WJEC Eduqas GCSE (9-1) in MATHEMATICS

For teaching from 2015
For award from 2017

GCSE MATHEMATICS

SUMMARY OF ASSESSMENT

Learners entered for this qualification must sit both components at either foundation or higher tier, in the same examination series.

Component 1: Non-calculator Mathematics

Written examination: **2 hours 15 minutes (120 marks)**

50% of qualification

The written paper for each tier will comprise a number of short and longer, both structured and unstructured questions which may be set on any part of the subject content of the specification.
A significant number of questions will assess learners' understanding of more than one topic from the subject content.
A calculator will **not** be allowed in this examination.

Component 2: Calculator-allowed Mathematics

Written examination: **2 hours 15 minutes (120 marks)**

50% of qualification

The written paper for each tier will comprise a number of short and longer, both structured and unstructured questions which may be set on any part of the subject content of the specification.
A significant number of questions will assess learners' understanding of more than one topic from the subject content.
A calculator will be allowed in this examination.

This linear qualification will be available in the summer and November series each year. It will be awarded for the first time in summer 2017.

Qualification Accreditation Number: 601/5503/6

GCSE MATHEMATICS

1 INTRODUCTION

1.1 Aims and objectives

The WJEC Eduqas GCSE in Mathematics provides a broad, coherent, satisfying and worthwhile course of study. It encourages learners to develop confidence in, and a positive attitude towards, mathematics and to recognise the importance of mathematics in their own lives and to society. It also provides a strong mathematical foundation for learners who go on to study mathematics at a higher level post-16.

This specification enables learners 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
- comprehend, interpret and communicate mathematical information in a variety of forms appropriate to the information and context.

The WJEC Eduqas GCSE in Mathematics places problem solving at the heart of mathematics learning, which helps learners tackle everyday mathematical problems whilst studying and after obtaining the qualification.

It encourages the teaching of links between different areas of the curriculum by targeting questions that cover the content from different subject areas within mathematics.

This specification is intended to promote a variety of styles of teaching and learning so that the courses are enjoyable for all participants. It will enable learners to progress to higher-level courses of mathematical studies. Following this linear course, learners could benefit from having a greater understanding of the links between subject areas, in particular graphical and algebraic representation, which are prevalent throughout A level mathematics.

1.2 Prior learning and progression

There are no previous learning requirements for this specification. Any requirements set for entry to a course based on this specification are at the school/college's discretion.

This specification builds on subject content which is typically taught at Key Stage 3 and provides a suitable foundation for the study of mathematics at either AS or A level. In addition, the specification provides a coherent, satisfying and worthwhile course of study for learners who do not progress to further study in this subject.

1.3 Equality and fair assessment

This specification may be followed by any learner, irrespective of gender, ethnic, religious or cultural background. It has been designed to avoid, where possible, features that could, without justification, make it more difficult for a learner to achieve because they have a particular protected characteristic.

The protected characteristics under the Equality Act 2010 are age, disability, gender reassignment, pregnancy and maternity, race, religion or belief, sex and sexual orientation.

The specification has been discussed with groups who represent the interests of a diverse range of learners, and the specification will be kept under review.

Reasonable adjustments are made for certain learners in order to enable them to access the assessments (e.g. candidates are allowed access to a Sign Language Interpreter, using British Sign Language). Information on reasonable adjustments is found in the following document from the Joint Council for Qualifications (JCQ): *Access Arrangements, Reasonable Adjustments and Special Consideration: General and Vocational Qualifications.*

This document is available on the JCQ website (www.jcq.org.uk). As a consequence of provision for reasonable adjustments, very few learners will have a complete barrier to any part of the assessment.

2 SUBJECT CONTENT

All subject content within a particular tier (foundation and higher) can be assessed on either Component 1 (Non-calculator Mathematics) or Component 2 (Calculator-allowed Mathematics).

The subject content for both tiers is listed in the following pages.

