GCE

Rewarding Learning

CCEA GCE Specification in

Mathematics

For first teaching from September 2018
For first award of AS level in Summer 2019
For first award of A level in Summer 2019
Subject Code: 2210

Contents

Subject Code	2210
QAN AS Level	603/1761/9
QAN A Level	603/1717/6

This specification is available online at www.ccea.org.uk

1 Introduction

This specification sets out the content and assessment details for our Advanced Subsidiary (AS) and Advanced (A level) GCE courses in Mathematics. First teaching is from September 2018.

Students can take:

- the AS course as a final qualification; or
- the AS units plus the A2 units for a full GCE A level qualification.

We assess the AS units at a standard appropriate for students who have completed the first part of the full course. A2 units have an element of synoptic assessment (to assess students' understanding of the subject as a whole), as well as more emphasis on assessment objectives that reflect higher order thinking skills.

The full Advanced GCE award is based on students' marks from the AS (40 percent) and the A2 (60 percent). The guided learning hours for this specification, as for all GCEs, are:

- 180 hours for the Advanced Subsidiary level award; and
- 360 hours for the Advanced level award.

We will make the first AS awards for the specification in 2019 and the first A level awards in 2019. The specification builds on the broad objectives of the Northern Ireland Curriculum.

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

1.1 Aims

This specification aims to encourage students to:

- understand mathematics and mathematical processes in a way that promotes confidence, fosters enjoyment and provides a strong foundation for progress to further study;
- extend their range of mathematical skills and techniques;
- understand coherence and progression in mathematics and how different areas of mathematics are connected;
- apply mathematics in other fields of study and be aware of the relevance of mathematics to the world of work and to situations in society in general;
- use their mathematical knowledge to make logical and reasoned decisions in solving problems both within pure mathematics and in a variety of contexts, and communicate the mathematical rationale for these decisions clearly;
- reason logically and recognise incorrect reasoning;
- generalise mathematically;
- construct mathematical proofs;
- use their mathematical skills and techniques to solve challenging problems that require them to decide on the solution strategy;
- recognise when they can use mathematics to analyse and solve a problem in context;
- represent situations mathematically and understand the relationship between problems in context and mathematical models that they may apply to solve these;
- draw diagrams and sketch graphs to help explore mathematical situations and interpret solutions;
- make deductions and inferences and draw conclusions by using mathematical reasoning;
- interpret solutions and communicate their interpretation effectively in the context of the problem;
- read and comprehend mathematical arguments, including justifications of methods and formulae, and communicate their understanding;
- read and comprehend articles concerning applications of mathematics and communicate their understanding;
- use technology such as calculators and computers effectively, and recognise when such use may be inappropriate; and
- take increasing responsibility for their own learning and the evaluation of their own mathematical development.

1.2 Key features

The following are important features of this specification.

- It includes four externally assessed assessment units.
- It allows students to develop their subject knowledge, understanding and skills.
- Assessment at A2 includes more demanding question types and synoptic assessment that encourages students to develop their understanding of the subject as a whole.
- It gives students a sound basis for progression to higher education and to employment.
- A range of support is available, including specimen assessment materials.

1.3 Prior attainment

This specification assumes knowledge of Higher Tier GCSE Mathematics.

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 and colleges that they apply to may take the view that they have achieved only one of the two GCEs. The same may occur with any two GCE 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 universities and colleges that they would like to attend before beginning their studies.

2 Specification at a Glance

The table below summarises the structure of the AS and A level courses:

Content	Assessment	Weightings
AS 1: **Pure Mathematics**	External written examination 1 hour 45 mins Students answer all questions.	60% of AS 24% of A level
AS 2: **Applied Mathematics**	External written examination 1 hour 15 mins Students answer all questions.	40% of AS 16% of A level
A2 1: **Pure Mathematics**	External written examination 2 hours 30 mins Students answer all questions.	36% of A level
A2 2: **Applied Mathematics**	External written examination 1 hour 30 mins Students answer all questions.	24% of A level

3 Subject Content

We have divided this course into four units: two units at AS level and two units at A2. This section sets out the content and learning outcomes for each unit.

The use of technology, in particular mathematical and statistical graphing tools and spreadsheets, must permeate the teaching of the units in this specification.

Calculators used must include:

- an iterative function; and
- the ability to compute summary statistics and access probabilities from standard statistical distributions.

Students must not have access to technology with a computer algebra system function during examinations.

3.1 Overarching themes in GCE Mathematics

This GCE Mathematics specification gives students opportunities to demonstrate the following knowledge and skills. They must apply these, along with associated mathematical thinking and understanding, across the whole content of the AS and A2 units set out below.

