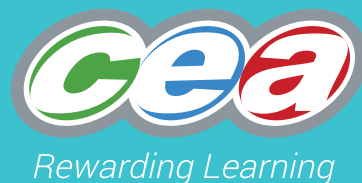


GCSE



# CCEA GCSE Specification in Mathematics

Version 2: 8 June 2017

For first teaching from September 2017  
For first assessment in Summer 2018  
For first award in Summer 2019  
Subject Code: 2210





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# 1 Introduction

This specification sets out the content and assessment details for our GCSE course in Mathematics. We have designed this specification to meet the requirements of:

- Northern Ireland GCSE Design Principles;
- Northern Ireland GCE and GCSE Qualifications Criteria; and
- Northern Ireland Subject Criteria and Requirements for Mathematics.

First teaching is from September 2017. We will make the first award based on this specification in Summer 2019.

This specification is a unitised course. The guided learning hours, as for all GCSEs, are 120 hours.

The specification supports the aim of the Northern Ireland Curriculum to empower young people to achieve their potential and to make informed and responsible decisions throughout their lives, as well as its objectives:

- to develop the young person as an individual;
- to develop the young person as a contributor to society; and
- to develop the young person as a contributor to the economy and environment.

If there are any major changes to this specification, we will notify centres in writing. The online version of the specification will always be the most up to date; to view and download this please go to [www.ccea.org.uk](http://www.ccea.org.uk)

## 1.1 Aims

This specification aims to encourage students to:

- develop fluent knowledge, skills and understanding of mathematical methods and concepts;
- acquire, select and apply mathematical techniques to solve problems;
- reason mathematically, make deductions and inferences and draw conclusions; and
- comprehend, interpret and communicate mathematical information in a variety of forms appropriate to the information and context.

## 1.2 Key features

The following are important features of this specification.

- It offers opportunities to build on the skills and capabilities developed through the delivery of the Northern Ireland Curriculum at Key Stage 3.
- It provides a strong foundation for progression to GCSE Further Mathematics and/or AS level Mathematics and for other disciplines where understanding and application of mathematics is essential.
- It gives students the appropriate mathematical skills, knowledge and understanding to help them progress to further academic and vocational study and to employment.
- This specification has two tiers: Foundation and Higher.
- Each tier offers a choice of units that are suited to a wide range of abilities and enable students to demonstrate achievement.
- At Foundation Tier, students can achieve a Level 1 or Level 2 in Functional Mathematics as well as a grade in GCSE Mathematics.
- The assessment model enables students to monitor their progress and offers opportunities to improve their results.
- Each assessment unit gives students enough time to consider various problem-solving strategies and to decide on the best approach.

## 1.3 Prior attainment

This specification builds on the knowledge, understanding and skills developed through the statutory requirements for Mathematics (including Financial Capability) in the Northern Ireland Curriculum at Key Stage 3. Students do not need to have reached a particular level before beginning to study this specification.

## **1.4 Classification codes and subject combinations**

Every specification has a national classification code that indicates its subject area. The classification code for this qualification is 2210.

Please note that if a student takes two qualifications with the same classification code, schools, colleges and universities that they apply to may take the view that they have achieved only one of the two GCSEs. The same may occur with any two GCSE qualifications that have a significant overlap in content, even if the classification codes are different. Because of this, students who have any doubts about their subject combinations should check with the schools, colleges and universities that they would like to attend before beginning their studies.

Students who enter for this GCSE may also enter for GCSE Further Mathematics and GCSE Statistics in the same examination series.

## 2 Specification at a Glance

The tables below and on the next page summarise the structure of this GCSE course. All units address the three assessment objectives and, where appropriate, questions may require students to know and use problem-solving strategies. Each written paper has a range of question types. Questions are set in both mathematical and non-mathematical contexts. Students take two units, one from M1, M2, M3 or M4 and one from M5, M6, M7 or M8. To receive an award, one of these must be a completion test. **Recommended pathways** are summarised below.

### Foundation Tier Option 1

Content	Assessment	Weightings	Availability
<b>Unit M1: Foundation Tier</b>	External written examination <b>with</b> calculator  1 hour 45 mins	45%	Summer from 2018 and January from 2019
<b>Unit M5: Foundation Tier Completion Test</b>	Two external written examinations: <ul style="list-style-type: none"> <li>• Paper 1 <b>without</b> calculator 1 hour</li> <li>• Paper 2 <b>with</b> calculator 1 hour</li> </ul>	55%	Summer from 2019 and January from 2020

### Foundation Tier Option 2

Content	Assessment	Weightings	Availability
<b>Unit M2: Foundation Tier</b>	External written examination <b>with</b> calculator  1 hour 45 mins	45%	Summer from 2018 and January from 2019
<b>Unit M6: Foundation Tier Completion Test</b>	Two external written examinations: <ul style="list-style-type: none"> <li>• Paper 1 <b>without</b> calculator 1 hour</li> <li>• Paper 2 <b>with</b> calculator 1 hour</li> </ul>	55%	Summer from 2019 and January from 2020



**Higher Tier Option 1**

Content	Assessment	Weightings	Availability
<b>Unit M3: Higher Tier</b>	External written examination <b>with</b> calculator  2 hours	45%	Summer from 2018 and January from 2019
<b>Unit M7: Higher Tier Completion Test</b>	Two external written examinations: <ul style="list-style-type: none"> <li>• Paper 1 <b>without</b> calculator 1 hour 15 mins</li> <li>• Paper 2 <b>with</b> calculator 1 hour 15 mins</li> </ul>	55%	Summer from 2019 and January from 2020

**Higher Tier Option 2**

Content	Assessment	Weightings	Availability
<b>Unit M4: Higher Tier</b>	External written examination <b>with</b> calculator  2 hours	45%	Summer from 2018 and January 2019
<b>Unit M8: Higher Tier Completion Test</b>	Two external written examinations: <ul style="list-style-type: none"> <li>• Paper 1 <b>without</b> calculator 1 hour 15 mins</li> <li>• Paper 2 <b>with</b> calculator 1 hour 15 mins</li> </ul>	55%	Summer from 2019 and January from 2020

Students must take at least 40 percent of the assessment (based on unit weightings) at the end of the course as terminal assessment.

