

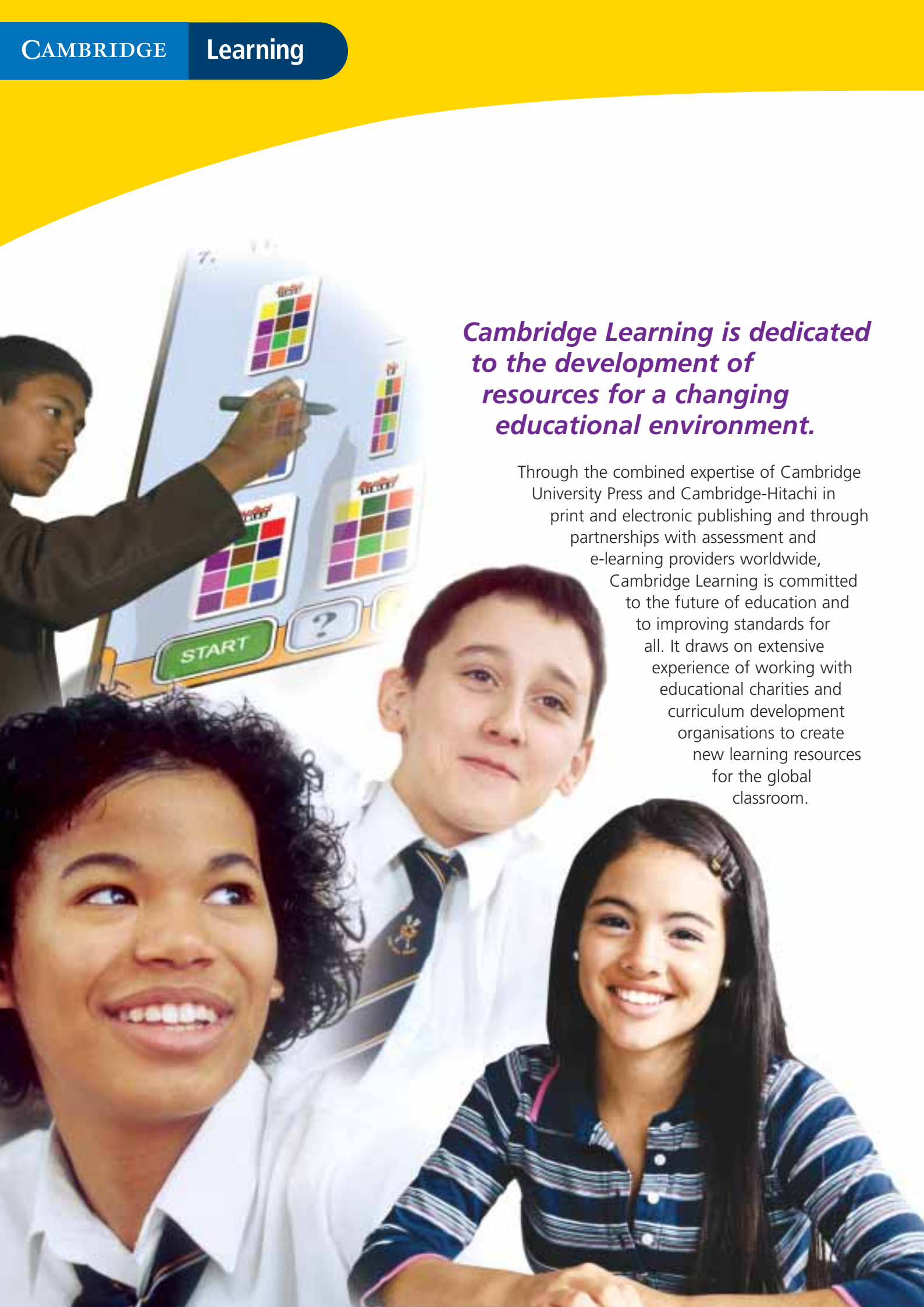
# mathematics

## 2006

See inside for:

- New software from Cambridge Hitachi
- New products in collaboration with the NRICH website and the Millennium Maths Project





*Cambridge Learning is dedicated to the development of resources for a changing educational environment.*

Through the combined expertise of Cambridge University Press and Cambridge-Hitachi in print and electronic publishing and through partnerships with assessment and e-learning providers worldwide, Cambridge Learning is committed to the future of education and to improving standards for all. It draws on extensive experience of working with educational charities and curriculum development organisations to create new learning resources for the global classroom.

# contents

## Key Stage 3

SMP Interact: Framework Edition	2–5
Task Maths Interactive	6–7
Maths Trails	8
Mult-e-Maths Toolbox	9
Perfect Times	10

## Key Stage 4

Vital Statistics	10
Coursework Techniques for GCSE Maths	11
SMP Interact for GCSE	12–13

## AS/A2 Level

AS/A2 SMP Mathematics for AQA	14–15
AS/A2 SMP Mathematics for Edexcel	16–17
Cambridge Advanced Mathematics for OCR	18–19

**Resource Books** 20

**For International qualifications** 20

**Order Form** Centre pages



**Authors**

The School  
Mathematics Project



# SMP Interact: Framework Edition

## The highly acclaimed Key Stage 3 book-based course

*SMP Interact: Framework Edition* supports a teacher-led, discussion-based approach as recommended by the Key Stage 3 Framework for Teaching Mathematics.

### Well-structured comprehensive book-based course

*SMP Interact: Framework Edition* comprises of one book per year in three differentiated tiers, with a teacher's guide and an optional practice booklet for each pupil's book. Resource sheets come as packs of photocopiable masters. *SMP Interact: Framework Edition* provides clear, coherent material that always lives up to your expectations.

### Assessment materials that save you time

For each year there's a pack of assessment materials, containing hundreds of high-quality assessment items linked to the units in the books and related to national curriculum levels; these packs can save a department weeks of test preparation. Photocopiable masters and alternative digital files are supplied in each assessment pack.

### Supportive Teacher Guides

The teacher's guides provide a rich vein of ideas for oral and mental starters. Advice throughout the teacher's guides, linked to beige T-bars on the edge of the pupil's pages, supports the teacher's central role in the main part of the lesson, particularly in managing effective whole-class discussion. Clear objectives and progress checks in blue panels, together with other key summaries, form an essential resource for the final plenary.

### Encouraging classroom discussion

*SMP Interact: Framework Edition* encourages discussion with its fresh approaches and spot-on activities that help pupils to throw light on misconceptions and create shared understanding for them to build on. *SMP Interact: Framework Edition* motivates pupils, offering all the support and challenge they need.

**'I'm sure using SMP Interact  
contributed to our superb  
Ofsted report'**

*Ian James,  
Head of Mathematics, Garibaldi School, Mansfield*

## Pupil's Books

Clearly explained

Teacher-led activities

Teacher-led activities

Clear layout

### C Solving equations

We can find the value of  $x$  in the equation  $2(x - 3) = 130$  using arrow diagrams.

