

# Accelerating Progress: mathematics

Tutor support manual

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## Tutor support manual

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# Section 1: Introduction

## Course aims and overview

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### Accelerating Progress

Accelerating Progress courses have been designed to support learners through GCSE courses and boost their grades, especially for marginal learners around the Grade 4 and Grade 5 borderline. These courses have been written by subject experts, all of whom are practising teachers in their respective subjects.

Accelerating Progress courses aim to:

- develop the essential subject-specific skills required to gain a good pass in GCSE examinations
- provide opportunities to practise these skills in contextual situations
- boost learners' grades and confidence in the subject

The courses contain a curriculum of challenges divided up into modules based on key aspects of the GCSE specifications.

### Mathematics course overview

This course is designed to support students through GCSE mathematics courses and boost their grades by developing not only the essential mathematical skills required, but by giving them opportunities to apply the maths to contextual situations.

For students to be successful in modern mathematics GCSE papers, they increasingly need to be able to apply the mathematics they have learnt to a problem – rather than just execute a skill on a basic problem. The material within this course puts skills into real-life problems and situations to allow students to explore how the mathematics they learn at GCSE can, and should, be applied to a problem.

The course also puts mathematics into many common day-to-day contexts; it allows students to understand how maths fits into their day-to-day world and to improve their basic problem-solving skills. All of this will increase a student's ability to access GCSE mathematics examination papers and improve their overall performance.

### About the author

With a career of 20 years as a mathematics teacher spanning six schools, Mike Randall is an experienced senior leader whose responsibilities have included curriculum and standards.

"I have delivered GCSE maths to what were once C/D borderline students in years 10 and 11 every year since 1998. I have seen many structural changes to GCSE maths over those years and various changes to content, but nothing on the scale of the developments in the last few years culminating in the first new specification exams in the summer of 2017.

"The increasing trend for students to have to apply their mathematics knowledge to contextual problems in exams in recent years and the more challenging content within the GCSE has made it increasingly difficult for those lower- to mid-ability students to access the higher GCSE grades. Many students understand the mathematics at that level, but need support in applying it to problems and practising the actual problem-solving skills required. The solution to this in schools has often been to give them more mathematics lessons, which can lead to disengagement and increased frustration for students and teachers alike.

"I hope that this course offers an opportunity for students to get the extra input they need to boost their grades, but through a more contextual and project-based approach. Moreover, it is intended as a course to supplement GCSE mathematics teaching and boost performance. This tutor support manual is intended to support a non-specialist in delivering the course."

# Section 1: Introduction

## Introduction to the modules

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### Modules

The Accelerating Progress: mathematics course contains challenges across five modules. These modules reflect the key aspects of the GCSE specification.

#### Module 1: Data handling and statistics

The aim of this module is to develop learners' understanding of how to collect and organise data from primary and secondary sources in a variety of ways. Learners will develop their ability to compare data sets and construct arguments based on data they have collected. Activities include exploring basic probability, understanding ways of working that involve sets of combinations, reasoning and making predictions.

#### Module 2: Money-related number problems

The aim of this module is to develop understanding within a range of different money-related contexts, such as purchasing a car and savings in a bank account. Learners will develop their understanding by considering how to make basic percentage calculations and apply them to contextual problems.

#### Module 3: Essential number skills

The aim of this module is to develop essential number skills within a range of different contexts, such as using ratio and proportion to calculate cost; adding, subtracting, multiplying and dividing fractions; and using percentages in real-life situations.

#### Module 4: Shape, space and measure

The aim of this module is to develop an understanding of area and practise using this in a real-life context. Learners will be expected to develop practical skills in construction by drawing nets and assembling the shapes. Activities include calculating area, calculating volume and estimating.

#### Module 5: Algebraic skills

The aim of this module is to develop knowledge of algebraic manipulation, reasoning, spotting patterns, understanding relationships, using formulae and the ability to write formulae and equations. Learners will have the opportunity to practise the skills required to work with formulae and the constructing of linear graphs.