### 3 Subject Content

We have divided this course into eight units. The content of each unit and the respective learning outcomes appear below.

An important element of the revised GCSE Mathematics is the assessment and reporting of Functional Mathematics in the Foundation Tier. Functional Mathematics refers to the skills and abilities students need to develop as a young person and as an individual, as a contributor to society and as a contributor to the economy and environment. These skills enable learners to operate confidently, effectively and independently in education, work and everyday life.

#### 3.1 Unit M1: Foundation Tier

This unit targets grades D, E, F and G at GCSE level and Level 1 in Functional Mathematics.

Content	Learning Outcomes
<b>Number and algebra</b>	Students should be able to: <ul style="list-style-type: none"> <li>● use the 4 operations applied to positive and negative integers, including efficient written methods;</li> <li>● order positive and negative integers, decimals and fractions;</li> <li>● use symbols =, ≠, &lt;, &gt;, ≤ and ≥ ;</li> <li>● use calculators effectively and efficiently;</li> <li>● understand and use conventional notation for the priority of operations, including brackets, powers, roots and reciprocals;</li> <li>● recognise and use relationships between operations, including inverse operations;</li> <li>● use index notation for squares, cubes and powers of 10;</li> <li>● use the concepts and vocabulary of factor, multiple, common factor, common multiple and prime; and</li> <li>● use the terms square, positive and negative square root, cube and cube root.</li> </ul>

Content	Learning Outcomes
<b>Number and algebra (cont.)</b>	<p>Students should be able to:</p> <ul style="list-style-type: none"> <li>• understand place value and decimal places;</li> <li>• read, write and compare decimals up to three decimal places;</li> <li>• add, subtract, multiply and divide decimals up to 3 decimal places;</li> <li>• round to a specified or appropriate degree of accuracy, number of decimal places or 1 significant figure, including a given power of 10;</li> <li>• use correct decimal notation when working with money;</li> <li>• understand and use equivalent fractions;</li> <li>• write a simple fraction as a terminating decimal;</li> <li>• add and subtract simple fractions and simple mixed numbers;</li> <li>• calculate a fraction of a quantity;</li> <li>• express one quantity as a fraction of another;</li> <li>• understand that percentage means number of parts per 100;</li> <li>• calculate a percentage of a quantity;</li> <li>• express one quantity as a percentage of another;</li> <li>• calculate percentage increase/decrease; and</li> <li>• use equivalences between fractions, decimals and percentages in a variety of contexts.</li> </ul>

Content	Learning Outcomes
<b>Number and algebra (cont.)</b>	<p>Students should be able to:</p> <ul style="list-style-type: none"> <li>● calculate with money and solve simple problems in the context of finance, for example profit and loss, discount, wages and salaries, bank accounts, simple interest, budgeting, debt, annual percentage rate (APR) and annual equivalent rate (AER);</li> <li>● distinguish the different roles that letter symbols play in algebra, using the correct notation;</li> <li>● understand and use the concepts and vocabulary of expressions, equations, formulae, inequalities, terms and factors;</li> <li>● interpret simple expressions as functions with inputs and outputs;</li> <li>● simplify and manipulate algebraic expressions by collecting like terms and multiplying a constant over a bracket;</li> <li>● manipulate algebraic expressions by taking out common factors that are constants;</li> <li>● write simple formulae and expressions from real-life contexts;</li> <li>● substitute numbers into formulae (which may be expressed in words or algebraically) and expressions;</li> <li>● use standard formulae;</li> <li>● set up and solve linear equations in one unknown;</li> <li>● work with co-ordinates in all 4 quadrants;</li> <li>● recognise and plot equations that correspond to straight line graphs in the co-ordinate plane; and</li> <li>● construct and interpret linear graphs in real world contexts.</li> </ul>

Content	Learning Outcomes
<p><b>Geometry and measures</b></p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> <li>● use conventional terms and notations such as points, lines, vertices, edges, parallel lines, perpendicular lines, right angles, polygons, regular polygons and polygons with reflection and/or rotation symmetries;</li> <li>● use the standard conventions for labelling and referring to the sides and angles of shapes;</li> <li>● draw diagrams from a written description;</li> <li>● apply the properties of angles: <ul style="list-style-type: none"> <li>– at a point;</li> <li>– at a point on a straight line; and</li> <li>– vertically opposite;</li> </ul> </li> <li>● understand and use alternate and corresponding angles on parallel lines;</li> <li>● identify and apply circle definitions and properties, including centre, radius, chord, diameter and circumference;</li> <li>● apply the properties and definitions of triangles and quadrilaterals, including square, rectangle, parallelogram, trapezium, and kite and rhombus;</li> <li>● identify properties of the faces, surfaces, edges and vertices of cubes, cuboids, prisms, cylinders, pyramids, cones and spheres;</li> <li>● draw and interpret 2D representations of 3D shapes, for example nets, plans and elevations;</li> <li>● understand and use metric units of measurement;</li> <li>● make sensible estimates of a range of measures;</li> <li>● convert metric measurements from one unit to another; and</li> <li>● solve problems involving length, area, volume/capacity, mass, time, and temperature.</li> </ul>



Content	Learning Outcomes
<b>Handling data (cont.)</b>	<p>Students should be able to:</p> <ul style="list-style-type: none"><li>• construct and interpret a wide range of graphs and diagrams including frequency tables and diagrams, pictograms, bar charts, pie charts, line graphs, frequency trees and flow charts, recognising that graphs may be misleading;</li><li>• examine data to find patterns and exceptions;</li><li>• compare distributions and make inferences; and</li><li>• plot and interpret scatter diagrams and recognise correlation.</li></ul>

### 3.2 Unit M5: Foundation Tier Completion Test

This unit targets grades D, E, F and G at GCSE level.