Draw an arrow diagram for the equation.

Reverse it to find the value of  $x$ .

It is called the solution of the equation.

Check the solution.

Check: When  $x = 68$ ,  
 $2(x - 3) = 2 \times (68 - 3)$   
 $= 2 \times 65$   
 $= 130$  which is correct!

Find the value of  $x$  in solving the equation.

1. Solve these equations, using arrow diagrams. Check each solution.  
 (a)  $7x - 5 = 45$     (b)  $4(x + 1) = 104$     (c)  $3(x - 3) = 48$   
 (d)  $5x + 3 = 48$     (e)  $8y - 5 = 123$     (f)  $12x + 81 = 132$

2. Solve these equations. Check each solution.  
 (a)  $8x = 28$     (b)  $3x - 5 = 9$     (c)  $9x + 4 = 26$   
 (d)  $10(y - 3) = 24$     (e)  $7(x + 3) = 87.2$     (f)  $3y - 2 = 40$

3. Check that  $x = 6$  is a solution to  $2x + 4 = 16$ .  
 Make up three different equations with  $x = 6$  as a solution.

4. Make up two different equations that have  $y = 1.5$  as a solution.

5. Solve these equations. Check each solution.  
 (a)  $3(x - 3) + 9 = 46$     (b)  $2(3y - 1) = 8$   
 (c)  $4.5(y + 2.5) - 5.6 = 6.975$

### D Quick solve

In the game 'Quick solve' you win points by solving equations.

**One way to play 'Quick solve'**

- Play in groups of three or four.
- Each group needs three sets of 12 different cards (36 cards in total) from sheet 158.
- Shuffle each set of cards.
- Put each set face down in a pile.
- Players have three piles of cards (10-point pile, 2-point pile and 3-point pile).
- At the start of the game, each player chooses a card from any pile and tries to solve the equation on the card.
- When a player thinks they have solved the equation, they take another card from any pile.
- Repeat until all the cards have been taken.
- Players check each other's solutions (total 188).

A correct solution wins the number of points on the card.

A point is lost for any incorrect solution.

The player with the most points is the winner.

You could write your solutions in a table like this.

Card number	Equation	Correct	Points
25	$x = 5$	Yes	10
12	$x = 18$	No	-1

Play 'Quick solve'!

Sample spread from pupil's book 75



'There are clearly defined objectives for each chapter, plenty of questions of increasing challenge and invaluable assessment at the end of the topic. Frequent investigation ideas provide suggestions for extension and display work.'

Shirley Rowlings, Head of Mathematics,  
Stratford Girls' Grammar School, Stratford upon Avon



'... with three interchangeable tiers, the children can move groups but carry on with the same work. The staff and students are enthusiastic about *SMP Interact*.'

Pete Jameson  
Head of Mathematics  
Ixworth Middle School  
Suffolk

## Teacher's Guides

### Supporting the teacher, motivating the pupil ...

#### ■ Stimulating

Careful development and full-scale trialling have gone into *SMP Interact*, with teachers' ideas and feedback enhancing the course at every stage. The result? A distillation of teaching material of unsurpassed quality – motivating, clear and thorough.

#### ■ Supportive

The teacher's guides include a wealth of ideas for oral and mental starters, together with advice on activities and discussion that bring the key mathematical ideas to life.

#### ■ Complete

All books are fully available, making the decision to adopt the course easy as it can be based on a comprehensive overview.

'In twenty-four years as a Head of Department, this is the best scheme that I have seen.'

M King, Head of Mathematics,  
Hastingsbury Upper School, Bedfordshire

#### Assessment packs available

Assessment materials for year 7  
**£85.00**

Assessment materials for year 8  
**£75.00**

Assessment materials for year 9  
**£65.00**

#### Contact SMP

The assessment materials are only available direct from SMP: go to [www.smpmaths.org.uk](http://www.smpmaths.org.uk) to find out more and to download sample assessments and an order form.

## SMP Interact assessment packs

There are three packs, one for each year, containing assessments linked to the units in the books, non-calculator assessments and mental questions. The assessments come as hard copy masters, pdf files, and as Word files that you can edit into assessments for your own particular needs. The unit assessments and non-calculator assessments give guidance on national curriculum levels. The assessment materials are only available direct from SMP.

## Free SMP Interact planning materials

Go to [www.smpmaths.org.uk](http://www.smpmaths.org.uk) for free cross-references from the Framework's yearly teaching programmes to the new Framework edition for Key Stage 3, as well as a free Excel-based medium-term planner, which gives detailed learning objectives and Framework references for the whole course, saving you hours of effort when writing a scheme of work.

## Book FN

*Book FN* offers additional help and support with number work for pupils following the T course in years 7 and 8. *Book FN* has an accompanying teacher's guide and resource sheets.