### Sections

Each module is split into two sections – Section A and Section B:

- Section A comprises shorter challenges that develop the skills, knowledge and understanding required for the module topic
- Section B comprises extended challenges that stretch the learner's independent thinking skills and further develop the learning from the section A challenges

# Section 2: Skills development

## Mathematics skills overview

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### Module-specific skills

Module-specific skills have also been identified for modules 1, 2, 4 and 5. Module 3 does not have module-specific skills as this module focuses on the development of general mathematical skills (see page 12).

#### Data handling and statistics skills (Module 1)

- Calculating relative frequency and experimental probability
- Collecting and displaying data
- Collecting primary data
- Constructing hypotheses
- Framing questions
- Interpreting data and summary statistics
- Making comparisons
- Organising data
- Questioning data sources
- Questioning validity
- Simplifying problems
- Sorting data
- Testing hypotheses
- Understanding bias and how it affects conclusions
- Understanding how data can be manipulated
- Understanding the data handling cycle
- Using evidence to support arguments

#### Money skills (Module 2)

- Calculating compound percentage
- Calculating fractions
- Calculating with time
- Interpreting problems
- Planning solutions
- Using calculators

#### Shape, space and measure skills (Module 4)

- Angle facts
- Calculating area
- Calculating volume
- Calculating with similar shapes
- Constructing shapes
- Drawing accurately
- Explaining thinking and justifying answers
- Measuring accurately
- Trigonometry
- Using isometric paper
- Using practical mathematical equipment
- Using scale

#### Algebraic skills (Module 5)

- Algebraic manipulation
- Calculation
- Interpretation
- Solving equations
- Spotting patterns
- Understanding relationships
- Using formulae
- Writing formulae and equations

# Section 2: Skills development

## Module-specific skills



### Shape, space and measure skills: Module 4

Mathematics skills	Section A					Section B	
	1	2	3	4	5	1	2
Angle facts					✓		
Calculating area	✓		✓			✓	
Calculating volume			✓				
Calculating with similar shapes							✓
Constructing shapes		✓					
Drawing accurately						✓	
Explaining thinking and justifying answers	✓		✓	✓	✓	✓	✓
Measuring accurately	✓	✓	✓	✓	✓	✓	✓
Trigonometry							✓
Using isometric paper				✓			
Using practical mathematical equipment		✓					
Using scale						✓	

### Algebraic skills: Module 5

Mathematics skills	Section A					Section B	
	1	2	3	4	5	1	2
Algebraic manipulation	✓	✓	✓	✓	✓	✓	✓
Calculation					✓		
Interpretation		✓	✓	✓	✓	✓	✓
Solving equations		✓					
Spotting patterns	✓	✓	✓	✓		✓	✓
Understanding relationships	✓	✓	✓	✓	✓	✓	✓
Using formulae	✓	✓		✓	✓	✓	✓
Writing formulae and equations	✓		✓	✓	✓	✓	✓

# Section 3: Tutor notes

## Introduction to the tutor notes



This section contains tutor notes to support tutors in delivering all of the challenges in Accelerating Progress: mathematics. These notes have been developed to support non-specialists in delivering the course content.

For each challenge, the following information is given:

- 1 Module, section and challenge reference
- 2 Challenge title
- 3 Challenge text (as it appears for learners in the learner workbook and e-portfolio system)
- 4 Learning aims of the challenge
- 5 Short challenge reference (eg 1A1)
- 6 The approximate amount of time the challenge will take to complete
- 7 Skills that learners will develop through this challenge
- 8 Notes for tutors on the suggested approach to the challenge
- 9 Suggested resources that can be used to support the delivery of the challenge, including learner resources available via the learner workbooks and e-portfolio

### Tutor notes for Module 1: Data handling and statistics

**1** **2**  
**3** **6**  
**4** **7**  
**5** **8**  
**8** **9**

<b>Module 1: Data handling and statistics, Section A, Challenge 1</b>	
<b>Challenge title</b>	Collect, display and compare data
<b>Challenge</b>	Keep a record of how you use your time every day for <b>one</b> week. Make charts to show the percentage of time you spend on each type of activity. Compare your charts with other <b>people's</b> and write <b>five</b> statements that compare how much time you spend on different activities.
<b>Aim</b>	<ul style="list-style-type: none"> <li>To develop students' understanding of how to collect and organise data</li> <li>To develop an understanding of the different charts that can be used to display data in different ways</li> <li>To develop students' abilities to compare data sets and construct arguments based on data they have collected</li> </ul>
<b>Challenge ref.</b>	1A1 <span style="margin-left: 20px;"><b>Session time</b> approx. 2.5 hours</span>
<b>Skills</b>	Calculating averages; Calculating percentages; Constructing and interpreting graphs and charts; Logical reasoning; Making comparisons; Planning and organisation; Simplifying problems; Sorting data.