Students should know the content of Unit M1 before taking this unit.

Content	Learning Outcomes
<b>Number and algebra</b>	<p>Students should be able to:</p> <ul style="list-style-type: none"> <li>● solve problems involving whole numbers, fractions, decimals and percentages without a calculator;</li> <li>● estimate answers and check calculations using approximation and estimation;</li> <li>● use ratio notation, including reduction to its simplest form and its various links to fraction notation;</li> <li>● divide a quantity in a given ratio;</li> <li>● apply ratio and proportion to real-life contexts and problems such as conversion, best-buy, comparison, scaling, mixing, concentrations and exchange rates;</li> <li>● recognise and use sequences of, for example, triangular, square and cube numbers;</li> <li>● generate terms of a sequence using term-to-term or a position-to-term rule; and</li> <li>● plot and interpret graphs modelling real situations, for example conversion graphs, distance/time graphs and intersecting travel graphs.</li> </ul>



Content	Learning Outcomes
<b>Geometry and measures</b>	<p>Students should be able to:</p> <ul style="list-style-type: none"><li>• interpret scales on a range of measuring instruments and recognise the continuous nature of measure and approximate nature of measurement;</li><li>• know and use imperial measures still in common use and their approximate metric equivalents;</li><li>• use and interpret maps, scale factors and scale drawings;</li><li>• use the sum of angles in a triangle, for example to deduce the angle sum in any polygon;</li><li>• describe and transform 2D shapes using single transformations;</li><li>• describe and transform 2D shapes using reflections about the <math>x</math> and <math>y</math> axes;</li><li>• describe and transform 2D shapes using single rotations about the origin;</li><li>• describe and transform 2D shapes using translations;</li><li>• describe and transform 2D shapes using enlargements by a positive whole number scale factor; and</li><li>• draw triangles and other 2D shapes using a ruler and protractor.</li></ul>

Content	Learning Outcomes
<b>Handling data</b>	<p>Students should be able to:</p> <ul style="list-style-type: none"><li>• understand and use the vocabulary of probability, including notions of uncertainty and risk;</li><li>• use the terms fair, random, evens, certain, likely, unlikely and impossible;</li><li>• understand and use the probability scale from 0 to 1;</li><li>• list all outcomes for single events, and for two successive events;</li><li>• apply systematic listing strategies;</li><li>• work out probabilities expressed as fractions or decimals from simple experiments with equally likely outcomes and simple combined events;</li><li>• identify different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1;</li><li>• understand the probability of an event not occurring is one minus the probability that it occurs; and</li><li>• use probabilities to calculate expectation.</li></ul>

### 3.3 Unit M2: Foundation Tier

This unit targets grades C\*, C, D, E, F and G at GCSE Level and Level 2 in Functional Mathematics.

Students should know the content of Unit M1 before taking this unit.

Content	Learning Outcomes
<b>Number and algebra</b>	<p>Students should be able to:</p> <ul style="list-style-type: none"> <li>● use index notation and index laws for positive, whole number powers;</li> <li>● use the concepts and vocabulary of divisor, highest common factor, least (lowest) common multiple and prime factor decomposition;</li> <li>● add, subtract, multiply and divide decimals of any size;</li> <li>● round to a specified or appropriate number of significant figures;</li> <li>● recognise that recurring decimals are exact fractions and that some exact fractions are recurring decimals;</li> <li>● add, subtract, multiply and divide fractions, including mixed numbers;</li> <li>● use percentage and repeated proportional change;</li> <li>● calculate with money and solve problems in a finance context, for example compound interest, insurance, taxation, mortgages and investments;</li> <li>● simplify and manipulate algebraic expressions by multiplying a single term over a bracket; and</li> <li>● manipulate algebraic expressions by taking out common factors that are terms.</li> </ul>

Content	Learning Outcomes
<b>Number and algebra (cont.)</b>	<p>Students should be able to:</p> <ul style="list-style-type: none"><li>• set up and solve linear equations in one unknown, including those with the unknown on both sides of the equation and equations of the form:<math display="block">\frac{x}{4} + 3 = 7</math></li><li>• find the midpoint and length of a line given in 2D co-ordinates;</li><li>• find and interpret gradients and intercepts of linear graphs, for example plot and interpret the graph of the cost of car hire at £40 per day plus a cost of 20p per mile;</li></ul>
<b>Geometry and measures</b>	<ul style="list-style-type: none"><li>• use compound measures or units such as density;</li><li>• calculate perimeters and areas of kite, parallelogram, rhombus and trapezium;</li><li>• calculate perimeters and areas of composite shapes;</li><li>• calculate volumes of right prisms; and</li><li>• use Pythagoras' theorem in 2D problems.</li></ul>

Content	Learning Outcomes
<b>Handling data</b>	<p>Students should be able to:</p> <ul style="list-style-type: none"><li>● use 3 circle Venn diagrams to sort data;</li><li>● estimate mean from a grouped frequency distribution;</li><li>● identify the modal class and the median class from a grouped frequency distribution;</li><li>● draw and/or use lines of best fit by eye, understanding what these lines represent;</li><li>● draw conclusions from scatter diagrams;</li><li>● use terms such as positive correlation, negative correlation and little or no correlation;</li><li>● interpolate and extrapolate from data and know the dangers of doing so;</li><li>● identify outliers; and</li><li>● appreciate that correlation does not imply causality.</li></ul>

### 3.4 Unit M6: Foundation Tier Completion Test

This unit targets grades C\*, C, D, E, F and G at GCSE level.