AS and A level students should be able to:

- understand and use mathematical language and syntax, including equals, identically equals, therefore, because, implies, is implied by, necessary, sufficient, $\therefore$, $=$, $\equiv$, $\neq$, $\Rightarrow$, $\Leftarrow$ and $\Leftrightarrow$;
- understand and use Venn diagrams, language and symbols associated with set theory, including complement, $\varnothing$, $\cap$, $\cup$, $\in$, $\notin$ and ε, and apply these to solutions of inequalities and probability;
- understand and use the structure of mathematical proof, proceeding from given assumptions through a series of logical steps to a conclusion;
- use methods of proof, including proof by deduction and proof by exhaustion;
- use disproof by counter example;
- comprehend and critique mathematical arguments, proofs and justifications of methods and formulae, including those relating to applications of mathematics;
- recognise the underlying mathematical structure in a situation and simplify and abstract appropriately to solve problems;
- construct extended arguments to solve problems presented in an unstructured form, including problems in context;
- interpret and communicate solutions in the context of the original problem;
- evaluate, including by making reasoned estimates, the accuracy or limitations of solutions;
- understand the concept of a problem-solving cycle, including specifying the problem, collecting information, processing and representing information and interpreting results, which may identify the need to repeat the cycle;

- understand, interpret and extract information from diagrams and construct mathematical diagrams to solve problems, including in mechanics;
- translate a situation in context into a mathematical model, making simplifying assumptions;
- use a mathematical model with suitable inputs to engage with and explore situations (for a given model or a model constructed or selected by the student);
- interpret the outputs of a mathematical model in the context of the original situation (for a given model or a model constructed or selected by the student);
- understand that a mathematical model can be refined by considering its outputs and simplifying assumptions;
- evaluate whether a mathematical model is appropriate; and
- understand and use modelling assumptions.

A level students should also be able to:

- understand and use proof by contradiction;
- construct and present mathematical arguments through appropriate use of diagrams, sketching graphs, logical deduction, precise statements involving correct use of symbols and connecting language, including constant, coefficient, expression, equation, function, identity, index, term and variable;
- understand that many mathematical problems cannot be solved analytically, but numerical methods permit solution to a required level of accuracy; and
- evaluate the accuracy or limitations of solutions obtained using numerical methods.

3.2 Unit AS 1: Pure Mathematics

This unit covers the pure content of AS Mathematics. It is compulsory for both AS and A level Mathematics. The unit is assessed by a 1 hour 45 minute external examination, with 6–10 questions worth 100 raw marks.

Content	Learning Outcomes
Algebra and functions	Students should be able to: • demonstrate understanding of and use the laws of indices for all rational exponents; • use and manipulate surds, including rationalising the denominator; • work with quadratic functions and their graphs; • demonstrate understanding of and use the discriminant of a quadratic function, including the condition for real and repeated roots; • complete the square in a quadratic function; • solve quadratic equations, including quadratic equations in a function of the unknown; • solve simultaneous equations in two variables by elimination and by substitution, including one linear and one quadratic equation; • solve simultaneous equations in three variables; • solve linear and quadratic inequalities in a single variable and interpret such inequalities graphically, including inequalities with brackets and fractions; • manipulate polynomials algebraically, including expanding brackets and collecting like terms, factorisation and simple algebraic division; • use the remainder and factor theorems; and • sketch curves defined by simple equations, including polynomials.

Content	Learning Outcomes
Algebra and functions (cont.)	Students should be able to: • sketch curves defined by equations of the form $y = \frac{a}{x}$ and $y = \frac{a}{x^2}$ (including their vertical and horizontal asymptotes); • interpret the algebraic solution of equations graphically; • use intersection points of graphs to solve equations; • demonstrate understanding of the effect of simple transformations on the graph of $y = \mathrm{f}(x)$, including sketching associated graphs: $y = a\mathrm{f}(x)$, $y = \mathrm{f}(x) + a$, $y = \mathrm{f}(x + a)$ and $y = \mathrm{f}(ax)$
Co-ordinate geometry in the (x, y) plane	• demonstrate understanding of and use the equation of a straight line, including the forms $y - y_1 = m(x - x_1)$ and $ax + by + c = 0$ • demonstrate understanding of how to find the mid-point of a line segment; • use the gradient conditions for two straight lines to be parallel or perpendicular; • use straight line models in a variety of contexts; • demonstrate understanding of and use the co-ordinate geometry of the circle, including using the equation of a circle in the forms: $(x - a)^2 + (y - b)^2 = r^2$ and $x^2 + y^2 + 2gx + 2fy + c = 0$ • find the centre and radius of a circle by completing the square; • use the standard circle properties: angle in a semicircle is a right angle, perpendicular from centre to a chord bisects the chord and perpendicularity of radius and tangent; and • find the equation of the tangent to a circle through a given point on the circumference.

