

## Doing better in GCSE mathematics

This guidance is for teachers working with students who are predicted to be grade D/C on the GCSE exams. It is intended to support teachers in helping these students to achieve a grade C. The advice offered may also be useful to other teachers and in turn to many other students.

By the time students come to revise for their GCSEs they have covered most of the syllabus in lessons. Revision is not about doing those lessons again but about reminding students of what they have covered and learned and revisiting any aspects which remain unclear in their minds.

An important element of subject revision lessons is to provide students with the opportunity to learn, practise and refine revision techniques. In this way individual students will discover for themselves those techniques which are personally most effective. In addition, you can provide focused feedback, not just on the subject material, but also on the techniques. Using lessons just to complete or review past test papers is unlikely to be an effective strategy for helping D/C students to improve. Neither is giving students unstructured lesson time 'to revise' since many of these students are not very good at revising although they may well give the impression of industriously getting on with their work.

Remember to link your planned mathematics revision with any whole-school programme and with advice that students may be receiving in their other subjects.

Further information and advice on helping these students revise and prepare for their exams can be found towards the beginning of the *GCSE booster pack* in the section 'GCSE booster: guidance for teachers and school leaders on using the materials'.

### Using the subject guidance leaflets

There are two leaflets for mathematics. One is for you, the teacher; the other is for students.

It is envisaged that you will use these flexibly to suit your own circumstances. The student's leaflet can be photocopied and given to targeted students. Go through the leaflet with them. Encourage them to annotate it, and explain how your subject revision programme will fit with and support the students' own revision programmes and the advice on their leaflet.

Use the teacher's leaflet to plan your revision programme, covering those topics and aspects which you have identified as most relevant to the students. Encourage the students, at intervals during the revision programme, to use the traffic light system on their leaflet to assess their confidence in each aspect and to check with you those which remain difficult.

A number of revision activities are suggested in the teacher's leaflet, but plan your revision programme to suit your own students. Using specific revision activities is less important than planning to use a range to ensure that your lessons retain variety and that you offer students opportunities to work in their preferred ways.

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To achieve a grade C in GCSE mathematics your students need to be able to show that they can do all of the following, not just by chance, but because they understand and are confident in what they are doing. At the heart of mathematics is the ability to calculate accurately using the appropriate method. Students need to be taught and practise their mental skills as well as be able to estimate an answer and to check that it is reasonable. As the intermediate tier of entry covers work at grade B, students need to be taught elements of this so that they are able to maximise their available marks.

What students need to be able to do	What this means to them	How you can help them improve
<p><b>1</b> Justify answers with suitable insight into mathematical structure and correct mathematical terminology</p>	<ul style="list-style-type: none"> <li>• Knowing the difference between an explanation and a proof</li> <li>• Using correct terminology, e.g. <i>alternate angles</i> and not 'Z' angles</li> <li>• Ensuring all steps are recorded</li> </ul>	<ul style="list-style-type: none"> <li>• Teaching students to give correct and full answers both in writing and orally</li> <li>• Modelling how to set out steps in solutions to problems</li> </ul>
<p><b>2</b> Have a good feel for number and be able to calculate and check answers by making appropriate estimates</p>	<ul style="list-style-type: none"> <li>• Using mental strategies appropriate for their level of work</li> <li>• Estimating answers and always checking the sense of an answer</li> </ul>	<ul style="list-style-type: none"> <li>• Helping students to improve their mental recall and explanation of their methods</li> <li>• Ensuring students always check whether an answer is sensible and of the right magnitude</li> <li>• Ensuring students give the correct units as part of their answer</li> </ul>
<p><b>3</b> Have confidence in using fractions, decimals and percentages and their equivalences Use ratios and understand proportional change</p>	<ul style="list-style-type: none"> <li>• Adding and subtracting fractions correctly</li> <li>• Using ratios and proportional change</li> <li>• Being confident with trigonometry (even though trigonometry is a higher-grade skill, students will meet it as part of the intermediate-level paper)</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrate the impact of division by a fraction in either fractional or decimal form</li> <li>• Make links to proportionality when introducing trigonometry</li> </ul>
<p><b>4</b> Understand the difference between an expression and an equation Describe and explain the position-to-term relationship of a sequence in an algebraic form</p>	<ul style="list-style-type: none"> <li>• Using the position-to-term rather than just the term-to-term relationship</li> <li>• Explaining answers based on situations which need reference to a pattern</li> </ul>	<ul style="list-style-type: none"> <li>• Teach students to relate the solution to the situation in which it is set</li> <li>• Provide opportunities for students to practise questions which are not just linear and easily solved by considering term-to-term relationships</li> <li>• Use investigations to enhance work on sequences and algebra</li> </ul>