Students should know the content of Units M1, M2 and M5 before taking this unit.

Content	Learning Outcomes
<b>Number and algebra</b>	<p>Students should be able to:</p> <ul style="list-style-type: none"> <li>● understand the principles of number systems;</li> <li>● convert numbers from decimal to binary (base 2) and vice versa;</li> <li>● use index laws in algebra for positive powers;</li> <li>● use systematic trial and improvement to find approximate solutions of equations where there is no simple analytical method of solving them;</li> <li>● solve linear inequalities in one variable, and represent the solution set on a number line;</li> <li>● change the subject of a simple formula;</li> <li>● find the <math>n</math>th term of a sequence where the rule is linear;</li> <li>● solve two linear simultaneous equations graphically; and</li> <li>● generate points and plot graphs of simple quadratic functions and use these to find approximate solutions for points of intersection with lines of the form <math>y = \pm a</math> only.</li> </ul>

Content	Learning Outcomes
<b>Geometry and measures</b>	<p>Students should be able to:</p> <ul style="list-style-type: none"><li>• understand and use bearings;</li><li>• calculate and use the sums of the interior and exterior angles of polygons;</li><li>• distinguish properties that are preserved under particular transformations;</li><li>• describe and transform 2D shapes using reflections in lines parallel to the <math>x</math> or <math>y</math> axis;</li><li>• describe and transform 2D shapes using rotations about any point;</li><li>• describe and transform 2D shapes using translations, to include using vector notation;</li><li>• understand and use the effect of enlargement on perimeter and area of shapes;</li><li>• understand the term congruent;</li><li>• use the standard ruler and compass constructions;</li><li>• identify the loci of points, including real life problems;</li></ul>
<b>Handling data</b>	<ul style="list-style-type: none"><li>• systematically list all outcomes for single events and for two successive events;</li><li>• understand and use estimates or measures of probability from relative frequency;</li><li>• compare experimental data and theoretical probabilities; and</li><li>• understand that increasing sample size generally leads to better estimates of probability.</li></ul>

### 3.5 Unit M3: Higher Tier

This unit targets grades B, C\*, C, D and E at GCSE level.

Students should know the content of Units M1 and M2 before taking this unit.

Content	Learning Outcomes
<b>Number and algebra</b>	<p>Students should be able to:</p> <ul style="list-style-type: none"> <li>• find the least common multiples (LCM) and highest common factor (HCF) of numbers written as the product of their prime factors;</li> <li>• find the original quantity, given the result of a proportional change;</li> <li>• calculate the upper and lower bounds in calculations involving addition and multiplication of numbers expressed to a given degree of accuracy;</li> <li>• know the difference between an equation and an identity;</li> <li>• multiply two linear expressions;</li> <li>• factorise quadratic expressions of the form:           <math display="block">x^2 + bx + c</math> </li> <li>• factorise using the difference of two squares;</li> <li>• add or subtract algebraic fractions, for example simplify:           <math display="block">\frac{4x + 3}{10} + \frac{6x - 5}{5}</math> </li> <li>• simplify, multiply and divide algebraic fractions with linear or quadratic numerators and denominators;</li> <li>• set up and solve linear equations of the form:           <math display="block">\frac{4x + 3}{10} + \frac{6x - 5}{5} = \frac{13}{2}</math> </li> <li>• set up and solve quadratic equations using factors.</li> </ul>



Content	Learning Outcomes
<p><b>Number and algebra (cont.)</b></p> <p><b>Geometry and measures</b></p> <p><b>Handling data</b></p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> <li>● understand that the form <math>y = mx + c</math> represents a straight line and that <math>m</math> is the gradient of the line and <math>c</math> is the value of the <math>y</math> – intercept;</li> <li>● find the equation of a line through two given points or through one point with a given gradient;</li> <li>● understand and use the gradients of parallel lines;</li> <li>● identify and apply circle definitions and properties, including tangent, arc, sector and segment;</li> <li>● use compound measures or units such as pressure;</li> <li>● solve mensuration problems that involve arc length and area of sector, surface area of a cylinder and volume and surface area of a cone and sphere;</li> <li>● understand and use the trigonometric ratios of sine, cosine and tangent to solve 2D problems, including those involving angles of elevation and depression;</li> <li>● calculate quartiles and interquartile range from a list of values and understand their uses;</li> <li>● construct and interpret cumulative frequency tables and the cumulative frequency curve;</li> <li>● estimate the median, quartiles and interquartile range from a cumulative frequency curve and display information using box plots; and</li> <li>● infer properties of populations or distributions from a sample and know the limitations of doing so.</li> </ul>

### 3.6 Unit M7: Higher Tier Completion Test

This unit targets grades B, C\*, C, D, and E at GCSE level.

Students should know the content of Units M1, M2, M3, M5 and M6 before taking this unit.