Content	Learning Outcomes
Sequences and series	Students should be able to: • demonstrate understanding of and use the binomial expansion of $(a + bx)^n$ for positive integer n • demonstrate understanding of and use the notations $n!$ and $n\mathrm{C}r$
Trigonometry	• demonstrate understanding of and use the definitions of sine, cosine and tangent for all arguments; • demonstrate understanding of and use the sine and cosine rules; • calculate the area of a triangle in the form $\frac{1}{2}ab\sin C$ • demonstrate understanding of and use the sine, cosine and tangent functions, including their graphs, symmetries and periodicity; • demonstrate understanding of and use $\tan\theta = \frac{\sin\theta}{\cos\theta}$ • demonstrate understanding of and use $\sin^2\theta + \cos^2\theta = 1$ • solve simple trigonometric equations in a given interval, including quadratic equations in sin, cos and tan and equations involving multiples of the unknown angle;
Exponentials and logarithms	• demonstrate understanding of and use the function a^x and its graph, where a is positive; • demonstrate understanding of and use the function e^x and its graph; • demonstrate understanding of and use the definition of $\log_a x$ as the inverse of a^x, where a is positive and $x \geq 0$ • demonstrate understanding of and use the function $\ln x$ and its graph; and • demonstrate understanding of and use $\ln x$ as the inverse function of e^x

Content	Learning Outcomes
Exponentials and logarithms (cont.)	Students should be able to: • demonstrate understanding, prove and use the laws of logarithms: $\log_a x + \log_a y = \log_a xy$ $\log_a x - \log_a y = \log_a \left(\frac{x}{y}\right)$ $k \log_a x = \log_a (x^k)$ (including, for example $k = -1$ and $k = -\frac{1}{2}$) • solve equations of the form $a^x = b$ • solve inequalities involving exponential functions, for example $a^x < b$ • demonstrate understanding of and use exponential growth and decay; • use exponential growth and decay in modelling continuous compound interest, population growth, radioactive decay and drug concentration decay;
Differentiation	• demonstrate understanding of and use the derivative of $\mathrm{f}(x)$ as a function for the gradient of the tangent to the graph of $y = \mathrm{f}(x)$ at a general point (x, y) • demonstrate understanding of the gradient of the tangent to a curve as a limit; • interpret the gradient of a tangent as a rate of change; • demonstrate understanding of and find second derivatives; • demonstrate understanding of and use the second derivative as the rate of change of gradient; • differentiate x^n, for rational values of n, and related constant multiples, sums and differences; • apply differentiation to find gradients, tangents and normals, maxima and minima and stationary points; and • identify increasing and decreasing functions.

Content	Learning Outcomes
Integration **Vectors**	Students should be able to: • demonstrate understanding of and use indefinite integration as the reverse of differentiation; • integrate x^n (excluding $n = -1$) and related sums, differences and constant multiples; • evaluate definite integrals; • use a definite integral to find the area defined by a curve and either axis; • use vectors in two dimensions (including **i** and **j** unit vectors); • calculate the magnitude and direction of a vector and convert between component form and magnitude/direction form; • perform the algebraic operations of vector addition and multiplication by scalars, and understand their geometrical interpretations; • demonstrate understanding of and use position vectors; and • calculate the distance between two points represented by position vectors.

3.3 Unit AS 2: Applied Mathematics

This unit, which assumes knowledge of Unit AS 1, covers the applied content of AS Mathematics and is compulsory for both AS and A level Mathematics. The unit addresses aspects of both mechanics (50% of the assessment) and statistics (50% of the assessment). It assesses modelling and the application of mathematics. The unit is assessed by a 1 hour 15 minute external examination, with 5–10 questions worth 70 raw marks. The examination has two sections: Section A assesses mechanics and Section B assesses statistics. Students answer all questions in both sections.

The statistical content of this unit should be taught through the use and interrogation of a large data set. The examination tests students' ability to:

- interpret real data presented in summary or graphical form; and
- use data to investigate questions arising in real contexts.

