often called 'lower ground' floors.

Sea level can be given the value 'zero'. Mountains are described as being 'above sea level' and ocean floors as 'below sea level'. This means that when a submarine goes under the sea the depths that it reaches are given using negative numbers.

As you can see, negative numbers are just as important as positive numbers and you will encounter them in your everyday life.

Chapter 3

Negative numbers

- 1 Introduction to negative numbers
- 2 Everyday use of negative numbers
- 3 The number line
- 4 Arithmetic with negative numbers

This chapter will show you ...

- how negative numbers are used in real life
- what is meant by a negative number
- how to use inequalities with negative numbers
- how to do arithmetic with negative numbers

Visual overview

```

graph LR
    A[Negative numbers] --> B[In context]
    A --> C[Inequalities]
    A --> D[Arithmetic]
    B --> E[Simple problems]
    C --> E
    D --> E
                    
```

What you should already know

- What a negative number means (KS3 level 3, GCSE grade G)
- How to put numbers in order (KS3 level 3, GCSE grade G)

Quick check

Put the numbers in the following lists into order, smallest first.

1 8, 2, 5, 9, 1, 0, 4

2 14, 19, 11, 10, 17

3 51, 92, 24, 0, 32

4 87, 136, 12, 288, 56

5 5, 87, $\frac{1}{2}$, 100, 0, 50

Current Specification

GCSE

Age
14-16

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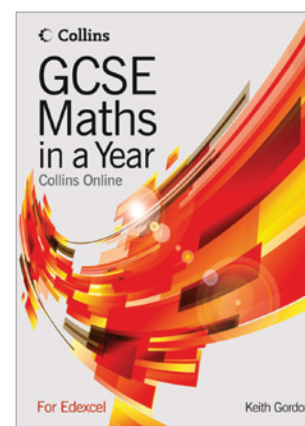
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GCSE Maths in a Year	978-0-00-752041-1	£250.00 + VAT

Age
14-16

GCSE

AQA

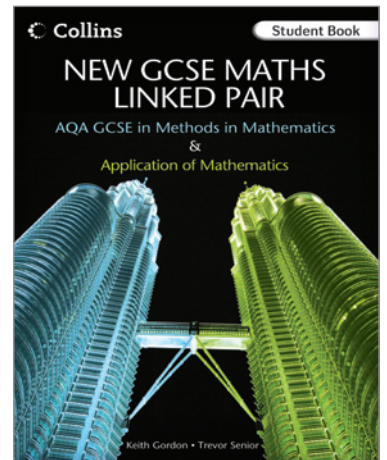
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Age
14-16

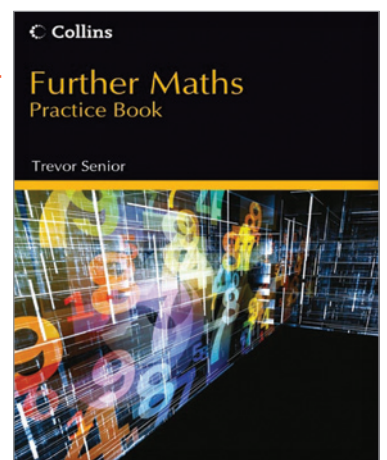
AQA

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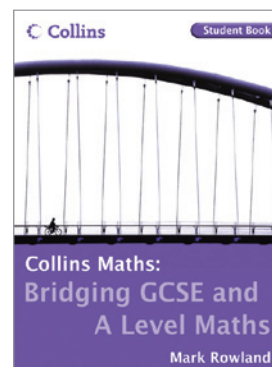


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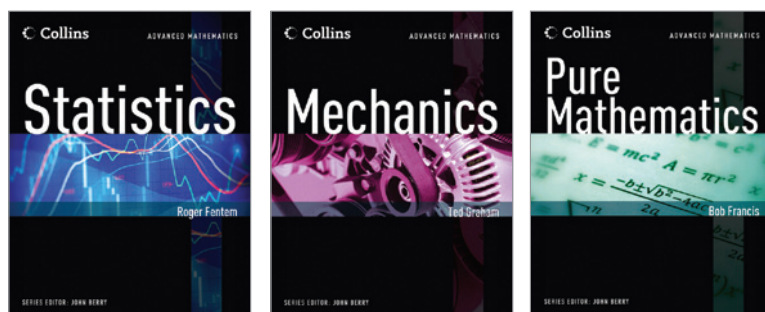
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Age
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AS/A