Content	Learning Outcomes
<b>Number and algebra</b>	<p>Students should be able to:</p> <ul style="list-style-type: none"> <li>• use surds and <math>\pi</math> in exact calculations;</li> <li>• use index notation and index laws for zero, positive and negative powers;</li> <li>• interpret, order and calculate with numbers written in standard index form;</li> <li>• use index laws in algebra for integer powers;</li> <li>• set up and solve two linear simultaneous equations algebraically;</li> <li>• solve linear inequalities in two variables representing the solution set on a graph;</li> <li>• change the subject of a formula, including cases where a power or root of the subject appears and cases where the subject appears in more than one term;</li> <li>• find the <math>n</math>th term of non-linear sequences;</li> <li>• recognise, sketch and interpret graphs of linear functions, quadratic functions, simple cubic functions and the reciprocal function <math>y = \frac{a}{x}</math> with <math>x \neq 0</math>;</li> <li>• generate points and plot graphs of simple quadratic functions and use these to find approximate solutions for points of intersection with lines of the form <math>y = mx + c</math>; and</li> <li>• set up equations and solve problems involving direct proportion, including graphical and algebraic representations.</li> </ul>



### 3.7 Unit M4: Higher Tier

This unit targets grades A, B, C\* and C with an allowable grade D at GCSE level. The A\* grade is awarded at subject level and is dependent on the total marks gained from the M4 and M8 assessment units.

Students should know the content of Units M1, M2, and M3 before taking this unit.

Content	Learning Outcomes
<b>Number and algebra</b>	<p>Students should be able to:</p> <ul style="list-style-type: none"> <li>calculate the upper and lower bounds in calculations involving subtraction and division of numbers expressed to a given degree of accuracy;</li> <li>factorise quadratic expressions of the form:           <math display="block">ax^2 + bx + c</math> </li> <li>add or subtract algebraic fractions with linear denominators, for example simplify:           <math display="block">\frac{2}{x+2} + \frac{3}{2x-1}</math> </li> <li>set up and solve equations such as:           <math display="block">\frac{2}{x+2} + \frac{3}{2x-1} = 1</math> </li> <li>set up and solve quadratic equations using factors and the formula where the coefficient of <math>x^2 \neq 1</math>, and more complex equations;</li> <li>understand and use the gradients of perpendicular lines;</li> </ul>
<b>Geometry and measures</b>	<ul style="list-style-type: none"> <li>solve more complex mensuration problems, for example frustums;</li> <li>understand and use circle theorems;</li> </ul>
<b>Handling data</b>	<ul style="list-style-type: none"> <li>understand and use stratified sampling techniques; and</li> <li>construct and interpret histograms for grouped continuous data with unequal class intervals.</li> </ul>

### 3.8 Unit M8: Higher Tier Completion Test

This unit targets grades A, B, C\* and C with an allowable grade D at GCSE level. The A\* grade is awarded at subject level and is dependent on the total marks gained from the M4 and M8 assessment units.

Students should know the content of Units M1, M2, M3, M4, M5, M6 and M7 before taking this unit.

Content	Learning Outcomes
<p><b>Number and algebra</b></p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> <li>● distinguish between rational and irrational numbers;</li> <li>● change a recurring decimal to a fraction;</li> <li>● use index notation and index laws for integer, fractional and negative powers;</li> <li>● set up, solve and interpret the answers in growth and decay problems, for example use the formula for compound interest;</li> <li>● simplify numerical expressions involving surds, including the rationalisation of the denominator of a fraction such as:           <math display="block">\frac{5}{3\sqrt{2}}</math> </li> <li>● use index laws in algebra for integer, fractional and negative powers;</li> <li>● set up and solve two simultaneous equations, one linear and one non-linear;</li> <li>● recognise, sketch and interpret graphs of exponential functions <math>y = k^x</math> for positive values of <math>k</math>, for example growth and decay rates; and</li> <li>● find the intersection points of the graphs of a linear and quadratic function, knowing that these are the approximate solutions of the corresponding simultaneous equations representing the linear and quadratic functions, which may require algebraic manipulation.</li> </ul>

Content	Learning Outcomes
<p><b>Number and algebra (cont.)</b></p> <p><b>Geometry and measures</b></p> <p><b>Handling data</b></p>	<p>Students should be able to:</p> <ul style="list-style-type: none"> <li>● interpret the gradient at a point on a curve as the instantaneous rate of change;</li> <li>● recognise and use the equation of a circle, centre the origin and radius <math>r</math>;</li> <li>● find the equation of a tangent to a circle at a given point on the circle;</li> <li>● set up equations and solve problems involving indirect proportion, including graphical and algebraic representations;</li> <li>● understand and use the sine and cosine rules;</li> <li>● calculate the area of a triangle using <math>A = \frac{1}{2} ab \sin C</math> ;</li> <li>● use Pythagoras' theorem and trigonometry to solve 2D and 3D problems;</li> <li>● enlarge 2D shapes using negative scale factors;</li> <li>● use the relationship between the ratios of lengths, areas and volumes of similar 3D shapes;</li> <li>● use the most appropriate method when solving complex probability problems; and</li> <li>● use tree diagrams to represent successive events that are not independent.</li> </ul>

## 4 Scheme of Assessment

### 4.1 Assessment opportunities

For the availability of examination and assessment, see Section 2.

This is a unitised specification; candidates must complete at least 40 percent of the overall assessment requirements at the end of the course, in the examination series in which they request a final subject grade. This is the terminal rule.