The subject content has been grouped into the following topic areas:

- Number
- Algebra
- Ratio, proportion and rates of change
- Geometry and measures
- Probability
- Statistics

It is important that, during the course, learners should be given opportunities to:

- develop problem solving skills
- generate strategies to solve problems that are unfamiliar
- answer questions that span more than one topic area of the curriculum
- make mental calculations and calculations without the aid of a calculator
- make estimates
- understand 3-D shape
- use computers and other technological aids
- collect data
- understand and use the statistical problem solving cycle.

This linear specification allows for a holistic approach to teaching and learning, giving teachers flexibility to teach topics in any order and to combine different topic areas.

2.1 Foundation tier

- All learners at foundation tier will develop confidence and competence with the content identified by standard type.

- All learners at foundation tier will be assessed on the content identified by the standard and the underlined type; more highly attaining learners will develop confidence and competence with all of this content.

Note: Learners can be said to have confidence and competence with mathematical content when they can apply it flexibly to solve problems.

Number

Structure and calculation

FN1.	order positive and negative integers, decimals and fractions; use the symbols =, ≠, <, >, ≤, ≥
FN2.	apply the four operations, including formal written methods, to integers, decimals and simple fractions (proper and improper), and mixed numbers – all both positive and negative; understand and use place value (e.g. when working with very large or very small numbers, and when calculating with decimals)
FN3.	recognise and use relationships between operations, including inverse operations (e.g. cancellation to simplify calculations and expressions; use conventional notation for priority of operations, including brackets, powers, roots and reciprocals)
FN4.	use the concepts and vocabulary of prime numbers, factors (divisors), multiples, common factors, common multiples, highest common factor, lowest common multiple, prime factorisation, including using product notation and the unique factorisation theorem
FN5.	apply systematic listing strategies
FN6.	use positive integer powers and associated real roots (square, cube and higher), recognise powers of 2, 3, 4, 5
FN7.	calculate with roots, and with integer indices
FN8.	calculate exactly with fractions and multiples of π
FN9.	calculate with and interpret standard form $A \times 10^n$, where $1 \leq A < 10$ and n is an integer

Fractions, decimals and percentages

FN10.	work interchangeably with terminating decimals and their corresponding fractions (such as 3·5 and $\frac{7}{2}$ or 0·375 and $\frac{3}{8}$)
FN11.	identify and work with fractions in ratio problems
FN12.	interpret fractions and percentages as operators

Measures and accuracy

FN13.	use standard units of mass, length, time, money and other measures (including standard compound measures) using decimal quantities where appropriate
FN14.	estimate answers; check calculations using approximation and estimation, including answers obtained using technology
FN15.	round numbers and measures to an appropriate degree of accuracy (e.g. to a specified number of decimal places or significant figures); use inequality notation to specify simple error intervals due to truncation or rounding
FN16.	apply and interpret limits of accuracy

Algebra

Notation, vocabulary and manipulation

FA1.	use and interpret algebraic notation, including: • ab in place of $a \times b$ • $3y$ in place of $y + y + y$ and $3 \times y$ • a^2 in place of $a \times a$, a^3 in place of $a \times a \times a$, a^2b in place of $a \times a \times b$ • $\frac{a}{b}$ in place of $a \div b$ • coefficients written as fractions rather than as decimals • brackets
FA2.	substitute numerical values into formulae and expressions, including scientific formulae
FA3.	understand and use the concepts and vocabulary of expressions, equations, formulae, identities, inequalities, terms and factors
FA4.	simplify and manipulate algebraic expressions (including those involving surds) by: • collecting like terms • multiplying a single term over a bracket • taking out common factors • expanding products of two binomials • factorising quadratic expressions of the form $x^2 + bx + c$, including the difference of two squares • simplifying expressions involving sums, products and powers, including the laws of indices
FA5.	understand and use standard mathematical formulae; rearrange formulae to change the subject
FA6.	know the difference between an equation and an identity; argue mathematically to show algebraic expressions are equivalent, and use algebra to support and construct arguments
FA7.	where appropriate, interpret simple expressions as functions with inputs and outputs