What students need to be able to do	What this means to them	How you can help them improve
<p><b>5</b> Manipulate equations and expressions, including multiplying two linear expressions to make and simplify a quadratic expression</p>	<ul style="list-style-type: none"> <li>Relating algebra to the rules of arithmetic</li> </ul>	<ul style="list-style-type: none"> <li>Ensure students know the difference between an expression and an equation</li> <li>Develop the connection between arithmetic and algebraic manipulation</li> <li>Demonstrate the grid method for multiplication of linear expressions, practising algebra alongside arithmetic to reinforce ideas and concepts</li> </ul>
<p><b>6</b> Solve linear and simultaneous equations and describe the connection between equations and graphical representations Solve equations by trial and improvement and represent inequalities using a number line</p>	<ul style="list-style-type: none"> <li>Understanding that the solution of equations is not simply a series of steps which do not relate to the problem</li> <li>Using simultaneous equations in context as well as abstract situations</li> <li>Considering simultaneous equations whose coefficients are easy to handle, e.g.: <math>3X + 4Y = 18</math> <math>7X - 2Y = 8</math></li> <li>Linking the use of a number line to inequalities</li> </ul>	<ul style="list-style-type: none"> <li>Provide opportunities to practise solving different types of equation and also those whose variables appear more than once</li> <li>Provide opportunities to practise solving simultaneous equations written in different formats</li> <li>Work with some equations in real-life situations and relate the solution back to the original problem</li> <li>Demonstrate and practise understanding the effect of changing coefficients on graphs</li> </ul>
<p><b>7</b> Solve geometrical problems using parallel and intersecting lines, using the correct terminology</p>	<ul style="list-style-type: none"> <li>Using correct terminology in answers</li> <li>Understanding transformations and describing them in full</li> <li>Understanding what is required when dealing with geometrical problems</li> </ul>	<ul style="list-style-type: none"> <li>Ensure full reasons for answers are given and the correct terminology is used</li> <li>Help students give all the elements when describing a transformation, e.g. the angle (measured anti-clockwise) and the centre of rotation</li> </ul>
<p><b>8</b> Know and use correct formulae to calculate areas and perimeters of shapes including the circle and volumes of plane shapes and prisms</p>	<ul style="list-style-type: none"> <li>Knowing the formulae or how to calculate the areas and perimeters of simple shapes including the circle</li> <li>Using an appropriate value of <math>\pi</math> or the value on their calculator</li> <li>Calculating the volumes of simple and compound shapes</li> </ul>	<ul style="list-style-type: none"> <li>Ensure that students know the correct formulae for areas, perimeters and volumes and how to work these out</li> <li>Demonstrate and practise calculating the area and circumference of a circle using the <math>\pi</math> button on a calculator</li> </ul>
<p><b>9</b> Know and use Pythagoras' theorem</p>	<ul style="list-style-type: none"> <li>Using Pythagoras' theorem to find lengths other than the hypotenuse and for triangles in different orientations</li> <li>Knowing when to use Pythagoras' theorem and trigonometry</li> </ul>	<ul style="list-style-type: none"> <li>Model and practise using Pythagoras' theorem for triangles in a variety of situations and orientations, including finding the hypotenuse and other sides</li> <li>Explore problems where students decide whether to use Pythagoras' theorem or trigonometry</li> </ul>