**8** **9**  
**Suggested approach**

It will be necessary for tutors to guide students in how they collect the data. Tutors should make sure it is easy for a student to sort all their activities into a maximum of six categories and record time spent as whole hours to avoid the data getting too complex. The **weekly diary** resource can be used to support this part of the challenge.

Students should produce a pie chart showing how they spend their time. Their calculations in working out the angle of the pie chart for each category will give decimal answers that need to be rounded off. Students should round to the nearest degree, however tutors will need to explain that this may result in a total that is smaller or greater than 360°. The **weekly tally chart** resource can be used to support this part of the challenge.

There is also the opportunity to create a bar chart using the same data; students may forget to leave gaps between the bars unless reminded.

The average calculations are important when making comparisons. In this case, make sure that learners are talking about the mean. The **weekly tally chart** resource can be used to support this part of the challenge. It would be good to discuss the median, mode and range as well and there is potential to work these out for each activity per day, however the mode may not work if there is little repetition in their numbers.

Introduce percentage calculations to help students compare their results and ask them to calculate the percentage of their time they spent on each activity. This will enable them to have a solid numerical argument in their conclusions. The **making comparisons** resource can be used to support this part of the challenge.

**9** **9**  
**Suggested resources**

The following learner resources are provided for this challenge:

- Challenge walkthrough 1A1
- Weekly diary (p.10 of the learner workbook)
- Weekly tally chart (p.11 of the learner workbook)
- Making comparisons (p.13 of the learner workbook)

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# Tutor notes for Module 1: Data handling and statistics



## Module 1: Data handling and statistics, Section A, Challenge 1

<b>Challenge title</b>	Collect, display and compare data		
<b>Challenge</b>	Keep a record of how you use your time every day for <b>one</b> week. Make charts to show the percentage of time you spend on each type of activity.  Compare your charts with other people's and write <b>five</b> statements that compare how much time you spend on different activities.		
<b>Aim</b>	<ul style="list-style-type: none"><li>• To develop students' understanding of how to collect and organise data</li><li>• To develop an understanding of the different charts that can be used to display data in different ways</li><li>• To develop students' abilities to compare data sets and construct arguments based on data they have collected</li></ul>		
<b>Challenge ref.</b>	1A1	<b>Session time</b>	approx. 2.5 hours
<b>Skills</b>	Calculating averages; Calculating percentages; Constructing and interpreting graphs and charts; Logical reasoning; Making comparisons; Planning and organisation; Simplifying problems; Sorting data.		

### **i** Suggested approach

It will be necessary for tutors to guide students in how they collect the data. Tutors should make sure it is easy for a student to sort all their activities into a maximum of six categories and record time spent as whole hours to avoid the data getting too complex. The **weekly diary** resource can be used to support this part of the challenge.

Students should produce a pie chart showing how they spend their time. Their calculations in working out the angle of the pie chart for each category will give decimal answers that need to be rounded off. Students should round to the nearest degree, however tutors will need to explain that this may result in a total that is smaller or greater than 360°. The **weekly tally chart** resource can be used to support this part of the challenge. There is also the opportunity to create a bar chart using the same data; students may forget to leave gaps between the bars unless reminded.

The average calculations are important when making comparisons. In this case, make sure that learners are talking about the mean. The **weekly tally chart** resource can be used to support this part of the challenge. It would be good to discuss the median, mode and range as well and there is potential to work these out for each activity per day, however the mode may not work if there is little repetition in their numbers.

Introduce percentage calculations to help students compare their results and ask them to calculate the percentage of their time they spent on each activity. This will enable them to have a solid numerical argument in their conclusions. The **making comparisons** resource can be used to support this part of the challenge.