Graphs

FA8.	work with coordinates in all four quadrants
FA9.	plot graphs of equations that correspond to straight-line graphs in the coordinate plane; use the form $y = mx + c$ to identify parallel lines; find the equation of the line through two given points, or through one point with a given gradient
FA10.	identify and interpret gradients and intercepts of linear functions graphically and algebraically
FA11.	identify and interpret roots, intercepts, turning points (stationary points) of quadratic functions graphically; deduce roots algebraically
FA12.	recognise, sketch and interpret graphs of linear functions, quadratic functions, simple cubic functions, the reciprocal function $y = \frac{1}{x}$, with $x \neq 0$
FA13.	plot and interpret graphs (including reciprocal graphs) and graphs of non-standard functions in real contexts, to find approximate solutions to problems such as simple kinematic problems involving distance, speed and acceleration

Solving equations and inequalities

FA14.	solve linear equations in one unknown algebraically (including those with the unknown on both sides of the equation); find approximate solutions using a graph
FA15.	solve quadratic equations of the form $x^2 + bx + c$ (NOT including those that require rearrangement) algebraically by factorising; find approximate solutions using a graph
FA16.	solve two simultaneous linear equations in two variables algebraically; find approximate solutions using a graph
FA17.	translate simple situations or procedures into algebraic expressions or formulae; derive an equation (or two simultaneous equations), solve the equation(s) and interpret the solution
FA18.	solve linear inequalities in one variable; represent the solution set on a number line

Sequences

FA19.	generate terms of a sequence from either a term-to-term or a position-to-term rule
FA20.	recognise and use sequences of triangular, square and cube numbers, simple arithmetic progressions, Fibonacci type sequences, quadratic sequences, and simple geometric progressions (r^n where n is an integer, and r is a rational number > 0)
FA21.	deduce expressions to calculate the nth term of linear sequences

Ratio, proportion and rates of change

FR1.	change freely between related standard units (e.g. time, length, area, volume/capacity, mass) and compound units (e.g. speed, rates of pay, prices, density, pressure) in numerical and algebraic contexts
FR2.	understand the concept of density and be able to use the relationship between density, mass and volume; understand the concept of pressure and be able to use the relationship between pressure, force and area
FR3.	use scale factors, scale diagrams and maps
FR4.	express one quantity as a fraction of another, where the fraction is less than 1 or greater than 1
FR5.	use ratio notation, including reduction to simplest form
FR6.	divide a given quantity into two parts in a given part:part or part:whole ratio; divide a given quantity into more than two parts; express the division of a quantity into two parts as a ratio; apply ratio to real contexts and problems (such as those involving conversion, comparison, scaling, mixing, concentrations)
FR7.	express a multiplicative relationship between two quantities as a ratio or a fraction
FR8.	understand and use proportion as equality of ratios
FR9.	relate ratios to fractions and to linear functions
FR10.	define percentage as ‘number of parts per hundred’; interpret percentages and percentage changes as a fraction or a decimal, and interpret these multiplicatively; express one quantity as a percentage of another; compare two quantities using percentages; work with percentages greater than 100%; solve problems involving percentage change, including percentage increase / decrease and original value problems, and simple interest including in financial mathematics
FR11.	solve problems involving direct and inverse proportion, including graphical and algebraic representations
FR12.	use compound units such as speed, rates of pay, unit pricing, density and pressure
FR13.	compare lengths, areas and volumes using ratio notation; make links to similarity (including trigonometric ratios) and scale factors
FR14.	understand that X is inversely proportional to Y is equivalent to X is proportional to $\frac{1}{Y}$; interpret equations that describe direct and inverse proportion
FR15.	interpret the gradient of a straight line graph as a rate of change; recognise and interpret graphs that illustrate direct and inverse proportion
FR16.	set up, solve and interpret the answers in growth and decay problems, including compound interest