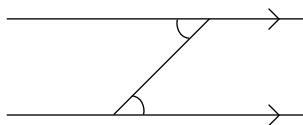
What students need to be able to do	What this means to them	How you can help them improve
<p><b>10</b> Calculate the median, mode and mean from grouped data and find the range</p> <p>Identify and justify which measure to use and use it, along with a frequency polygon to compare distributions</p>	<ul style="list-style-type: none"> <li>• Calculating the mean, mode and median and estimating these for continuous data</li> <li>• When estimating the mean in grouped data ensure the mid-point in the class interval is used (and that values should not be rounded)</li> <li>• Plotting the points of the cumulative frequency at the end of the class interval and not of the mid-point</li> <li>• Using both an average and range when comparing two distributions</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure students know the difference between the mean, mode and median and they are able to calculate these for both simple and grouped data</li> <li>• Explain and reinforce simple rules, e.g. <ul style="list-style-type: none"> <li>– plotting the cumulative frequency at the end of the class interval</li> <li>– not rounding values when calculating the mean in a grouped table</li> </ul> </li> <li>• Provide pairs of distributions for students to compare, using an average and the range and explaining what the differences signify</li> </ul>
<p><b>11</b> Draw a line of best fit by eye for a set of data on a scattergram</p>	<ul style="list-style-type: none"> <li>• Drawing a line of best fit by eye for a set of data on a scattergram</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrate using a clear plastic ruler to draw the best-fit line on a scattergram</li> <li>• Provide examples of scattergrams for students to practise</li> </ul>
<p><b>12</b> Understand and calculate relative frequencies as an estimate of probability</p> <p>Use this to compare outcomes from experiments</p>	<ul style="list-style-type: none"> <li>• Using relative frequencies to estimate probabilities and then the outcomes to check the accuracy of results</li> </ul>	<ul style="list-style-type: none"> <li>• Provide experiments for students to find relative frequencies and to compare these with calculated values</li> <li>• Ensure students know that probabilities always add up to one when all the outcomes are found</li> </ul>

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To achieve a grade C in GCSE mathematics you need to be confident in all these aspects.

(Use the code in the second column to say how well you think you are doing: G - green, very confident;

O - orange, not fully sure; and R - red, not very confident. Ask your teacher about anything you colour red.)

Can I?		What can I do to improve?
<p><b>Explain fully an answer using correct mathematics language.</b></p>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; margin: 2px; text-align: center; line-height: 20px;">R</div> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; margin: 2px; text-align: center; line-height: 20px;">O</div> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; margin: 2px; text-align: center; line-height: 20px;">G</div> </div>	<ul style="list-style-type: none"> <li>• Write down a proof, using correct mathematics terms, and talking the steps through with a friend (or myself) to make sure <b>I have given all the parts in full.</b></li> <li>• When asked to explain an answer make sure <b>I write down all the steps.</b></li> <li>• Make a list of <b>mathematics terms</b> with diagrams to help me remember - for example, <i>alternate angles</i> (and not 'Z' angles).</li> </ul> <div style="text-align: center; margin-top: 10px;">  </div>
<p><b>Calculate using the best method</b> (mental, written or calculator). <b>Check my answer.</b> <b>Give the correct units.</b></p>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; margin: 2px; text-align: center; line-height: 20px;">R</div> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; margin: 2px; text-align: center; line-height: 20px;">O</div> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; margin: 2px; text-align: center; line-height: 20px;">G</div> </div>	<ul style="list-style-type: none"> <li>• Work with a partner to <b>practise mental calculations</b> and check each other.</li> <li>• Whenever doing calculations at school or at home make sure I always:             <ul style="list-style-type: none"> <li>- <b>estimate the calculation</b> to check my answer;</li> <li>- <b>give correct units.</b></li> </ul> </li> <li>• Before any mathematics exam <b>check that my calculator is set correctly.</b></li> </ul>
<p>Add, subtract, multiply and divide by <b>fractions and decimals.</b> Link these to <b>ratios and proportions.</b></p>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; margin: 2px; text-align: center; line-height: 20px;">R</div> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; margin: 2px; text-align: center; line-height: 20px;">O</div> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; margin: 2px; text-align: center; line-height: 20px;">G</div> </div>	<ul style="list-style-type: none"> <li>• Check <b>I know how to add, subtract, multiply and divide with fractions and decimals.</b></li> <li>• Check <b>I know the effects of multiplying and dividing by numbers between 0 and 1.</b></li> <li>• Try some questions where I have to <b>calculate with ratios.</b></li> <li>• Be able to <b>recognise when values are in proportion</b> and decide if a missing value should be larger or smaller.</li> </ul>
<p>Give an <b>expression for the general term of a sequence.</b> <b>Explain</b> the expression in the context of a question.</p>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; margin: 2px; text-align: center; line-height: 20px;">R</div> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; margin: 2px; text-align: center; line-height: 20px;">O</div> <div style="border: 1px solid black; border-radius: 50%; width: 20px; height: 20px; margin: 2px; text-align: center; line-height: 20px;">G</div> </div>	<ul style="list-style-type: none"> <li>• Working with a friend, try to find the position-to-term relationships in some mathematical problems.</li> <li>• Practise explaining expressions in the context of the problem.</li> </ul>