## Pupil's Books

## Teacher's Guides

## Practice Books



## Titles available

<p><b>Book 7T</b> 978 0 521 53797 1 (0 521 53797 5) <b>£10.50</b></p> <p>Teacher's Guide to Book 7T 978 0 521 53798 8 (0 521 53798 3) <b>£18.95</b></p> <p>Practice for Book 7T 978 0 521 53799 5 (0 521 53799 1) <b>£3.50</b></p>	<p>Teacher's Guide to Book 7C 978 0 521 53791 9 (0 521 53791 6) <b>£18.95</b></p> <p>Practice for Book 7C 978 0 521 53792 6 (0 521 53792 4) <b>£3.50</b></p> <p>Resource Sheets for Books 7T, 7S &amp; 7C 978 0 521 53796 4 (0 521 53796 7) <b>£55.00</b></p>	<p>Teacher's Guide to Book 8T 978 0 521 53809 1 (0 521 53809 2) <b>£15.95</b></p> <p>Practice for Book 8T 978 0 521 53810 7 (0 521 53810 6) <b>£3.50</b></p> <p>Resource Sheets for Book 8T 978 0 521 53811 4 (0 521 53811 4) <b>£25.00</b></p>	<p>Teacher's Guide to Book 8C 978 0 521 53802 2 (0 521 53802 5) <b>£15.95</b></p> <p>Practice for Book 8C 978 0 521 53803 9 (0 521 53803 3) <b>£3.50</b></p> <p>Resource Sheets for Books 8S &amp; 8C 978 0 521 53807 7 (0 521 53807 6) <b>£25.00</b></p>	<p><b>Book 9S</b> 978 0 521 53815 2 (0 521 53815 7) <b>£8.95</b></p> <p>Teacher's Guide to Book 9S 978 0 521 53816 9 (0 521 53816 5) <b>£11.95</b></p> <p>Practice for Book 9S 978 0 521 53817 6 (0 521 53817 3) <b>£2.95</b></p>
<p><b>Book 7S</b> 978 0 521 53793 3 (0 521 53793 2) <b>£10.50</b></p> <p>Teacher's Guide to Book 7S 978 0 521 53794 0 (0 521 53794 0) <b>£18.95</b></p> <p>Practice for Book 7S 978 0 521 53795 7 (0 521 53795 9) <b>£3.50</b></p>	<p><b>Book FN</b> 978 0 521 78547 1 (0 521 78547 2) <b>£3.95</b></p> <p>Teacher's Guide to Book FN 978 0 521 78543 3 (0 521 78543 X) <b>£8.25</b></p> <p>Resource Sheets for Book FN 978 0 521 78542 6 (0 521 78542 1) <b>£12.95</b></p>	<p><b>Book 8S</b> 978 0 521 53804 6 (0 521 53804 1) <b>£9.95</b></p> <p>Teacher's Guide to Book 8S 978 0 521 53805 3 (0 521 53805 X) <b>£15.95</b></p> <p>Practice for Book 8S 978 0 521 53806 0 (0 521 53806 8) <b>£3.50</b></p>	<p><b>Book 9T</b> 978 0 521 53819 0 (0 521 53819 X) <b>£8.95</b></p> <p>Teacher's Guide to Book 9T 978 0 521 53820 6 (0 521 53820 3) <b>£11.95</b></p> <p>Practice for Book 9T 978 0 521 53821 3 (0 521 53821 1) <b>£2.95</b></p> <p>Resource Sheets for Book 9T 978 0 521 53822 0 (0 521 53822 X) <b>£25.00</b></p>	<p><b>Book 9C</b> 978 0 521 53812 1 (0 521 53812 2) <b>£8.95</b></p> <p>Teacher's Guide to Book 9C 978 0 521 53813 8 (0 521 53813 0) <b>£11.95</b></p> <p>Practice for Book 9C 978 0 521 53814 5 (0 521 53814 9) <b>£2.95</b></p> <p>Resource Sheets for Books 9S &amp; 9C 978 0 521 53818 3 (0 521 53818 1) <b>£25.00</b></p>
<p><b>Book 7C</b> 978 0 521 53790 2 (0 521 53790 8) <b>£10.50</b></p>	<p><b>Book 8T</b> 978 0 521 53808 4 (0 521 53808 4) <b>£9.95</b></p>	<p><b>Book 8C</b> 978 0 521 53801 5 (0 521 53801 7) <b>£9.95</b></p>		

Find details of local sales consultants on the outside back page and arrange for a convenient time for them to talk to you about SMP Interact Framework edition.

## Authors

Derek Ball  
Barbara Ball

## Titles available

## Sequence Machines

978 1 84565 124 4

(1 84565 124 3)

CD-ROM

£95.00 + VAT

## Mathematical Art

978 1 84565 945 5

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Available Spring 2006

## Number Pyramids

978 1 84565 947 9

(1 84565 947 3)

CD-ROM

£95.00 + VAT

Available Spring 2006

## NEW

# Task Maths Interactive

## Take a creative approach to problem-solving and reasoning skills!

*Task Maths Interactive* is a series of CD-ROMs containing rich mathematical tasks for whole-class teaching and individual pupil use for problem-solving and reasoning skills.

### ■ Meeting your curriculum needs

With the flexibility to fit into your scheme of work, each CD-ROM contains an engaging task from which you can draw out mathematics to meet your particular curriculum need. Each task includes software for whole-class and individual pupil use with teacher support material and worksheets.

### ■ Provides several weeks work

The tasks provide a coherent structure for several weeks work and can be used flexibly for a consolidated piece of work, a starter activity or during a plenary.

### ■ Challenging tasks

There are different levels of challenge within each task, with core questions linked to objectives and further ideas for extension and promoting problem solving. Pupils can enhance and consolidate their understanding of key mathematical concepts from the KS3 Programme of Study while solving problems. Different activities within each task focus on objectives across all the year groups.

### ■ Adaptable activities

All the activities are adaptable with choice of numbers, operations, hiding and revealing options so you can set the software up to suit your requirements.

### ■ Printable worksheets to save time

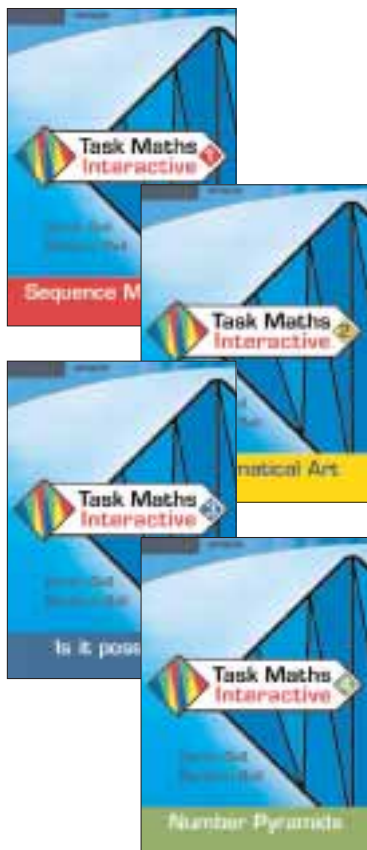
Printable worksheets are included for consolidation away from the computer or setting situations to investigate with the computer.

### ■ Creative ideas to engage your pupils

The teacher's notes suggest a range of different activities for each task, with detailed guidance offering a wealth of creative ideas for immediate use.

### ■ Suitable for all pupils

The material is organised by task rather than by content to be suitable for pupils with a wide range of abilities.



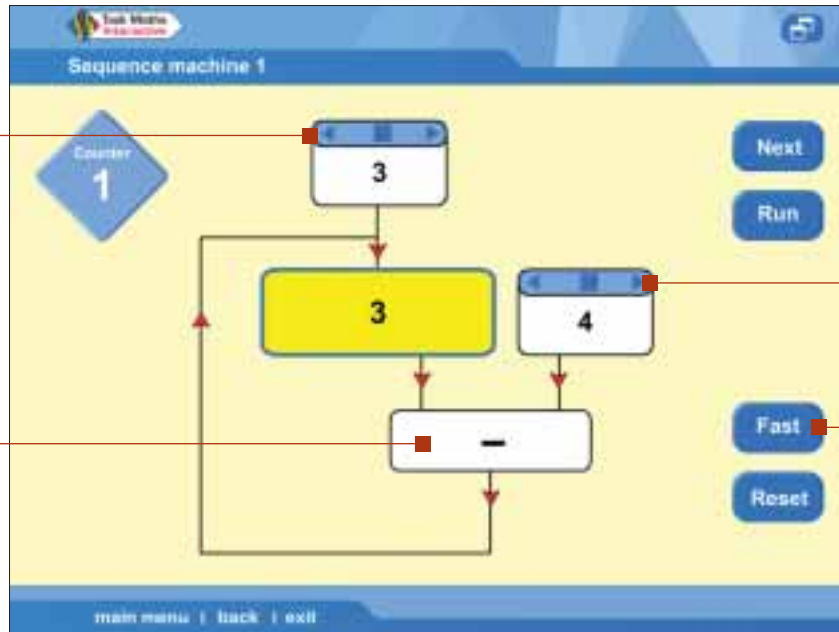


### Whole class screen

This activity uses a number machine that generates sequences, by taking a start number and then continually adding, subtracting, multiplying by or dividing by a fixed number.