Candidates may resit individual assessment units once before cash-in. The better of the two results will count towards their final GCSE grade unless a unit is required to meet the 40 percent terminal rule. If it is, the more recent mark will count (whether or not it is the better result). Results for individual assessment units remain available to count towards a GCSE qualification until we withdraw the specification.

### 4.2 Assessment objectives

There are three assessment objectives for this specification.

#### AO1 Use and apply standard techniques

Candidates must:

- accurately recall facts, terminology and definitions;
- use and interpret notation correctly; and
- accurately carry out routine procedures or set tasks requiring multi-step solutions.

#### AO2 Reason, interpret and communicate mathematically

Candidates must:

- make deductions, inferences and draw conclusions from mathematical information;
- construct chains of reasoning to achieve a given result;
- interpret and communicate information accurately;
- present arguments and proofs; and
- assess the validity of an argument and critically evaluate a given way of presenting information.

#### AO3 Solve problems in mathematics and other contexts

Candidates must:

- translate problems in mathematical or non-mathematical contexts into a process or a series of mathematical processes;
- make and use connections between different parts of mathematics;
- interpret results in the context of a given problem;
- evaluate methods used and results obtained; and
- evaluate solutions to identify how they may have been affected by assumptions made.

### 4.3 Assessment objective weightings

The table below sets out the assessment objective weightings for each assessment component and the overall GCSE qualification.

Assessment Objective	Unit Weighting (%)	
	Foundation Tier M1 and M5 or M2 and M6	Higher Tier M3 and M7 or M4 and M8
AO1	47–53	37–43
AO2	22–28	27–33
AO3	22–28	27–33

### 4.4 Functional mathematics

In this specification, the term Functional Mathematics refers to the skills and abilities students need to develop as a young person and as an individual, as a contributor to society and as a contributor to the economy and environment. Functional Mathematics requires students to use mathematics effectively in a wide range of contexts. The introduction of functional mathematics is a response to employers' perceptions that many students are not achieving a sufficiently firm grounding in the basics. Units M1 and M2 are designed to assess the functional elements in Mathematics.

The following table details the specific units that we use to determine the award in Functional Mathematics:

GCSE Units	Functional Award Available
M1	Level 1
M2	Level 1 or Level 2



## 4.5 Reporting and grading

We report the results of individual assessment units on a uniform mark scale that reflects the assessment weighting of each unit.

Each unit in GCSE Mathematics is targeted at a specific grade range as shown below:

Assessment unit	Targeted unit grades	Comment
M1	D, E, F and G	Level 1 Functional Mathematics awarded
M2	C*, C, D, E, F and G	Level 1 or Level 2 Functional Mathematics awarded
M3	B, C*, C, D and E	
M4	A, B, C*, C and allowable D	A* awarded at qualification level and is dependent on total marks gained from M4 and M8 assessment units
M5	D, E, F and G	
M6	C*, C, D, E, F and G	
M7	B, C*, C, D and E	
M8	A, B, C*, C and allowable D	A* awarded at qualification level and is dependent on total marks gained from M4 and M8 assessment units

Candidates may enter any one of Units M1, M2, M3 or M4 together with any one of Units M5, M6 or M8 to receive a GCSE grade. See the table on the next page for the most common combinations.

We determine the grades awarded by aggregating the uniform marks that candidates obtain in individual assessment units. We award GCSE qualifications on a grade scale from A\* to G, with A\* being the highest. The nine grades available are as follows:

Grade	A*	A	B	C*	C	D	E	F	G
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If candidates fail to attain a grade G or above, we report their result as unclassified (U).

The following table details the overall qualification grades available when units are combined as specified below:

Assessment Unit Combinations	Available Final GCSE Grades	Comment
<b>M1 and M5</b>	D–G	All grades in this range are available.
<b>M2 and M6</b>	C*–G	All grades in this range are available.
<b>M3 and M7</b>	B–E	All grades in this range are available.
<b>M4 and M8</b>	A*–D	All grades in this range are available.

Examinations for Units M1, M2, M3 and M4 take place at the same time, so candidates can take only one examination. Therefore, candidates may enter only one of these examinations in each session.

Completion assessment Units M5, M6, M7 and M8 are timetabled concurrently, on a different day to M1, M2, M3 and M4. For both Foundation and Higher Tier completion assessment units, Paper 2 (with calculator) takes place immediately after Paper 1 (without calculator).

### Functional Mathematics

The achievement in Functional Mathematics is based on the candidate's performance in Units M1 and M2. In Unit M1, recognition is at Level 1 and in M2 at Level 1 or Level 2. In Unit M2, where a candidate does not achieve a Level 2, Level 1 may be awarded if the required standard is reached. The standard required to achieve a level will be based on a minimum raw mark threshold that we set for each series. Functional Mathematics is awarded within the context of GCSE study and is reported with the results for GCSE Mathematics as a 'pass' at either Level 1 or Level 2. For candidates achieving Functional Mathematics at Level 2, this achievement will be reported as an endorsement on the GCSE Mathematics certificate. If a candidate does not achieve a level, this will not be reported.

## 4.6 Use of calculators

Candidates must use calculators in assessment Units M1, M2, M3 and M4 and in Paper 2 of each Completion Test (M5, M6, M7 and M8). Candidates must not use calculators in Paper 1 of each Completion Test.

Calculators should have the following functions: +, −,  $\times$ ,  $\div$ ,  $\sqrt{\quad}$ ,  $x^y$  and single memory. These are the minimum functions required.

For the Higher Tier papers, candidates must use electronic calculators with trigonometric and relevant statistical functions. For the Foundation Tier papers, candidates must use electronic calculators with relevant statistical functions.