Students should be familiar with methods of presenting data, including frequency tables for ungrouped and grouped data, box plots and stem-and-leaf diagrams. They should also be familiar with mean, mode and median as summary measures of location of data. We will not set questions that directly test students' ability to construct such tables and diagrams and calculate such measures, but students will be expected to interpret and draw inferences from them.

Section A: Mechanics

Content	Learning Outcomes
Quantities and units in mechanics	Students should be able to: • demonstrate understanding of and use fundamental quantities and units in the SI system: length, time and mass; • demonstrate understanding of and use derived quantities and units: velocity, acceleration, force and weight;
Kinematics	• demonstrate understanding of and use the language of kinematics: position, displacement, distance travelled, velocity, speed and acceleration; and • demonstrate understanding of, use and interpret graphs in kinematics for motion in a straight line: – displacement against time and interpretation of gradient; and – velocity against time and interpretation of gradient and area under the graph.

Content	Learning Outcomes
Kinematics (cont.) **Forces and Newton's laws**	Students should be able to: • demonstrate understanding of and use the formulae for constant acceleration for motion in a straight line; • demonstrate understanding of and use the constant acceleration formulae in two dimensions using vectors; • demonstrate understanding of and use Newton's first law and the concept of a force; • resolve forces in two dimensions; • demonstrate understanding of and use addition of forces to find the resultant of a system of forces; • demonstrate understanding of and use Newton's second law, including forces given as 2D vectors; • demonstrate understanding of and use the gravitational acceleration, g, and its value in SI units to varying degrees of accuracy; • demonstrate understanding of and use weight and motion in a straight line under gravity; • demonstrate understanding of and use Newton's third law; • demonstrate understanding of and use Newton's second and third laws to solve problems involving connected particles; • solve problems involving equilibrium of forces on a particle; • demonstrate understanding of and use the $F \leq \mu R$ model of friction; • demonstrate understanding of and use the coefficient of friction; • solve problems involving the motion of a body on a rough surface; and • solve problems involving limiting friction and statics.

Section B: Statistics

Content	Learning Outcomes
Statistical sampling	Students should be able to: • demonstrate understanding of and use the terms population and sample; • use samples to make informal inferences about the population; • demonstrate understanding of and use sampling techniques, including simple random sampling and stratified sampling; • select or critique sampling techniques in the context of solving a statistical problem, including understanding that different samples can lead to different conclusions about the population;
Data presentation and interpretation	• interpret diagrams for single-variable data, including understanding that area in a histogram represents frequency and connections to probability distributions; • interpret measures of central tendency and variation, including standard deviation and variance; • calculate standard deviation and variance of a population or sample, including from summary statistics; • interpret scatter diagrams and regression lines for bivariate data, including recognition of scatter diagrams that include distinct sections of the population (excluding calculations involving regression lines); • demonstrate understanding of informal interpretation of correlation; • calculate and interpret the product-moment correlation coefficient; • demonstrate understanding that correlation does not imply causation; and • recognise and interpret possible outliers in data sets and statistical diagrams.

Content	Learning Outcomes
Data presentation and interpretation (cont.)	Students should be able to: • select or critique data presentation techniques in the context of a statistical problem; • clean data, including dealing with missing data, errors and outliers;
Probability	• demonstrate understanding of and use the addition and multiplication laws; • demonstrate understanding of and use the following concepts: – mutually exclusive events; – exhaustive events; and – statistical dependence and independence; • calculate combined probabilities of up to three events, using tree diagrams, Venn diagrams and two-way tables;
Statistical distributions	• demonstrate understanding of and use the binomial distribution as an example of a discrete probability distribution; • calculate probabilities using the binomial distribution; and • link binomial probabilities to the binomial expansion and tree diagrams.

3.4 Unit A2 1: Pure Mathematics

This unit assumes knowledge of Units AS 1 and AS 2. It covers the pure content of A2 Mathematics and is compulsory for A level Mathematics. The unit is assessed by a 2 hours 30 minute external examination, with 7–12 questions. It is worth 150 raw marks.

Content	Learning Outcomes
Algebra and functions	Students should be able to: • simplify rational expressions, including by factorising and cancelling, and algebraic division; • demonstrate understanding of and use the definition of a function; • demonstrate understanding of and use the terms domain and range in the context of functions; • demonstrate understanding of and use composite functions; • demonstrate understanding of and use inverse functions and their graphs; • demonstrate understanding of and use the modulus function (including $\|x-a\|<b$) • demonstrate understanding of the effect of combinations of simple transformations on the graph of $y=\mathrm{f}(x)$ as represented by $y=a\mathrm{f}(x)$, $y=\mathrm{f}(x)+a$, $y=\mathrm{f}(x+a)$ and $y=\mathrm{f}(ax)$ • decompose rational functions into partial fractions (denominators not more complicated than squared linear terms); • use functions in modelling, including consideration of limitations and refinements of the models;
Co-ordinate geometry in the (x, y) plane	• demonstrate understanding of and use the parametric equations of curves and conversion between Cartesian and parametric forms; and • use parametric equations in modelling in a variety of contexts.