### **📖** Suggested resources

The following learner resources are provided for this challenge:

- Challenge walkthrough 1A1
- Weekly diary (p.10 of the learner workbook)
- Weekly tally chart (p.11 of the learner workbook)
- Weekly bar chart and pie chart (p.12 of the learner workbook only)
- Making comparisons (p.13 of the learner workbook)



# Tutor notes for Module 2: Money-related number problems



## Module 2: Money-related number problems, Section B, Challenge 1

<b>Challenge title</b>	Holiday plans
<b>Challenge</b>	Plan a 14-night holiday in a destination of your choice. Make sure you include travel, accommodation, transfers, meals and spending money. Look at similar holidays in <b>at least three</b> different brochures and websites. One of your holidays must be organised in separate parts and not as a straightforward package deal.  Present your holidays to your group and decide which is the best deal.
<b>Aim</b>	<ul style="list-style-type: none"> <li>To understand how to interrogate databases and compare information, calculate with time and money</li> <li>To compare deals using ratio and proportion as well as percentage</li> <li>To be able to explain working out and what is being done in a fluid, clear and cohesive way</li> </ul>

<b>Challenge ref.</b>	2B1	<b>Session time</b>	10 hours
<b>Skills</b>	Calculating with money; Calculating percentages; Calculating with time; Constructing arguments; Financial literacy; Independent living skills; Interpreting problems; Planning and organisation; Planning solutions; Presentation skills; Ratio and proportion; Reasoning.		

### **i** Suggested approach

It will be easy for students to find 14-night all-inclusive holidays by different companies to the same destination. There will be very little mathematics required to investigate these, therefore the do-it-yourself option is important so that students are practising the mathematical skills developed in section A of this module.

Tutors should ensure that students consider all aspects of the journey, including transfers and the cost of eating out in their destinations. This is an opportunity to introduce currency conversion, which is another key skill. Students need to be able to do this through calculations and a conversion graph.

An extension to this challenge would be investigating the cost of the same sorts of things in different countries (eg the cost of a fairly standard meal out in the UK compared with other countries around the world). This will again need currency conversions, which can be investigated through individual calculations or by creating conversion graphs.

In order to include vital fraction and percentage work, students should work out what fraction or percentage of the cost of the holiday would be spent on different elements (eg transport, accommodation, food, activities). If they also plan for a group holiday, students can practise fractional calculation by presenting how much each person should pay; this could be weighted in terms of their earnings, which would allow for further ratio and proportion calculations.

When presenting their work to the group, students should include an explanation of the structure of each holiday and the cost of each different element. Students will often find it difficult to articulate what they have done, so they need to have their reasoning written down with their calculations – as well as a step-by-step outline of the calculations they have done. This will help illustrate to other members of the group the importance of explaining working and justifying conclusions.

### **📖** Suggested resources

The following learner resources are provided for this challenge:

- Challenge walkthrough 2B1

# Tutor notes for Module 4: Shape, space and measure



## Module 4: Shape, space and measure, Section A, Challenge 4

<b>Challenge title</b>	3D drawing		
<b>Challenge</b>	Look at the way supermarkets display their products. Draw different ways you could stack and display <b>six</b> cube shaped boxes of tea bags. Use isometric paper for your 3D drawings.  Choose your favourite <b>three</b> arrangements and draw the plan and elevation views from each side of the shapes.		
<b>Aim</b>	<ul style="list-style-type: none"> <li>To develop an understanding of 3D shapes</li> <li>To develop skills in representing 3D shapes in two dimensions</li> </ul>		
<b>Challenge ref.</b>	4A4	<b>Session time</b>	approx. 2 hours
<b>Skills</b>	Drawing and building 3D shapes; Estimating; Explaining thinking and justifying answers; Logical reasoning; Measuring accurately; Planning and organisation; Using isometric paper.		

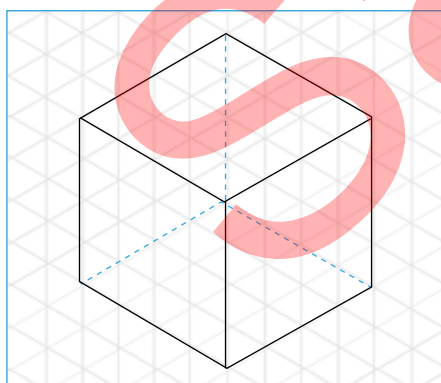
### **i** Suggested approach

Some students find drawing on isometric paper really easy, but some find it very difficult to see how the shapes work; tutors may find that some fairly able students still need support with this.