Calculators must be:

- suitable for use on the desk;
- either battery or solar powered; and
- free of lids, cases and covers that have printed instructions or formulae.

Calculators must **not**:

- be designed or adapted to offer:
  - language translators;
  - symbolic algebra manipulation;
  - symbolic differentiation or integration; or
  - communication with other machines or the internet;
- be borrowed from another candidate during an assessment by examination for any reason; or
- have retrievable information stored in them, including (but not limited to):
  - databanks;
  - dictionaries;
  - mathematical formulae; or
  - text.

## 5 Grade Descriptions

Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by candidates awarded particular grades. The descriptions must be interpreted in relation to the content in the specification; they are not designed to define that content. The grade awarded depends in practice upon the extent to which the candidate has met the assessment objectives overall. Shortcomings in some aspects of candidates' performance in the assessment may be balanced by better performances in others.

Grade	Description
<b>A</b>	Candidates characteristically: <ul style="list-style-type: none"> <li>• perform procedures accurately;</li> <li>• interpret and communicate complex information accurately;</li> <li>• make deductions and inferences and draw conclusions;</li> <li>• construct substantial chains of reasoning, including convincing arguments and formal proofs;</li> <li>• generate efficient strategies to solve complex mathematical and non-mathematical problems by translating them into a series of mathematical processes;</li> <li>• make and use connections, which may not be immediately obvious, between different parts of mathematics;</li> <li>• interpret results in the context of the given problem; and</li> <li>• critically evaluate methods, arguments, results and the assumptions made.</li> </ul>
<b>C</b>	Candidates characteristically: <ul style="list-style-type: none"> <li>• perform routine single- and multi-step procedures effectively by recalling, applying and interpreting notation, terminology, facts, definitions and formulae;</li> <li>• interpret and communicate information effectively;</li> <li>• make deductions and inferences and draw conclusions;</li> <li>• construct chains of reasoning, including arguments;</li> <li>• generate strategies to solve mathematical and non-mathematical problems by translating them into mathematical processes, realising connections between different parts of mathematics;</li> <li>• interpret results in the context of the given problem; and</li> <li>• evaluate methods and results.</li> </ul>

Grade	Description
F	<p>Candidates characteristically:</p> <ul style="list-style-type: none"><li>• recall and use notation, terminology, facts and definitions;</li><li>• perform routine procedures, including some multi-step procedures;</li><li>• interpret and communicate basic information;</li><li>• make deductions and use reasoning to obtain results;</li><li>• solve problems by translating simple mathematical and non-mathematical problems into mathematical processes;</li><li>• provide basic evaluation of methods or results; and</li><li>• interpret results in the context of the given problem.</li></ul>

## 6 Curriculum Objectives

This specification builds on the learning experiences from Key Stage 3 as required for the statutory Northern Ireland Curriculum. It also offers opportunities for students to contribute to the aim and objectives of the Curriculum at Key Stage 4, and to continue to develop the Cross-Curricular Skills and the Thinking Skills and Personal Capabilities. The extent of the development of these skills and capabilities will be dependent on the teaching and learning methodology used.

### 6.1 Cross-Curricular Skills at Key Stage 4

Communication
<p>Students should be able to:</p> <ul style="list-style-type: none"> <li>• communicate meaning, feelings and viewpoints in a logical and coherent manner, <i>for example by using appropriate mathematical language and notation in response to open-ended tasks, problems, structured questions or examination questions;</i></li> <li>• make oral and written summaries, reports and presentations, taking account of audience and purpose, <i>for example through the use of varied learning activities applied to a wide range of contexts that require students to organise and record data, justify choice of strategy to solve problems, articulate processes, proofs etc. and provide feedback from collaborative learning activities;</i></li> <li>• participate in discussions, debates and interviews, <i>for example by sharing ideas, investigating misconceptions, exploring alternative strategies, justifying choice of strategy, negotiating decisions and listening to others;</i></li> <li>• interpret, analyse and present information in oral, written and ICT formats, <i>for example by developing a mathematical solution to a problem and communicating ideas, strategies and solutions;</i> and</li> <li>• explore and respond, both imaginatively and critically, to a variety of texts, <i>for example by using open-ended tasks and activities.</i></li> </ul>
Using Mathematics
<p>Students should be able to:</p> <ul style="list-style-type: none"> <li>• use mathematical language and notation with confidence, <i>for example by communicating their ideas and findings mathematically in a consistent and accurate way through the use of vocabulary, symbols, algebra and/or graphical representations to justify their conclusions;</i></li> <li>• use mental computation to calculate, estimate and make predictions in a range of simulated and real-life contexts, <i>for example by using appropriate approximations to estimate the answer to a problem;</i> and</li> <li>• select and apply mathematical concepts and problem-solving strategies in a range of simulated and real-life contexts, <i>for example by translating problems in mathematical or non-mathematical contexts into a process or a series of mathematical processes.</i></li> </ul>

### Using Mathematics (cont.)

Students should be able to:

- interpret and analyse a wide range of mathematical data, *for example by choosing the most appropriate measures of central location and dispersion to compare two sets of data;*
- assess probability and risk in a range of simulated and real-life contexts, for example by exploring the link between probability and expected frequency to investigate risk and its impact on life; and
- present mathematical data in a variety of formats which take account of audience and purpose, *for example by choosing the best type of graph, chart or diagram to present their findings.*

### Using ICT

Students should be able to make effective use of information and communications technology in a wide range of contexts to access, manage, select and present information, including mathematical information, *for example by researching data online, analysing data and working with formulae in spreadsheets, and using various software applications to explore geometry and algebraic functions.*