Content	Learning Outcomes
Sequences and series	Students should be able to: • work with sequences, including those given by a formula for the n^{th} term and those generated by a simple relation of the form $x_{n+1} = \mathrm{f}(x_n)$ • demonstrate understanding of the behaviour of sequences, including convergence, divergence and oscillation; • demonstrate understanding of and use sigma notation for sums of series; • demonstrate understanding of and work with arithmetic sequences and series, including the formulae for n^{th} term and the sum to n terms; • demonstrate understanding of and work with geometric sequences and series, including the formulae for the n^{th} term and the sum of a finite geometric series; • prove the formula for the sum of the first n terms of an arithmetic series or a geometric series; • find the sum to infinity of a convergent geometric series, including the use of $\lvert r\rvert < 1$ • demonstrate understanding of and use the expansion of $(a + bx)^n$ for any rational n, including its use for approximation and knowledge that the expansion is valid for $\left\lvert\frac{bx}{a}\right\rvert < 1$ • use sequences and series in modelling;
Trigonometry	• work with radian measure, including use for arc length and area of sector; and • demonstrate understanding of and use the definitions of secant, cosecant and cotangent and of arcsin, arccos and arctan, including their relationships to sine, cosine and tangent, their graphs and their domains and ranges.

Content	Learning Outcomes
Trigonometry (cont.)	Students should be able to: • demonstrate understanding of the graphs of the secant, cosecant, cotangent, arcsin, arccos and arctan functions, including their ranges and appropriate restricted domains; • demonstrate understanding of and use $\sec^2\theta = 1 + \tan^2\theta$ and $\operatorname{cosec}^2\theta = 1 + \cot^2\theta$ • demonstrate understanding of and use the compound angle formulae for $\sin(A \pm B)$, $\cos(A \pm B)$ and $\tan(A \pm B)$ • demonstrate understanding of, use and prove the double angle formulae; • demonstrate understanding of and use expressions for $a\cos\theta + b\sin\theta$ in the equivalent forms of $r\cos(\theta \pm \alpha)$ or $r\sin(\theta \pm \alpha)$ • construct proofs involving trigonometric functions and identities; • use trigonometric functions to solve problems in context;
Differentiation	• differentiate e^{kx}, $\ln kx$, $\sin kx$, $\cos kx$, $\tan kx$ and related sums, differences and constant multiples; • differentiate using: – the product rule; – the quotient rule; and – the chain rule; • differentiate $\operatorname{cosec} x$, $\sec x$ and $\cot x$ • differentiate simple functions and relations defined implicitly or parametrically, including finding the second derivative; and • construct simple differential equations in pure mathematics and in context.

Content	Learning Outcomes
Integration	Students should be able to: • integrate $e^{kx}, \frac{1}{x}, \sin kx, \cos kx$ and related functions; • use a definite integral to find the area between two curves; • demonstrate understanding of and use integration as the limit of a sum; • carry out simple cases of integration by substitution and integration by parts and understand these methods as the inverse processes of the chain and product rules respectively; • integrate using partial fractions; • evaluate the analytical solution of simple first order differential equations with separable variables, including finding particular solutions; • interpret the solution of a differential equation in the context of solving a problem, including identifying limitations of the solution; • evaluate a volume generated by the rotation of the area under a single curve about the x-axis;
Numerical methods	• locate roots of $\mathrm{f}(x) = 0$ by considering changes of sign of $\mathrm{f}(x)$ in an interval of x in which $\mathrm{f}(x)$ is continuous; • solve equations approximately using simple iterative methods, for example the Newton–Raphson method; • demonstrate understanding of and use numerical integration of functions (via trapezium rule), including finding the approximate area under a curve; and • use numerical methods to solve problems in context.

3.5 Unit A2 2: Applied Mathematics

This unit assumes knowledge of Units AS 1, AS 2 and A2 1. It covers the applied content of A2 Mathematics and is compulsory for A level Mathematics. The unit addresses aspects of both mechanics (50 percent of the assessment) and statistics (50 percent of the assessment). It assesses modelling and the application of mathematics. The unit is assessed by a 1 hour 30 minute external examination, with 6–10 questions worth 100 raw marks. The examination has two sections: Section A assesses mechanics and Section B assesses statistics. Students answer all questions in both sections.