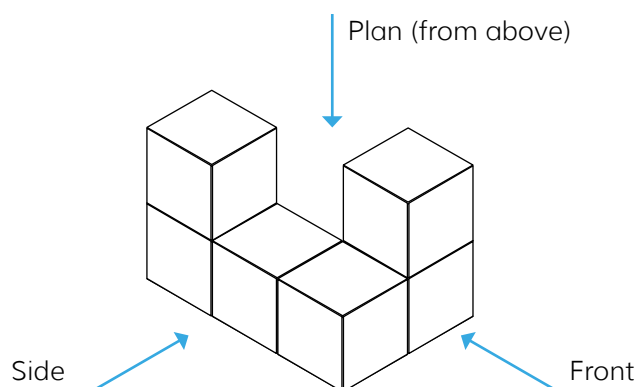
There are a lot of combinations of six cubes that students can use. If students are struggling with their isometric drawings it may be easier for them to use fewer cubes. Modelling the shapes with plastic blocks (eg multi-link) before drawing can also support students.

Below are diagrams showing how to use isometric paper and what is meant by the different elevations in technical drawing. The **isometric drawing** and **technical drawing** resources can be used to support this part of the challenge.

#### Isometric cube



#### Technical drawing elevations



### **📖** Suggested resources

The following learner resources are provided for this challenge:

- Challenge walkthrough 4A4
- Isometric drawing (p.80–81 of the learner workbook)
- Technical drawing (p.82–83 of the learner workbook)

# Tutor notes for Module 5: Algebraic skills



## Module 5: Algebraic skills, Section B, Challenge 2

<b>Challenge title</b>	Converting Celcius to Fahrenheit	
<b>Challenge</b>	<p>The formula for converting from degrees Celsius (C) to Fahrenheit (F) is: <math>F = 1.8C + 32</math></p> <p>Draw a conversion graph to change temperatures ranging from <math>-50^{\circ}\text{C}</math> to <math>100^{\circ}\text{C}</math> into degrees Fahrenheit.</p> <p>Find the temperature at which the two temperature scales read the same. Now try and write a simpler formula that converts Celsius into Fahrenheit. Convert <b>three</b> temperatures from Fahrenheit to Celsius using the above formula and then back using your formula.</p> <p>Describe the differences between the results and calculate the percentage error: <math>(\text{Actual error} \div \text{original temp}) \times 100</math></p> <p>Now look at other temperature scales and compare to Fahrenheit and Celsius in the same way.</p>	
<b>Aim</b>	<ul style="list-style-type: none"> <li>• To develop an understanding of linear graphs</li> <li>• To practise the skills required to work with formulae</li> <li>• To improve all round algebraic and number skills</li> </ul>	
<b>Challenge ref.</b>	5B2	<b>Session time</b> 10 hours
<b>Skills</b>	Algebraic manipulation; Constructing and interpreting graphs and charts; Interpretation; Problem solving; Reasoning; Spotting patterns; Understanding relationships; Using formulae; Writing formulae and equations.	

### **i** Suggested approach

This challenge enables students to practise many of the skills developed in section A within one project. The conversion graphs students produce need to be carefully constructed and the scale used will make a big difference. Students will need to use spacing that maximises the size of the graph on the piece of paper they are using. This could also be an opportunity to look at plotting graphs in Excel.

The changing formula task will be difficult for some; the simpler formula would be to use 2 instead of 1.8 and 30 instead of 32.

- $F = 1.8C + 32$
- simplifies to  $F = 2C + 32$

It may be necessary to practice the basic manipulation of formulae before students start the challenge, so they are confident in the skills they need to use.

When looking at other temperature scales, Kelvins is an obvious one as the conversion to Celsius is straightforward and to Fahrenheit the formula is similar. This will enable students to practise the skills without significantly different thinking.

Students should write up this challenge with a careful explanation of what they have done and what they have found out, with particular emphasis on the mathematical skills and processes they have used throughout.

### **📖** Suggested resources

The following learner resources are provided for this challenge:

- Challenge walkthrough 5B2

Sample