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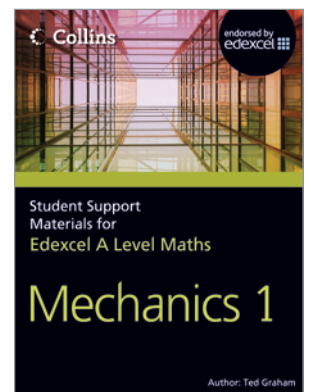
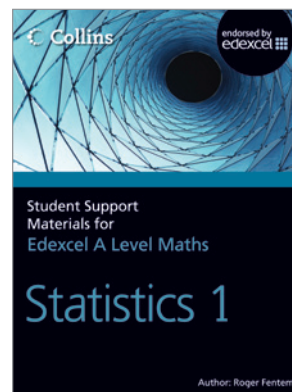
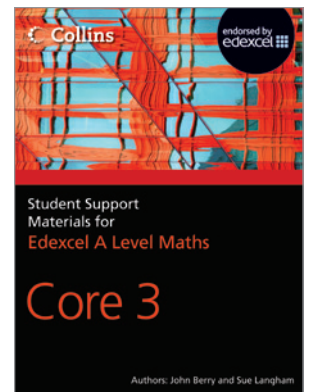
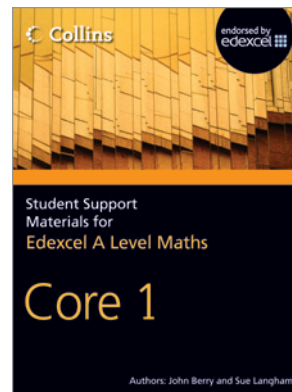
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1 Algebra and functions

Exam tip
A common error is to write $\sqrt{a^2 + b^2} = a + b$ or $\sqrt{a^2 - b^2} = a - b$.

Quadratic functions
The product of two linear functions such as $f(x) = x - 2$ and $g(x) = x - 3$ introduces a new function $fg = (x - 2)(x - 3) = x^2 - 5x + 6$. The highest power is 2 so it is called a **quadratic function**. Any expression with a term in x^2 , with or without a term in x and with or without a constant, is a quadratic function. The following are all quadratic functions in a variable x .

$y = x^2$
 $y = 2x^2 + 11$
 $y = 2x^2 - 3x + 5$

You can use other letters to represent the variables. For example,
 $y = 14t - 10t^2$
is a quadratic function in t .

The general form of a quadratic function in the variable x is
 $y = ax^2 + bx + c$
where a , b and c are constants, are called **coefficients** and $a \neq 0$.

- a is the coefficient of x^2
- b is the coefficient of x
- c is the constant term (or coefficient of x^0).

Graphs of quadratic functions
The graph of a quadratic function is called a **parabola**. Every parabola is symmetrical about a line of symmetry through the vertex as shown in Figure 1.2.

Fig. 1.2 Shapes of parabolas.

shape of the parabola for $a > 0$

shape of the parabola for $a < 0$

Quadratic functions

Example
A quadratic function is defined by $y = x^2 - 2x - 3$.

- Plot a graph of the function.
- Find the coordinates of the y -intercept.
- Find the coordinates of the points where the graph intersects the x -axis.
- Draw it in, and give the equation of the line of symmetry.
- Write down the coordinates of the vertex.

Answer:
A table of values for $y = x^2 - 2x - 3$ gives:

x	-3	-2	-1	0	1	2	3	4	5
y	12	5	0	-3	-4	-3	0	5	12

Fig. 1.3 Graph of quadratic function $y = x^2 - 2x - 3$.

Solution:
 (i) $(0, -3)$
 (ii) $(-1, 0)$ and $(3, 0)$
 (iii) $x = 1$
 (iv) $(1, -4)$

The position and shape of the parabolic graph for a quadratic function $y = ax^2 + bx + c$ depends on the values of a , b and c . The constant c gives a similar role as it does for the straight line graph $y = mx + c$. It gives the coordinates of the y -intercept $(0, c)$. The constant a gives either a concave up shape for $a > 0$ (a 'smiley face') or a concave down shape (a 'sad face') for $a < 0$ as shown in Figure 1.2. The effect of varying a is to stretch the parabola parallel to the y -axis.