The statistical content of this unit should be taught through the use and interrogation of a large data set. The examination will test students' ability to:

- interpret real data presented in summary or graphical form; and
- use data to investigate questions arising in real contexts.

Section A: Mechanics

Content	Learning Outcomes
Kinematics	Students should be able to: • use calculus in kinematics for motion in a straight line: $$v = \frac{\mathrm{d}s}{dt}$$ $$a = \frac{\mathrm{d}v}{\mathrm{d}t} = \frac{\mathrm{d}^2 s}{\mathrm{d}t^2}$$ $$s = \int v \,\mathrm{d}t$$ $$v = \int a \,\mathrm{d}t$$ • use calculus in kinematics in two dimensions: $$\mathbf{v} = \frac{\mathrm{d}\mathbf{r}}{\mathrm{d}t}$$ $$\mathbf{a} = \frac{\mathrm{d}\mathbf{v}}{\mathrm{d}t} = \frac{\mathrm{d}^2\mathbf{r}}{\mathrm{d}t^2}$$ $$\mathbf{r} = \int \mathbf{v} \,\mathrm{d}t$$ $$\mathbf{v} = \int \mathbf{a} \,\mathrm{d}t$$ • model motion under gravity in two dimensions using vectors; and • solve problems involving projectiles.

Content	Learning Outcomes
Moments **Impulse and momentum**	Students should be able to: • demonstrate understanding of and use moments in simple static contexts, including rods, ladders and hinged beams; • demonstrate understanding of and use impulse and momentum; and • demonstrate understanding of and use the principle of conservation of linear momentum to solve problems involving direct collisions and explosions.

Section B: Statistics

Content	Learning Outcomes
Probability **Statistical distributions**	Students should be able to: • demonstrate understanding of and use conditional probability, including tree diagrams, Venn diagrams and two-way tables; • demonstrate understanding of and use the conditional probability formula: $\mathrm{P}(A\|B) = \frac{\mathrm{P}(A \cap B)}{\mathrm{P}(B)}$ • model with probability, including critiquing assumptions made and the likely effect of more realistic assumptions; • demonstrate understanding of and use the normal distribution as an example of a continuous probability distribution; • find probabilities using the normal distribution; and • select an appropriate probability distribution for a context, with appropriate reasoning, including recognising when a binomial or normal model may not be appropriate.

Content	Learning Outcomes
Statistical hypothesis testing	Students should be able to: • demonstrate understanding and use the language of statistical hypothesis testing: – null hypothesis; – alternative hypothesis; – significance level; – test statistic; – 1-tail test; – 2-tail test; – critical value; – critical region; – acceptance region; and – p-value; • demonstrate understanding that a sample is being used to make an inference about the population and appreciate that the significance level is the probability of incorrectly rejecting the null hypothesis; • conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret the results in context; • conduct a statistical hypothesis test for the mean of a normal distribution with known, given or assumed variance and interpret the results in context; and • interpret a given correlation coefficient using a given p-value or critical value.

4 Scheme of Assessment

4.1 Assessment opportunities

Each unit is available for assessment in summer each year. It is possible to resit individual AS and A2 assessment units once and count the better result for each unit towards an AS or A level qualification. Candidates' results for individual assessment units can count towards a qualification until we withdraw the specification.

4.2 Assessment objectives

There are three assessment objectives for this specification. Candidates must:

AO1 use and apply standard techniques, by:

- selecting and correctly carrying out routine procedures; and
- accurately recalling facts, terminology and definitions;

AO2 reason, interpret and communicate mathematically, by:

- constructing rigorous mathematical arguments (including proofs);
- making deductions and inferences;
- assessing the validity of mathematical arguments;
- explaining their reasoning; and
- using mathematical language and notation correctly;

AO3 solve problems within mathematics and in other contexts, by:

- translating problems in mathematical and non-mathematical contexts into mathematical processes;
- interpreting solutions to problems in their original context and, where appropriate, evaluate their accuracy and limitations;
- translating situations in context into mathematical models;
- using mathematical models; and
- evaluating the outcomes of modelling in context, recognise the limitations of models and, where appropriate, explain how to refine them.