Geometry and measures

Properties and constructions

FG1.	use conventional terms and notations: points, lines, vertices, edges, planes, parallel lines, perpendicular lines, right angles, polygons, regular polygons and polygons with reflection and/or rotation symmetries; use the standard conventions for labelling and referring to the sides and angles of triangles; draw diagrams from written description
FG2.	use the standard ruler and compass constructions (perpendicular bisector of a line segment, constructing a perpendicular to a given line from/at a given point, bisecting a given angle); use these to construct given figures and solve loci problems; know that the perpendicular distance from a point to a line is the shortest distance to the line
FG3.	apply the properties of angles at a point, angles at a point on a straight line, vertically opposite angles; understand and use alternate and corresponding angles on parallel lines; derive and use the sum of angles in a triangle (e.g. to deduce and use the angle sum in any polygon, and to derive properties of regular polygons)
FG4.	derive and apply the properties and definitions of: special types of triangles, quadrilaterals (including square, rectangle, parallelogram, trapezium, kite and rhombus)and other plane figures using appropriate language
FG5.	use the basic congruence criteria for triangles (SSS, SAS, ASA, RHS)
FG6.	apply angle facts, triangle congruence, similarity and properties of quadrilaterals to conjecture and derive results about angles and sides, including Pythagoras' Theorem and the fact that the base angles of an isosceles triangle are equal, and use known results to obtain simple proofs
FG7.	identify, describe and construct congruent and similar shapes, including on coordinate axes, by considering rotation, reflection, translation and enlargement (including fractional scale factors)
FG8.	identify and apply circle definitions and properties, including: centre, radius, chord, diameter, circumference, tangent, arc, sector and segment
FG9.	solve geometrical problems on coordinate axes
FG10.	identify properties of the faces, surfaces, edges and vertices of: cubes, cuboids, prisms, cylinders, pyramids, cones and spheres
FG11.	construct and interpret plans and elevations of 3D shapes

Mensuration and calculation

FG12.	use standard units of measure and related concepts (length, area, volume/capacity, mass, time, money, etc.)
FG13.	measure line segments and angles in geometric figures, including interpreting maps and scale drawings and use of bearings
FG14.	know and apply formulae to calculate: area of squares, rectangles, triangles, parallelograms, trapezia; volume of cuboids and other right prisms (including cylinders)
FG15.	know the formulae: circumference of a circle = $2\pi r = \pi d$, area of a circle = πr^2; calculate perimeters of 2D shapes, including circles; areas of circles and composite shapes; surface area and volume of spheres, pyramids, cones and composite solids
FG16.	calculate arc lengths, angles and areas of sectors of circles
FG17	apply the concepts of congruence and similarity, including the relationships between lengths in similar figures
FG18.	know the formulae for: Pythagoras' theorem, $a^2 + b^2 = c^2$, and the trigonometric ratios, $\sin\theta = \frac{opposite}{hypotenuse}$, $\cos\theta = \frac{adjacent}{hypotenuse}$, $\tan\theta = \frac{opposite}{adjacent}$; apply them to find angles and lengths in right-angled triangles in two dimensional figures
FG19.	know the exact values of $\sin\theta$ and $\cos\theta$ for θ = 0°, 30°, 45° , 60° and 90°; know the exact value of $\tan\theta$ for θ = 0°, 30°, 45° and 60°

Vectors

FG20.	describe translations as 2D vectors
FG21.	apply addition and subtraction of vectors, multiplication of vectors by a scalar, and diagrammatic and column representations of vectors

Probability

FP1.	record describe and analyse the frequency of outcomes of probability experiments using tables and frequency trees
FP2.	apply ideas of randomness, fairness and equally likely events to calculate expected outcomes of multiple future experiments
FP3.	relate relative expected frequencies to theoretical probability, using appropriate language and the 0 - 1 probability scale
FP4.	apply the property that the probabilities of an exhaustive set of outcomes sum to one; apply the property that the probabilities of an exhaustive set of mutually exclusive events sum to one
FP5.	understand that empirical unbiased samples tend towards theoretical probability distributions, with increasing sample size
FP6.	enumerate sets and combinations of sets systematically, using tables, grids, Venn diagrams and tree diagrams
FP7.	construct theoretical possibility spaces for single and combined experiments with equally likely outcomes and use these to calculate theoretical probabilities
FP8.	calculate the probability of independent and dependent combined events, including using tree diagrams and other representations, and know the underlying assumptions