## 6.2 Thinking Skills and Personal Capabilities at Key Stage 4

### Self-Management

Students should be able to:

- plan work *for example by identifying appropriate strategies, working systematically and persisting with open-ended tasks and problems;*
- set personal learning goals and targets to meet deadlines *for example by identifying, prioritising and managing actions to develop competence and confidence in more challenging mathematics;*
- monitor, review and evaluate their progress and improve their learning, *for example through self-evaluating their performance, identifying strengths and areas for improvement and seeking support where required;* and
- effectively manage their time, *for example through planning, prioritising and minimising distractions to meet deadlines that teachers set.*

### Working with Others

Students should be able to:

- learn with and from others, *for example by co-operating, engaging in discussions, explaining ideas, challenging and supporting one another, creating and solving each other's questions and working collaboratively to share methods and results during small group tasks;*
- participate in effective teams and accept responsibility for achieving collective goals, *for example by working together on challenging small group tasks with shared goals but individual accountability;* and
- listen actively to others and influence group thinking and decision-making, taking account of others' opinions, *for example by participating constructively in small group activities, proposing possible problem-solving strategies and presenting a well thought out rationale for one approach.*



## Problem Solving

Students should be able to:

- identify and analyse relationships and patterns, *for example make links between cause and effects by comparing distribution and making inference in statistics;*
- propose justified explanations, *for example by proving a mathematical statement is true;*
- reason, form opinions and justify their views;
- analyse critically and assess evidence to understand how information or evidence can be used to serve different purposes or agendas, *for example using data to make predictions about the likelihood of future events occurring;*
- analyse and evaluate multiple perspectives, *for example modelling real-life scenarios as mathematics problems;*
- explore unfamiliar views without prejudice;
- weigh up options and justify decisions, *for example using the most appropriate method to solve complex mathematical problems;* and
- apply and evaluate a range of approaches to solve problems in familiar and novel contexts, *for example by choosing the appropriate diagrammatic method in probability or the use of Pythagoras' theorem in the solution of problems involving right angled triangles.*

This revised specification has increased emphasis on problem solving, which will require students to further develop these skills.

## 7 Links and Support

### 7.1 Support

The following resources are available to support this specification:

- our Mathematics microsite at [www.ccea.org.uk](http://www.ccea.org.uk) and
- specimen assessment materials.

We also intend to provide:

- past papers;
- mark schemes;
- Chief Examiner's reports;
- Principal Moderator's reports;
- guidance on progression from Key Stage 3;
- planning frameworks;
- centre support visits;
- support days for teachers;
- a resource list; and
- exemplification of examination performance.

### 7.2 Examination entries

Entry codes for this subject and details on how to make entries are available on our Qualifications Administration Handbook microsite, which you can access at [www.ccea.org.uk](http://www.ccea.org.uk)

Alternatively, you can telephone our Examination Entries, Results and Certification team using the contact details provided.

### 7.3 Equality and inclusion

We have considered the requirements of equality legislation in developing this specification and designed it to be as free as possible from ethnic, gender, religious, political and other forms of bias.

GCSE qualifications often require the assessment of a broad range of competences. This is because they are general qualifications that prepare students for a wide range of occupations and higher level courses.

During the development process, an external equality panel reviewed the specification to identify any potential barriers to equality and inclusion. Where appropriate, we have considered measures to support access and mitigate barriers.

We can make reasonable adjustments for students with disabilities to reduce barriers to accessing assessments. For this reason, very few students will have a complete barrier to any part of the assessment.

It is important to note that where access arrangements are permitted, they must not be used in any way that undermines the integrity of the assessment. You can find information on reasonable adjustments in the Joint Council for Qualifications document *Access Arrangements and Reasonable Adjustments* available at [www.jcq.org.uk](http://www.jcq.org.uk)

## 7.4 Contact details

If you have any queries about this specification, please contact the relevant CCEA staff member or department:

- Specification Support Officer: Nuala Tierney  
(telephone: (028) 9026 1200, extension 2292, email: [ntierney@ccea.org.uk](mailto:ntierney@ccea.org.uk))
- Subject Officer: Joe McGurk  
(telephone: (028) 9026 1200, extension 2106, email: [jmcgurk@ccea.org.uk](mailto:jmcgurk@ccea.org.uk))
- Examination Entries, Results and Certification  
(telephone: (028) 9026 1262, email: [entriesandresults@ccea.org.uk](mailto:entriesandresults@ccea.org.uk))
- Examiner Recruitment  
(telephone: (028) 9026 1243, email: [appointments@ccea.org.uk](mailto:appointments@ccea.org.uk))
- Distribution  
(telephone: (028) 9026 1242, email: [cceadistribution@ccea.org.uk](mailto:cceadistribution@ccea.org.uk))
- Support Events Administration  
(telephone: (028) 9026 1401, email: [events@ccea.org.uk](mailto:events@ccea.org.uk))
- Moderation  
(telephone: (028) 9026 1200, extension 2236, email: [moderationteam@ccea.org.uk](mailto:moderationteam@ccea.org.uk))
- Business Assurance (Complaints and Appeals)  
(telephone: (028) 9026 1244, email: [complaints@ccea.org.uk](mailto:complaints@ccea.org.uk) or [appealsmanager@ccea.org.uk](mailto:appealsmanager@ccea.org.uk)).

## Summary of Changes since First Issue

(Most recent changes are indicated in red on the latest version)

<b>Revision History Number</b>	<b>Date of Change</b>	<b>Page Number</b>	<b>Change Made</b>
Version 1	N/A	N/A	First issue
Version 2	8 June 2017	6	Wording changed