Choose the numbers in the machine using sliders to tailor problems to pupil's needs

Choose from a range of operators to use with the machine to allow greater differentiation



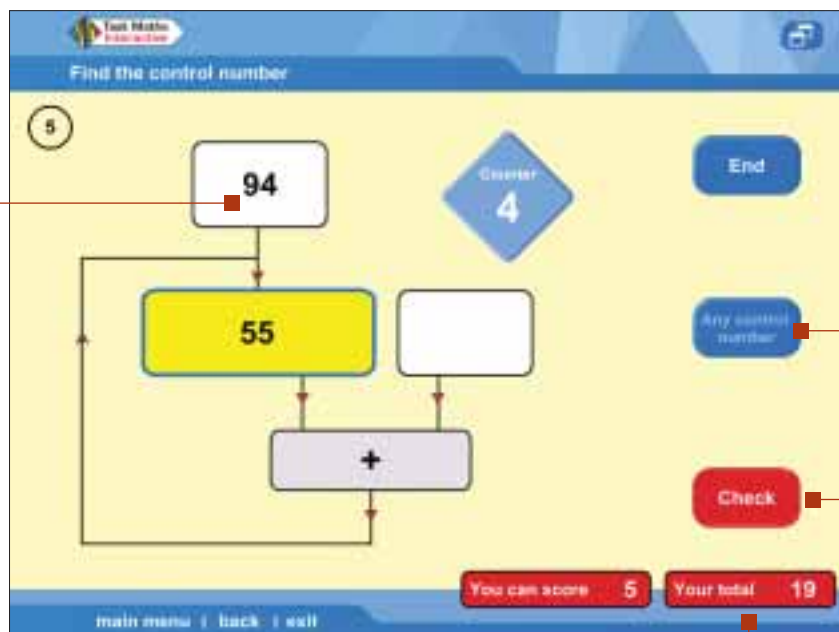
Use this slider to select a control number. The control number controls what the machine does

Choose the running speed of the machine

### Pupil challenges screen

For consolidation and practice of relevant strategies, knowledge and skills, pupils can do pupil challenges that are similar to the related whole-class teaching sessions.

Randomly generated problems appear here



Press this button to have the control numbers that can be positive or negative

Press Check to check the answer

Running total of pupil's score to monitor progress

**Authors**

Jennifer Piggott  
Liz Pumfrey

**Titles available**

**Maths Trails – Generalising**  
978 0 521 68239 8  
(0 521 68239 8)  
Paperback and CD-ROM  
£19.95

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**COMING SOON!**

*Maths Trails 3*  
and *Maths Trails 4!*

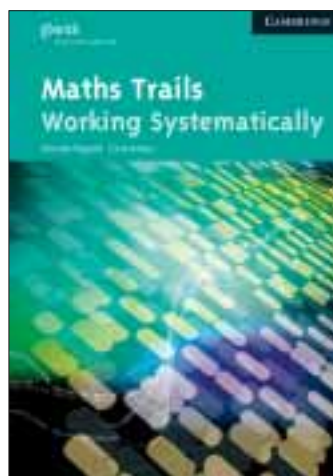
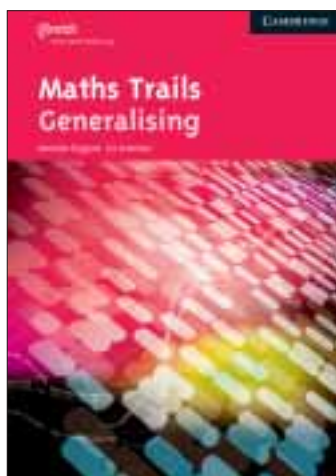
Visit the NRICH website  
at [www.nrich.maths.org](http://www.nrich.maths.org)

**NEW** Developed in partnership with the NRICH website

# Maths Trails

## Structured activities for problem-solving skills in a teacher book and CD-ROM

*Maths Trails* has been developed by members of the NRICH team at Cambridge University to complement resources on the NRICH website. The teacher book and CD-ROMs introduce, develop and enhance problem-solving skills for systematic working.



### Structured approach to problem solving

*Maths Trails* has a structured approach to problem solving for top primary and lower secondary pupils. You can choose from over 15 problem-solving activities on each trail helping pupils develop strategies and skills for problem solving. Each trail gives a progressive route to develop pupils' mathematical thinking skills and encourage collaborative work and discussion.

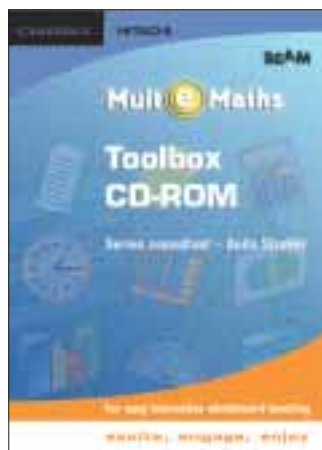
### Full support for teachers

The teacher's book includes links to the curriculum, planning suggestions, appropriate questions and prompts for lessons together with possible lesson outcomes and assessment for learning guidance is also included.

### Links to the NRICH website

To enable pupils to explore mathematical ideas and engage in mathematical discussions the CD-ROM also links to the NRICH website for further similar problems and for pupils to post their solutions.

Developed in partnership with the Millennium Maths Project  
Find out more at [www.mmp.maths.org](http://www.mmp.maths.org)



978 1 84565 075 9  
(1 84565 075 1)  
CD-ROM  
£350.00 + VAT

# Mult-e-Maths Toolbox

## Giving you the power to create and enhance maths lessons

With a wide range of functions on one CD-ROM, the *Mult-e-Maths Toolbox* gives teachers the power to create and enhance maths lessons using the interactive whiteboard. It includes tools for numbers and place value, fractions, calculations, measures, shape and space and handling data, all of which can be customised and saved ready for use within a lesson.

### ■ Customise according to your needs

The Toolbox consists of a workspace and tools that you combine and use to create learning experiences customised for your class. All tools are easily accessible at any point whilst using the program.

### ■ Works with your learning objectives

You can set up tools to suit your learning objectives, saving the files and having everything ready to teach. Six sheets, set up as progressive pages, give your lessons a clear structure and help you to maintain a good pace.

### ■ Works across networks

Share saved lessons across a network, email them to colleagues, or set them up at home and email them to yourself at school.

## Author

Fran Wilson



978 0 521 68340 1  
(0 521 68340 8)  
Paperback and CD-ROM  
£34.95

# Ideas for using the Mult-e-Maths Toolbox at lower secondary

## Giving you exciting ideas and suggestions for using the tools at Key Stage 3

An easy-to-use handbook and CD-ROM to accompany the *Mult-e-Maths Toolbox* with hundreds of ideas for teaching at the lower secondary level.