Statistics

FS1.	infer properties of populations or distributions from a sample, whilst knowing the limitations of sampling
FS2.	designing and criticising questions for a questionnaire, including notion of fairness
FS3.	interpret and construct tables, charts and diagrams, including frequency tables, bar charts, pie charts and pictograms for categorical data, vertical line charts for ungrouped discrete numerical data, tables and line graphs for time series data and know their appropriate use
FS4.	interpret, analyse and compare the distributions of data sets from univariate empirical distributions through: • appropriate graphical representation involving discrete, continuous and grouped data • appropriate measures of central tendency (median, mean, mode and modal class) and spread (range, including consideration of outlier)
FS5.	apply statistics to describe a population
FS6.	use and interpret scatter graphs of bivariate data; recognise correlation and know that it does not indicate causation; draw estimated lines of best fit; make predictions; interpolate and extrapolate apparent trends whilst knowing the dangers of so doing

2.2 Higher tier

- All learners at higher tier will develop confidence and competence with the content identified by standard type.
- All learners at higher tier will be assessed on the content identified by the standard and the underlined type; more highly attaining learners will develop confidence and competence with all of this content.
- The highest attaining learners will develop confidence and competence with the **bold** content.

Note: Learners can be said to have confidence and competence with mathematical content when they can apply it flexibly to solve problems.

Number

Structure and calculation

HN1.	order positive and negative integers, decimals and fractions; use the symbols =, ≠, <, >, ≤, ≥
HN2.	apply the four operations, including formal written methods, to integers, decimals and simple fractions (proper and improper), and mixed numbers – all both positive and negative; understand and use place value (e.g. when working with very large or very small numbers, and when calculating with decimals)
HN3.	recognise and use relationships between operations, including inverse operations (e.g. cancellation to simplify calculations and expressions; use conventional notation for priority of operations, including brackets, powers, roots and reciprocals)
HN4.	use the concepts and vocabulary of prime numbers, factors (divisors), multiples, common factors, common multiples, highest common factor, lowest common multiple, prime factorisation, including using product notation and the unique factorisation theorem
HN5.	apply systematic listing strategies **including use of the product rule for counting**
HN6.	use positive integer powers and associated real roots (square, cube and higher), recognise powers of 2, 3, 4, 5; **estimate powers and roots of any given positive number**
HN7.	calculate with roots, and with integer **and fractional** indices
HN8.	calculate exactly with fractions, **surds** and multiples of π**;** **simplify surd expressions involving squares** **(e.g.** $\sqrt{12} = \sqrt{4 \times 3} = \sqrt{4} \times \sqrt{3} = 2\sqrt{3}$ **and rationalise denominators**
HN9.	calculate with and interpret standard form $A \times 10^n$, where $1 \leq A < 10$ and n is an integer

Fractions, decimals and percentages

HN10.	work interchangeably with terminating decimals and their corresponding fractions (such as 3·5 and $\frac{7}{2}$ or 0·375 and $\frac{3}{8}$); **change recurring decimals into their corresponding fractions and vice versa**
HN11.	identify and work with fractions in ratio problems
HN12.	interpret fractions and percentages as operators

Measures and accuracy

HN13.	use standard units of mass, length, time, money and other measures (including standard compound measures) using decimal quantities where appropriate
HN14.	estimate answers; check calculations using approximation and estimation, including answers obtained using technology
HN15.	round numbers and measures to an appropriate degree of accuracy (e.g. to a specified number of decimal places or significant figures); use inequality notation to specify simple error intervals due to truncation or rounding
HN16.	apply and interpret limits of accuracy**, including upper and lower bounds**