Can I?		What can I do to improve?
<p><b>Manipulate</b> expressions and equations.</p> <p><b>Solve linear and simultaneous equations.</b></p> <p><b>Relate</b> equations to their graphs.</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;">           R O G         </div>	<ul style="list-style-type: none"> <li>• <b>Make a list of useful rules</b>, such as: Always do the same operation to both sides of an equation.</li> <li>• Solve simultaneous equations by getting the same number of x's or y's and then adding or subtracting.</li> <li>• Use a <b>graph plotter</b>, a computer or a graphical calculator and change the values in a formula to see the effect on the shape of the graph.</li> </ul>
<p>Explain problems of <b>parallel and intersecting lines</b> using the <b>correct mathematical words</b>.</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;">           R O G         </div>	<ul style="list-style-type: none"> <li>• Make a <b>display poster</b> of all the correct geometrical terms and the rules relating to parallel and intersecting lines.</li> <li>• When answering these types of question, <b>mark the diagram with any angle whose value I know</b>, but don't measure them.</li> </ul>
<p>Work out the <b>perimeter and area of different shapes</b> including a circle.</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;">           R O G         </div>	<ul style="list-style-type: none"> <li>• <b>Learn these formulae:</b> <ul style="list-style-type: none"> <li>- the circumference of a circle, <math>C = 2\pi r</math>;</li> <li>- the area of a circle, <math>A = \pi r^2</math>.</li> </ul> </li> <li>• Work with a friend on some problems and <b>practise splitting a complex shape into simpler parts</b>, and then work out the perimeter or area.</li> <li>• Remember to <b>always give units</b> with my answer and that, for example, area will be in the form <math>\text{cm}^2</math> and volume <math>\text{cm}^3</math>.</li> </ul>
<p>Use <b>Pythagoras' theorem</b>.</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;">           R O G         </div>	<ul style="list-style-type: none"> <li>• Try to <b>learn and follow these rules:</b> <ul style="list-style-type: none"> <li>- label a diagram with the hypotenuse before working out any sides;</li> <li>- check whether I am working out the hypotenuse or one of the other sides;</li> <li>- check my answer to see if it is sensible - for example, Is the hypotenuse I have worked out longer than the other two sides?</li> </ul> </li> </ul>
<p>Work out the <b>mean, mode and median</b> from data, including from a grouped data table.</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;">           R O G         </div>	<ul style="list-style-type: none"> <li>• Working with a friend, find some sets of data from a textbook. <b>One calculates the mean, mode and median for the other to check.</b></li> </ul> <p>These hints may help:</p> <ul style="list-style-type: none"> <li>• Check the value I have worked out is near the middle of the data.</li> <li>• Divide by the total frequencies and not the number of groups.</li> <li>• Plot cumulative frequencies at the end of the class interval and not the middle.</li> <li>• Draw lines on diagrams to show how I have worked out the median.</li> <li>• Don't approximate any values when calculating the mean from graphical data.</li> </ul>