- Ready made activities linked to medium-term plans that fit directly into schemes of work.
- Pre-prepared toolbox files for immediate use with no set-up required.
- Specific ideas for lesson starters and plenaries that can be used straightaway.



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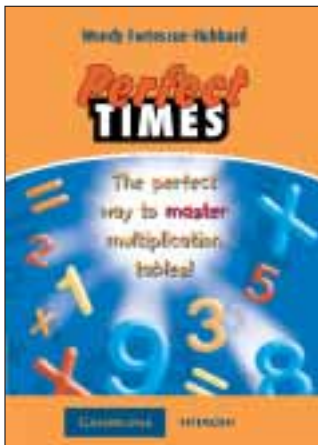
## Author

## Wendy Fortescue-Hubbard

Wendy Fortescue-Hubbard is a maths specialist with over 15 years of teaching experience. Since April 2002 she has written the Mathagony Aunt column in the *Times Educational Supplement*.

CAMBRIDGE

HITACHI



## Perfect Times

978 1 84565 013 1

(1 84565 013 1)

CD-ROM

£77.25 + VAT




# Perfect Times® CD-ROM

## The perfect way to master multiplication

*Perfect Times* is suitable for all ages, stimulating and challenging for children and adults alike. It is designed to develop multiplication and division skills as well as recognition of multiples and factors and different types of number sequences – squares, cubes, triangle numbers, and so on.

*Perfect Times* has been created by Wendy Fortescue-Hubbard, maths specialist and *TES* Mathagony Aunt.

- Fun and motivating games help pupils to improve their number skills. Raises standards for all ability levels and ages.
- Helps you to teach and reinforce number recognition, multiplication and division skills, as well as common number sequences.
- Allows you to set learning programmes to meet individual pupil needs.
- Results can be displayed as printable graphs so that you can monitor progress easily.
- For use on a whiteboard with the whole class or on single computers for individual learning.
- Standardises the assessment of fluency through a time score.
- For PC and Mac.



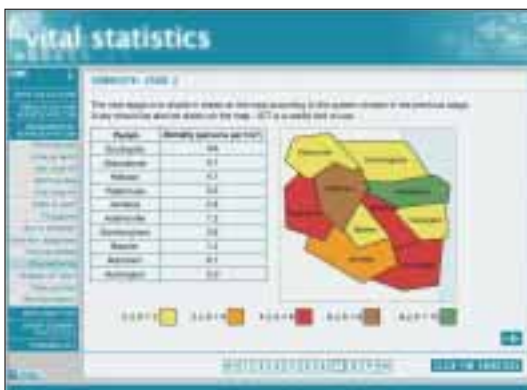

# Vital Statistics

## Versatile software, visually stimulating

An enjoyable and flexible CD-ROM that enables you to teach statistics with ease and build your students' confidence as they learn and revise.

*Vital Statistics* supports the teaching of statistics to GCSE Foundation level and the discrete sections make it ideal for revision at Key Stages 3 and 4.

- For PC and Mac.
- Divided into easy-to-teach sections: Data Collection, Tabulation and Representation, Diagrammatic Representation, Data Analysis, Summary Statistics and Probability.
- Clear explanations and animated examples support independent learning.
- Interactive exercises allow students to test their understanding.
- All sections are supported with paper-based worksheets.
- Can be used for whole-class teaching using an interactive whiteboard or for individual work for independent learning.
- Covers topics and knowledge for the Foundation GCSE Statistics course and beyond.



## Vital Statistics

978 1 84565 025 4

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CD-ROM

£180.00 + VAT

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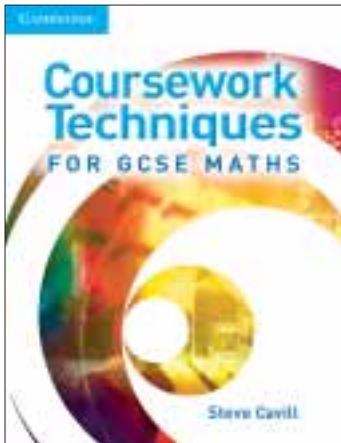
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£325.00 + VAT

Prices include single user and site licence. For a network licence please contact customer services on 01223 325588.

## Author

Steve Cavill



## Titles available

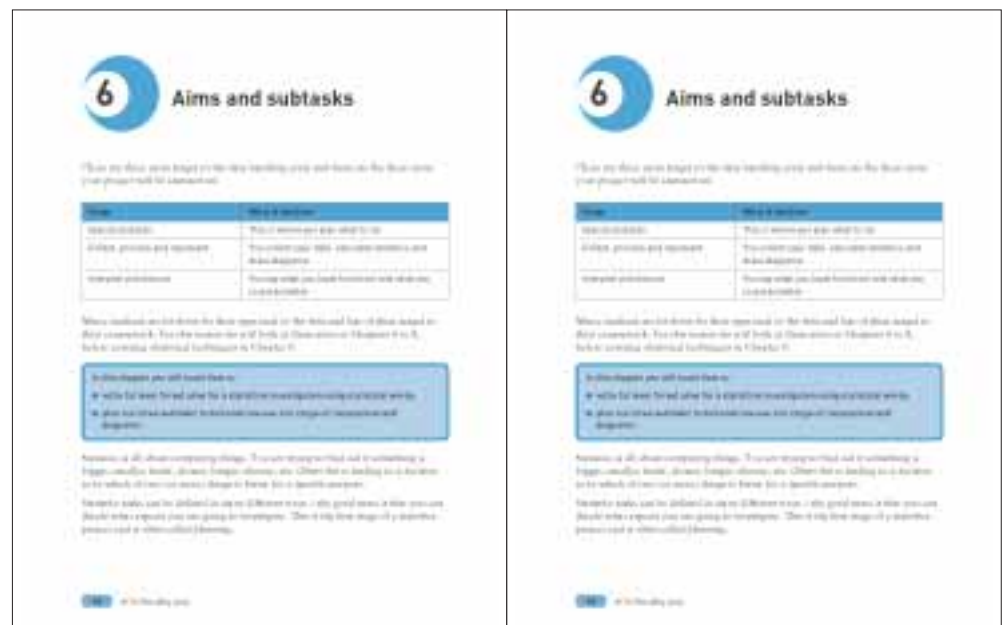
Coursework Techniques  
for GCSE Maths  
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(0 521 67787 4)  
112 pp. Paperback  
£5.50

## NEW

# Coursework Techniques for GCSE Maths

For success in coursework at Key Stage 4!

*Coursework Techniques for GCSE Maths* gives structured exercises for students to develop and practise the appropriate techniques for coursework.



Sample spread from *Coursework Techniques for GCSE Maths*

## ■ Straightforward resource by experienced author

Written by an experienced GCSE coursework examiner and moderator, *Coursework Techniques for GCSE Maths* is a straightforward resource of the techniques and strategies needed for students to achieve success in coursework at Key Stage 4.