Avoid common misconceptions and errors with exam tips

Worked examples help students to grasp concepts quickly and easily

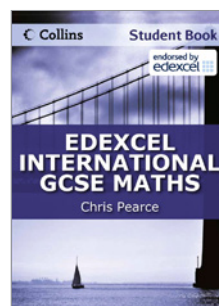
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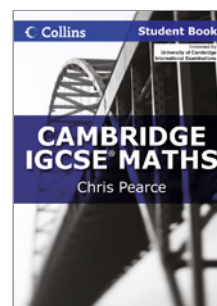
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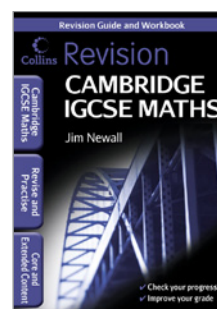
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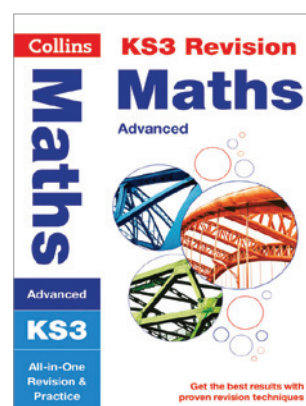
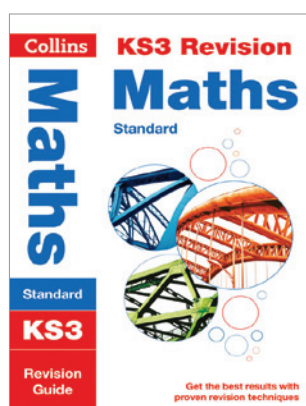
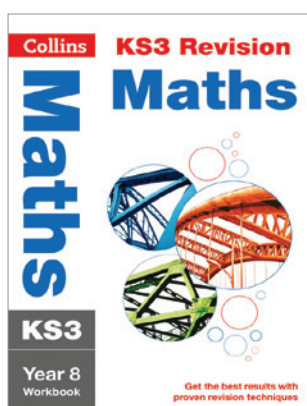
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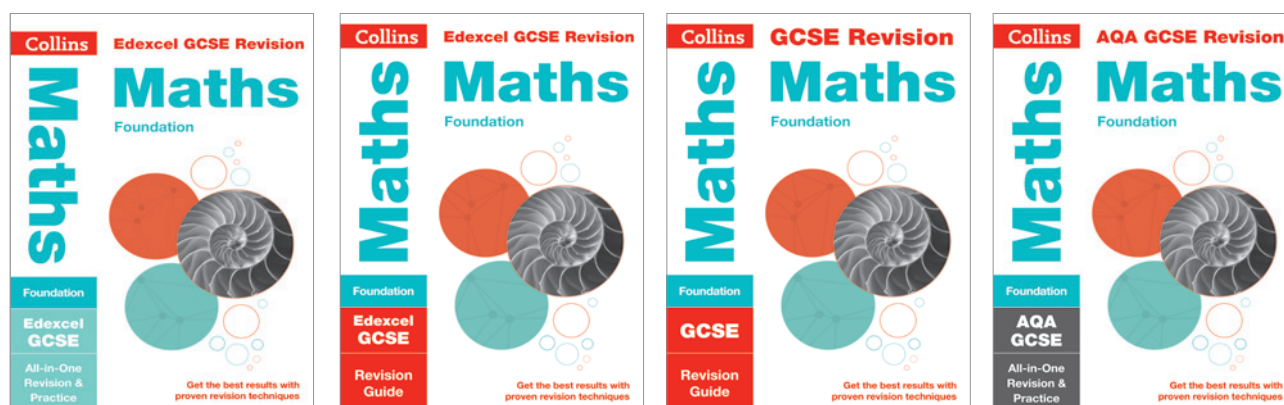
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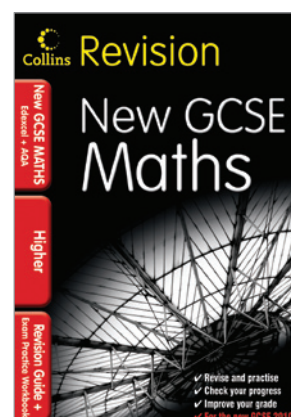
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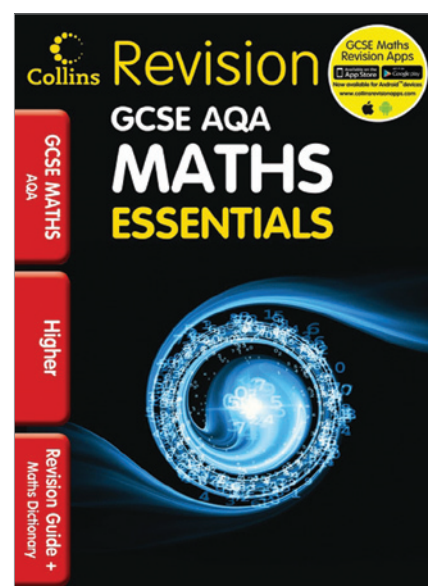
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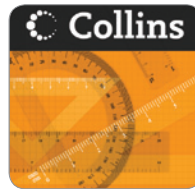
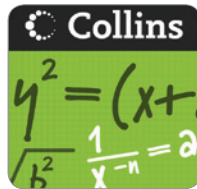
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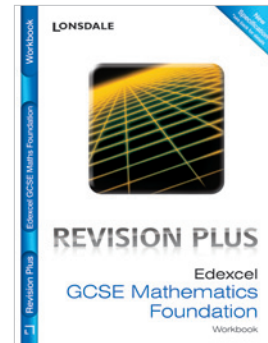
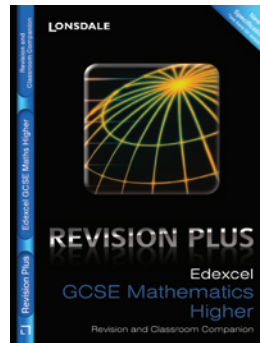
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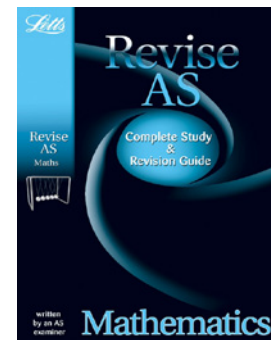
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