4.3 Assessment objective weightings

The table below sets out the assessment objective weightings for each assessment unit and the overall A level qualification:

Assessment Objective	Assessment Unit Weighting			
	AS 1	AS 2	A2 1	A2 2
AO1	50%	50%	50%	50%
AO2	25%	25%	25%	25%
AO3	25%	25%	25%	25%
Total	100%	100%	100%	100%
(Weightings have a tolerance of ±3%)				

4.4 Synoptic assessment at A2

The A2 assessment units include some synoptic assessment, which encourages candidates to develop their understanding of the subject as a whole. In our GCE Mathematics, synoptic assessment involves:

- building on material from the AS units; and
- bringing together and making connections between areas of knowledge, understanding and skills that they have explored throughout the course.

4.5 Higher order thinking skills

The A2 assessment units provide opportunities to demonstrate higher order thinking skills by incorporating:

- more demanding unstructured questions; and
- questions that require candidates to make more connections between sections of the specification.

4.6 Reporting and grading

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

We award AS qualifications on a five grade scale from A to E, with A being the highest. We award A level qualifications on a six grade scale from A* to E, with A* being the highest. To determine candidates' grades, we add the uniform marks obtained in individual assessment units.

To be awarded an A*, candidates need to achieve a grade A on their full A level qualification and at least 90 percent of the maximum uniform marks available for the A2 units. If candidates fail to attain a grade E, we report their results as unclassified (U).

The grades we award match the grade descriptions in Section 5 of this specification.

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.

AS Grade Descriptions

Grade	Description
AS **A Grade**	For AO1, candidates characteristically: • select and accurately carry out almost all routine procedures correctly; and • accurately recall almost all facts, terminology and definitions. For AO2, candidates characteristically: • independently construct rigorous mathematical arguments in almost all relevant contexts; • make valid deductions and inferences in almost all relevant contexts; • assess, critique and improve the validity of a mathematical argument in almost all relevant contexts; • construct extended chains of reasoning to achieve a given result, find and correct errors and explain their reasoning, evaluating evidence in almost all relevant contexts; and • use mathematical language and notation correctly in almost all relevant contexts. For AO3, candidates characteristically: • translate problems in mathematical or non-mathematical contexts into mathematical processes in almost all relevant contexts; • interpret solutions to problems in their original context and, where appropriate, evaluate their accuracy and limitations in almost all relevant contexts; • translate situations in context into mathematical models in almost all relevant contexts; • use mathematical models in almost all relevant contexts; and • evaluate the outcomes of modelling in context, recognise the limitations of models and, where appropriate, explain how to refine them in almost all relevant contexts.

Grade	Description
AS **E Grade**	For AO1, candidates characteristically: • select and accurately carry out some routine procedures correctly; and • accurately recall some facts, terminology and definitions. For AO2, candidates characteristically: • independently construct rigorous mathematical arguments in some relevant contexts; • make valid deductions and inferences in some relevant contexts; • assess, critique and improve the validity of a mathematical argument in some relevant contexts; • construct extended chains of reasoning to achieve a given result, find and correct errors and explain their reasoning, evaluating evidence in some relevant contexts; and • use mathematical language and notation correctly in some relevant contexts. For AO3, candidates characteristically: • translate problems in mathematical or non-mathematical contexts into mathematical processes in some relevant contexts; • interpret solutions to problems in their original context and, where appropriate, evaluate their accuracy and limitations in some relevant contexts; • translate situations in context into mathematical models in some relevant contexts; • use mathematical models in some relevant contexts; and • evaluate the outcomes of modelling in context, recognise the limitations of models and, where appropriate, explain how to refine them in some relevant contexts.

A2 Grade Descriptions

Grade	Description
A2 **A Grade**	For AO1, candidates characteristically: • select and accurately carry out almost all routine procedures correctly; and • accurately recall almost all facts, terminology and definitions. For AO2, candidates characteristically: • independently construct rigorous mathematical arguments in almost all relevant contexts; • make valid deductions and inferences in almost all relevant contexts; • assess, critique and improve the validity of a mathematical argument in almost all relevant contexts; • construct extended chains of reasoning to achieve a given result, find and correct errors and explain their reasoning, evaluating evidence in almost all relevant contexts; and • use mathematical language and notation correctly in almost all relevant contexts. For AO3, candidates characteristically: • translate problems in mathematical or non-mathematical contexts into mathematical processes in almost all relevant contexts; • interpret solutions to problems in their original context and, where appropriate, evaluate their accuracy and limitations in almost all relevant contexts; • translate situations in context into mathematical models in almost all relevant contexts; • use mathematical models in almost all relevant contexts; and • evaluate the outcomes of modelling in context, recognise the limitations of models and, where appropriate, explain how to refine them in almost all relevant contexts.