## ■ Exercises for practice and development

Double page spreads for many topics, with worked examples and exercises, allows students to develop and practise the specific techniques needed for coursework. Each chapter is divided into sections, each with clear objectives and a summary of the key ideas.

## ■ Easy-to-use

Full detailed answers in back of the book. Each chapter is divided into sections, each with clear objectives and a summary of the key ideas.

'... the materials have increased the students' confidence and are leading to improved performance in the classroom, which we are sure will be reflected in their examination result.'

M. King

Head of Mathematics  
Hastingsbury Upper School

#### Titles available

##### Foundation Student's Book

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£31.95

# SMP Interact for GCSE

## The popular GCSE course

Extensively trialled and praised for building students' confidence, *SMP Interact for GCSE* follows the same discussion, enjoyment and succeeding principles of the Framework Edition.



### Versatile

There's a two-year student's book for each tier, covering the tier content of all linear and modular specifications for the main exam boards.

### Supportive

There are helpful summaries and at the end of each unit there are questions for self-assessment. Real exam questions from a variety of boards boost confidence. There's a teacher's guide and an optional practice book for each student's book. The practice book follows the structure of the main text, making it easy to organise extra practice, homework and revision. Time-saving resource sheets come as packs of photocopiable masters.

### Comprehensive

Topics are explored thoroughly. And unique material builds the ideas needed for GCSE coursework, including data-handling.

### Confidence building

The books offer real exam questions from a variety of boards to help build students' confidence.

### Easy to use

*SMP Interact for GCSE* clearly states objectives, has questions for self-assessment and clearly marked links to advice in the teacher's guide.

'We can usually rely on SMP materials to be of a good quality but these particular texts must rank amongst the best so far.'

Mathematical Gazette

## Publication updates

We're sending schools publication details in the early part of 2006. You can also keep up to date on progress by visiting [www.smpmaths.org.uk](http://www.smpmaths.org.uk)

# Getting ready for a two-tier GCSE

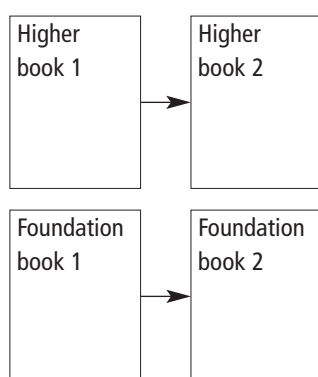
Ahead of a decision by QCA on making two-tier GCSE mathematics available to all schools, the SMP and Cambridge University Press have been working on providing the best possible support for the new exam. Publication is planned to start in spring 2006.

## For schools that have already invested in *SMP Interact for GCSE* mathematics

We think most will choose to use our three current textbooks as they have before: teachers are familiar with them and know which book suits each group of year 10 students. Students who do well on the Intermediate book and are entered for the new Higher tier can then work on selected topics from the existing Higher book: we'll provide free guidance on how to do this.

However, those students suited to our Foundation book who might gain a grade C on the new Foundation tier may find that the extra topics they need are dealt with at too brisk a pace in our Intermediate book. So we are working on a new book, Foundation extension, that will introduce and consolidate those extra topics at a carefully judged pace. It's to be used alongside our existing Foundation book as a source of extension material and then as the main text when the Foundation book has been completed.

Meanwhile, the original students' books and associated publications will be kept in print unchanged.



## For those that have not yet used our GCSE course

For these schools we are working on a new edition of *SMP Interact for GCSE* with this structure (see in the left-hand column).

With their comprehensive coverage of the new national structure the books will be ideally suited to all linear and major modular exams. They'll carry forward the outstanding quality of the original *SMP Interact*. At the same time, teachers who have never used that course will find placing students at the start of year 10 straightforward in the new structure. With each tier now spanning a wide range of attainment, work for those aspiring to the higher grades will be clearly labelled, as will material designed to bridge any gaps in coverage or understanding of Key Stage 3 content.

If your current GCSE books are starting to look distinctly out of date, there couldn't be a better moment to switch to an up-to-date course from a team with a reputation for producing stimulating and supportive material that is unrivalled.

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- Key points clearly highlighted and summarised

**'I would recommend this book for its varied selection of questions and examples'**

*Claire Turner, Teaching Statistics on Statistics 1*



Development questions suitable for discussion

Summary of what is expected

### 1 Linear graphs and equations

In this chapter you will

- work on linear graphs and their equations
- change a given linear equation to a different form
- use gradient triangles to find the gradient of a straight line
- find the equation of a straight line
- find the gradient of a line perpendicular to a given line

**A straight line** (Lesson 1.1)

On any part of a straight line graph, the gradient is the ratio  $\frac{\text{vertical change}}{\text{horizontal change}}$ .

A gradient can be a fraction. It is negative if the line goes down as it goes to the right (like the staircase in a graph).

Lines that have the same gradient are parallel.

**1** Give the gradients of each of these straight lines. Does it matter if you read in any one of the lines parallel?

- The line from (1, 1) to (4, 8)
- The line from (-4, -2) to (-1, -1)
- The line from (-1, 8) to (2, -1)
- The line from (-3, -2) to (1, 7)

An equation of the line is  $y = mx + c$  in a straight line, where  $m$  is the gradient and  $c$  is the y-intercept. The y-intercept is the value of  $y$  when the line joins the y-axis.

**2** Draw three straight lines on squared paper:

- $y = 2x + 3$
- $3x + 2y = 12$
- $xy = 6$

**3** A graph for the equation  $3x + 4y - 12 = 0$

- Sketch the graph.
- What point does the line join the y-axis through?
- What point does the line join the x-axis through?
- What point does the line join the graph through?

Sample spread from Core 1 for AQA

The straight line graph, if it will show where the graph cuts the axes, enabling you to draw the graph.

A straight graph is one that can be graphed by using Cartesian coordinates.

**1** Use the three methods to draw a graph of each of these equations:

- (a)  $2x + 3y - 12 = 0$
- (b)  $3x + 4y - 12 = 0$
- (c)  $3x + 4y + 12 = 0$
- (d)  $4x - 3y + 12 = 0$
- (e)  $4x - 3y - 12 = 0$
- (f)  $4x + 3y - 12 = 0$

**2** A straight line goes through (2, 4) and (5, 16). Write an equation for the line in the form  $y = mx + c$ , where  $m$  and  $c$  are constants.

You will often find it useful to change the equation of a line into an equivalent form, as in the following example.

**Example 1**

Find the equation of the straight line graph:  $3x + 4y - 12 = 0$ .

**Solution**

Make  $y$  the subject of the equation:  $4y = -3x + 12$

Divide by the coefficient of  $y$ :  $y = \frac{-3x + 12}{4}$

**1** Write each of these equations in the form  $y = mx + c$ :

- (a)  $2x + 3y - 12 = 0$
- (b)  $3x + 4y - 12 = 0$
- (c)  $3x + 4y + 12 = 0$

**2** Sketch three more sets of parallel lines giving the gradient the same as:

- (a)  $2x + 3y - 12 = 0$
- (b)  $3x + 4y - 12 = 0$
- (c)  $3x + 4y + 12 = 0$

**3** Draw two more sets of perpendicular lines from the line at right angles to the other.

**4** Record the gradient of each pair of perpendicular lines.

What do you notice about the gradients of perpendicular lines?

**5** What is the gradient of one line perpendicular to a line that has gradient  $m$ ?

**6** What is the gradient of one line perpendicular to a line with gradient  $-m$ ?

**7** If two lines with gradients  $m$  and  $n$  are perpendicular, what is the value of  $mn$ ?

Worked examples to clarify ideas and techniques

Key points established in the development material are marked for students to refer to

**Key points:**

- Integration is the reverse of differentiation. (1.1)
- The indefinite integral of a function includes a constant term. (1.1)
- The indefinite integral of a function  $f(x)$  is denoted by  $\int f(x) dx$ . (1.1)
- $\int x^n dx = \frac{x^{n+1}}{n+1} + c$  for positive integers  $n$ . (1.1)
- The indefinite integral of a sum of functions is the sum of the separate indefinite integrals. The indefinite integral of a times a function is a times the indefinite integral of the function. (1.1)
- Given  $\frac{dy}{dx} = f(x)$  and  $f(1) = 2$  and  $f(2) = 3$  find the area under the curve. (1.1)

**Worked questions (Lesson 1.1)**

**1** Find

- (a)  $\int (2x^2 + 3x - 1) dx$
- (b)  $\int (x^2 + 2x - 1) dx$
- (c)  $\int (2x^3 + 3x^2 - 4) dx$

**2** Given that  $f'(x) = 2x^2 - 5$  and  $f(1) = 10$ , find  $f(x)$  in terms of  $x$ .

**3** The curve  $C$  goes through the point (1, 2).

The gradient  $\frac{dy}{dx}$  at the point  $(x, y)$  on  $C$  is given by the equation  $\frac{dy}{dx} = x^2 + 1$ . Find the equation of  $C$ .

**4** Given that  $\frac{dy}{dx} = 3x + 4$  and the point  $P$  is  $(1, 2)$ , find  $y$  in terms of  $x$ .

**5** Given that  $f'(x) = 6x^2 + 4x - 3$  and  $f(1) = 2$ , find  $f(x)$  in terms of  $x$ .

**6** The rate of growth of a fish population is modelled by the equation  $\frac{dP}{dt} = kP$  where  $P$  is the population at time  $t$  and  $k$  is a constant.

Given that  $P = 100$  when  $t = 0$ ,  $P = 112$  when  $t = 1$ , and  $P = 125$  when  $t = 2$ ,

- Find the constants  $k$  and  $P$  for  $t = 0$ .
- Find the value of  $t$  for which  $P = 200$ .

Sample spread from Core 1 for AQA

**7** The rate of spread of an illness affecting animals on a colony is modelled by the equation  $\frac{dN}{dt} = k(N - 100)$  where  $N$  is the number of animals affected and  $t$  is the time in months since the outbreak began.

When the outbreak began, it actually never affected:

- Find a formula for  $N$  in terms of  $t$ .
- How many animals were affected at the start of the outbreak?
- After how many months does the number of affected animals reach a maximum?
- Show that, according to the model, the number of affected animals decreases after reaching a maximum and approaches 100.

**Test yourself (Lesson 1.1)**

**1** Find

- (a)  $\int (x^2 + 2x - 1) dx$
- (b)  $\int (x^3 + 3x - 1) dx$
- (c)  $\int (x^4 + 2x^2) dx$

**2** Find

- (a)  $\int (2x^2 - 1) dx$
- (b)  $\int (3x^2 + 2x - 1) dx$
- (c)  $\int (5x^3 - 2) dx$

**3** The gradient function of a curve is given by  $\frac{dy}{dx} = 3x^2 - 1$ . The curve goes through the point (1, 4). Find the equation of the curve.

**4** Given that  $\frac{dy}{dx} = 4x + 3$  and that  $y = 10$  when  $x = 1$ , find  $y$  in terms of  $x$ .

**5** Given that  $f'(x) = 6x^2 - 12x + 4$  and  $f(1) = 10$ , find  $f(x)$  in terms of  $x$ .

**6** Given that  $f'(x) = 2x + 3$  and  $f(1) = 4$ , find  $f(x)$  in terms of  $x$ .

**7** The curve  $C$  goes through the point (1, 2).

The gradient function of  $C$  is given by  $\frac{dy}{dx} = 2x - 1$ . Find the equation of  $C$ .

Test yourself questions



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'We ordered inspection copies from all the main publishers and trialled a chapter from each book in the classroom. SMP was clearly the best'

Claire Atkins,  
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### Features include:

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- New concepts clearly developed in a way that involves the student
- Carefully chosen worked examples
- Plenty of revision and practice, including real Edexcel exam questions
- Key points clearly highlighted and summarised

'Overall, this strikes me as a razor-sharp piece of writing that has been assembled in a really bright way, a book from which students and teachers alike will gain a huge amount.'

Association of Teachers of Mathematics

Summary of what is expected

Development questions suitable for discussion

### 11 Integration

in this chapter you will learn:

- what integration is and how it is related to differentiation
- how to integrate functions

#### A Thinking backwards (exercise 11A)

When a ball rolls down a slope it gains speed and takes less time to reach the end in proportion to the time it takes to travel. In the example shown here, the speed of the ball is equal to  $2t$ . They are a table of values and a graph showing how the speed increases over time.

time (s)	0	1	2	3	4
speed (m/s)	0	2	4	6	8

If  $t$  is the distance (in m) travelled in time  $t$ , then the speed of the ball is  $\frac{ds}{dt}$ . The question is how far does the distance function look like?

This is the reverse problem to finding a gradient function for a given function. We are given the gradient function or derivative and want to find the original function.

11 Which function of  $t$  has the derivative  $2t$ ?

There are three the distance function we can work out, for example:

- how far the ball will travel in a given time
- how long it will take to go a given distance

11 On a different slope the speed of the ball is  $3t$ . What is the distance function in this case?

Sample spread from Core 1 for Edexcel

### 11 Integration as the reverse of differentiation (exercise 11B)

If you differentiate  $y$  of the result is the derivative,  $\frac{dy}{dx}$ . The reverse process is called **integration**. Working with  $y = x^2$  (see 11A), what function has derivative  $2x$ ?

11 The obvious answer to the question above is  $y = x^2$ . But there is more to it than that. Differentiate each of these functions:  $x^2 + 1$ ,  $x^2 + 5$ ,  $x^2 - 3$ ,  $x^2 + 20$ . How would you answer the question 'What function has  $2x$  as its derivative?'