Grade	Description
A2 **E Grade**	For AO1, candidates characteristically: • select and accurately carry out some routine procedures correctly; and • accurately recall some facts, terminology and definitions. For AO2, candidates characteristically: • independently construct rigorous mathematical arguments in some relevant contexts; • make valid deductions and inferences in some relevant contexts; • assess, critique and improve the validity of a mathematical argument in some relevant contexts; • construct extended chains of reasoning to achieve a given result, find and correct errors and explain their reasoning, evaluating evidence in some relevant contexts; and • use mathematical language and notation correctly in some relevant contexts. For AO3, candidates characteristically: • translate problems in mathematical or non-mathematical contexts into mathematical processes in some relevant contexts; • interpret solutions to problems in their original context and, where appropriate, evaluate their accuracy and limitations in some relevant contexts; • translate situations in context into mathematical models in some relevant contexts; • use mathematical models in some relevant contexts; and • evaluate the outcomes of modelling in context, recognise the limitations of models and, where appropriate, explain how to refine them in some relevant contexts.

6 Guidance on Assessment

There are four external assessment units in this specification, two at AS level and two at A2:

- Unit AS 1: Pure Mathematics;
- Unit AS 2: Applied Mathematics;
- Unit A2 1: Pure Mathematics; and
- Unit A2 2: Applied Mathematics.

6.1 Unit AS 1: Pure Mathematics

This unit is assessed by a 1 hour 45 minute external examination, with 6–10 questions worth 100 raw marks.

6.2 Unit AS 2: Applied Mathematics

This unit is assessed by a 1 hour 15 minute external examination, with 5–10 questions worth 70 raw marks.

The examination has two sections: Section A assesses mechanics and Section B assesses statistics. Candidates answer all questions in both sections. Questions on the statistics and mechanics content of the unit are each worth 50 percent of the available raw marks.

6.3 Unit A2 1: Pure Mathematics

This unit is assessed by a 2 hour 30 minute external examination, with 7–12 questions worth 150 raw marks.

6.4 Unit A2 2: Applied Mathematics

This unit is assessed by a 1 hour 30 minute external examination, with 6–10 questions worth 100 raw marks.

The examination has two sections: Section A assesses mechanics and Section B assesses statistics. Candidates answer all questions in both sections. Questions on the statistics and mechanics content of the unit are each worth 50 percent of the available raw marks.

7 Links and Support

7.1 Support

The following resources are available to support this specification:

- our Mathematics microsite at www.ccea.org.uk
- specimen assessment materials; and
- guidance notes for teachers.

We also intend to provide:

- past papers and mark schemes;
- Chief Examiner's reports;
- planning frameworks;
- support days for teachers;
- a resource list; and
- exemplification of standards.

7.2 Curriculum objectives

This specification supports centres to build on the broader Northern Ireland Curriculum objectives to develop the young person:

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

It can contribute to meeting the requirements of the Northern Ireland Entitlement Framework at post-16 and the provision of a broad and balanced curriculum.

Curriculum Progression from Key Stage 4

This specification builds on learning from Key Stage 4 and gives students opportunities to develop their subject knowledge and understanding further. Students will also have opportunities to continue to develop the **Cross-Curricular Skills** and the **Thinking Skills and Personal Capabilities** shown below. The extent of this development depends on the teaching and learning methodology the teacher uses.

Cross-Curricular Skills

- Communication:
  – Talking and Listening
  – Reading
  – Writing
- Using Mathematics
- Using ICT

Thinking Skills and Personal Capabilities

- Problem Solving
- Working with Others
- Self-Management

For further guidance on the skills and capabilities in this subject, please refer to the support materials on the subject microsite.

7.3 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

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

7.4 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.

GCE 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

7.5 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)

- Subject Officer: Joe McGurk
  (telephone: (028) 9026 1200, extension 2106, email: jmcgurk@ccea.org.uk)

- Examination Entries, Results and Certification
  (telephone: (028) 9026 1262, email: entriesandresults@ccea.org.uk)

- Examiner Recruitment
  (telephone: (028) 9026 1243, email: appointments@ccea.org.uk)

- Distribution
  (telephone: (028) 9026 1242, email: cceadistribution@ccea.org.uk)

- Support Events Administration
  (telephone: (028) 9026 1401, email: events@ccea.org.uk)

- Moderation
  (telephone: (028) 9026 1200, extension 2236, email: moderationteam@ccea.org.uk)

- Business Assurance (Complaints and Appeals)
  (telephone: (028) 9026 1244, email: complaints@ccea.org.uk or appealsmanager@ccea.org.uk).

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