Because the derivative of any constant number, such as 5, is always zero, any function such as  $x^2 + 5$ ,  $x^2 + 3$ , and so on, also has derivative  $2x$ . So the function with derivative  $2x$  is  $x^2 + c$ , where  $c$  can be any number. This is what is shown in the graphs on the right.

The process of going from  $\frac{dy}{dx}$  to  $y$  is called **integration**.  $x^2 + c$  is called the **indefinite integral** of  $2x$ . 'Indefinite' because  $c$  can be any number.  $\int$  is called the **symbol of integration**.

11 Write down the derivative of  $3x^2$ .

11 How can you check the indefinite integral of  $3x^2$ ?

11 Write down the derivative of each of these three sets of  $x$ .

(a) $3x^2$	(b) $3x^2 + 1$	(c) $3x^2 + 5$	(d) $3x^2 - 2$
------------	----------------	----------------	----------------

11 For your answer to (a) to match the indefinite integral of  $3x^2$ .

(a) $3x^3$	(b) $3x^3 + 1$	(c) $3x^3 + 5$	(d) $3x^3 - 2$
------------	----------------	----------------	----------------

11 The derivative of  $x^2 + k$  is  $2x$ . Use this fact to find the indefinite integral of  $2x$ .

**Example 1**

Find the indefinite integral of  $3x^2$ .

**Solution:**

We are trying to find the function whose derivative is  $3x^2$ . We know that the derivative of  $x^3$  is  $3x^2$ . So if we differentiate  $\frac{1}{3}x^3$  we will get  $3x^2$ . The indefinite integral of  $3x^2$  is  $\frac{1}{3}x^3 + c$ .

Worked examples

Past Edexcel exam questions

Key points for students to refer to in later work or revision

### 11 The diagram shows the graph of the curve $y = f(x)$ . The line intersects $Ox$ at $a$ .

Match a graph for each function below, showing clearly the image of point  $A$ .

(a) $y = f(x) + 2$	(b) $y = f(x - 2)$	(c) $y = f(x + 2)$
(d) $y = -f(x)$	(e) $y = f(2x)$	(f) $y = f(2x + 1)$

### 11 The diagram shows the graph of the curve $y = g(x)$ . $Q$ has coordinates $(-2, 1)$ .

Match a graph for each function below, showing clearly the image of point  $Q$ .

(a) $y = g(x + 1)$	(b) $y = g(x - 1)$	(c) $y = g(2x)$
(d) $y = g(2x)$	(e) $y = g(x)$	(f) $y = g(x - 2) + 1$

#### Key points

Transformation	For the equation of the image	Image of $(x, y)$	See 11C, 11D
Translation of $\frac{1}{2}$ units in the $x$ -direction	replace $x$ by $x - \frac{1}{2}$ and replace $y$ by $y - \frac{1}{2}$	$(x - \frac{1}{2}, y - \frac{1}{2})$	see 11C, 11D
Reflection in the $y$ -axis	replace $x$ by $-x$	$(-x, y)$	see 11C, 11D
Reflection in the $x$ -axis	replace $y$ by $-y$	$(x, -y)$	see 11C, 11D
Stretch by factor $k$ in the $x$ -direction	replace $x$ by $\frac{x}{k}$	$(\frac{x}{k}, y)$	see 11E, 11G, 11H
Stretch by factor $k$ in the $y$ -direction	replace $y$ by $\frac{y}{k}$	$(x, \frac{y}{k})$	see 11E, 11G, 11H

Sample spread from Core 1 for Edexcel

### 11 Further work (exercise 11C)

Note: these questions require a calculator.

11 (a) Describe the translation that will map  $y = \frac{1}{2}x^2$  on to  $y = \frac{1}{2}(x + 2)^2$ .

(b) Hence sketch the graph of  $y = \frac{1}{2}(x + 2)^2$ .

(c) What is the equation of the vertical asymptote?

11 What is the equation of  $y = x^2 + 3$ , its other reflection in the  $y$ -axis?

11 Find the two tangent lines that touch the graph of  $y = x + 3$  on to the graph of  $y = x^2 + 3$ .

11 What is the image of  $y = x^2$  when a stretch by factor  $\frac{1}{2}$  is applied to the  $x$ -axis?

11 Sketch the graph of  $y = 2x^2$ .

(a) The graph of  $y = 2x^2$  is stretched by a factor of 4 in the  $x$ -direction. What is the equation of the transformed graph?

(b) Find the two tangent lines that touch on the graph of  $y = 2x^2 + 1$  in the graph of  $y = 2x^2 + 1$ .

11 The diagram shows a sketch of the curve with equation  $y = f(x)$ .

11 Separate diagrams show the  $x$ -axis with points  $a, b, c$  and the curve with equation  $y = f(x)$ .

(a) $y = f(x)$	(b) $y = f(x)$
----------------	----------------

11 The diagram shows the graph of  $y = f(x)$ . It has a vertical asymptote at  $x = 2$ . Point  $P(1, -2)$  lies on the curve.

(a) Sketch six separate diagrams for the following graphs. Do not graph, label the image of point  $P$ , giving its coordinates.

(a) $y = f(2x)$	(b) $y = 2f(x)$	(c) $y = f(x + 1)$
-----------------	-----------------	--------------------

(d) Describe the transformation that maps the graph of  $y = f(x)$  on to the graph of  $y = f(2x)$ .

11 Describe the transformation that maps the graph of  $y^2 = x^2 + 4$  on to the graph of  $y^2 = x^2 + 8$ .



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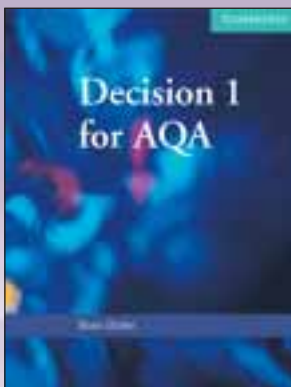
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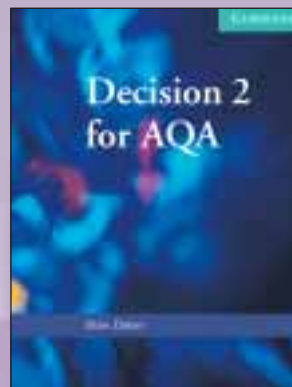
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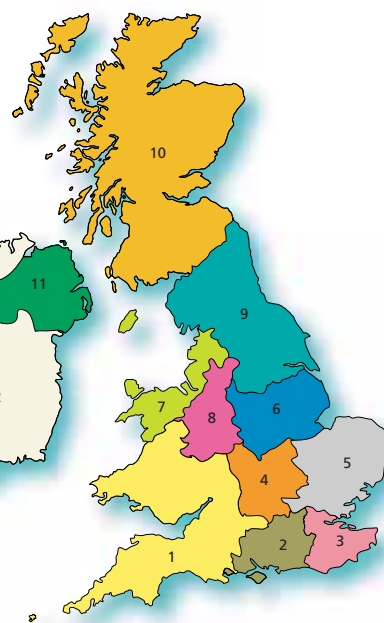
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