Algebra

Notation, vocabulary and manipulation

HA1.	use and interpret algebraic notation, including: • ab in place of $a \times b$ • $3y$ in place of $y + y + y$ and $3 \times y$ • a^2 in place of $a \times a$, a^3 in place of $a \times a \times a$, a^2b in place of $a \times a \times b$ • $\frac{a}{b}$ in place of $a \div b$ • coefficients written as fractions rather than as decimals • brackets
HA2.	substitute numerical values into formulae and expressions, including scientific formulae
HA3.	understand and use the concepts and vocabulary of expressions, equations, formulae, identities, inequalities, terms and factors
HA4.	simplify and manipulate algebraic expressions (including those involving surds **and algebraic fractions**) by: • collecting like terms • multiplying a single term over a bracket • taking out common factors • expanding products of two **or more** binomials • factorising quadratic expressions of the form $x^2 + bx + c$, including the difference of two squares**;** **factorising quadratic expressions of the form $ax^2 + bx + c$** • **completing the square** • simplifying expressions involving sums, products and powers, including the laws of indices
HA5.	understand and use standard mathematical formulae; rearrange formulae to change the subject
HA6.	know the difference between an equation and an identity; argue mathematically to show algebraic expressions are equivalent, and use algebra to support and construct arguments **and proofs**
HA7.	where appropriate, interpret simple expressions as functions with inputs and outputs**; interpret the reverse process as the 'inverse function';** **interpret the succession of two functions as a 'composite function'**

Graphs

HA8.	work with coordinates in all four quadrants
HA9.	plot graphs of equations that correspond to straight-line graphs in the coordinate plane; use the form $y = mx + c$ to identify parallel **and perpendicular lines**; find the equation of the line through two given points, or through one point with a given gradient
HA10.	identify and interpret gradients and intercepts of linear functions graphically and algebraically
HA11.	identify and interpret roots, intercepts, turning points (stationary points) of quadratic functions graphically; deduce roots algebraically, **turning points (stationary points) by completing the square**
HA12.	recognise, sketch and interpret graphs of linear functions, quadratic functions, simple cubic functions, the reciprocal function $y = \frac{1}{x}$, with $x \neq 0$**, exponential functions $y = k^x$ for positive values of k, and the trigonometric functions (with arguments in degrees) $y = \sin x$, $y = \cos x$ and $y = \tan x$ for angles of any size**
HA13.	**sketch translations and reflections of a given function**
HA14.	plot and interpret graphs (including reciprocal graphs **and exponential graphs**) and graphs of non-standard functions in real contexts, to find approximate solutions to problems such as simple kinematic problems involving distance, speed and acceleration
HA15.	**calculate or estimate gradients of graphs and areas under graphs (including quadratic and other non-linear graphs), and interpret results in cases such as distance-time graphs, velocity-time graphs and graphs in financial contexts**
HA16.	**recognise and use the equation of a circle with centre at the origin; find the equation of a tangent to a circle at a given point**

Solving equations and inequalities

HA17.	solve linear equations in one unknown algebraically (including those with the unknown on both sides of the equation); find approximate solutions using a graph
HA18.	solve quadratic equations of the form $x^2 + bx + c$ and $\boldsymbol{ax^2 + bx + c}$ (**including those that require rearrangement**) algebraically by factorising**, by completing the square and by using the quadratic formula**; find approximate solutions using a graph
HA19.	solve two simultaneous equations in two variables (linear/linear **or linear/quadratic**) algebraically; find approximate solutions using a graph
HA20.	**find approximate solutions to equations numerically using iteration, e.g. trial and improvement, decimal search or interval bisection**
HA21.	translate simple situations or procedures into algebraic expressions or formulae; derive an equation (or two simultaneous equations), solve the equation(s) and interpret the solution
HA22.	solve linear inequalities in one **or two** variable(**s), and quadratic inequalities in one variable**; represent the solution set on a number line**, using set notation and on a graph**

Sequences

HA23.	generate terms of a sequence from either a term-to-term or a position-to-term rule
HA24.	recognise and use sequences of triangular, square and cube numbers, simple arithmetic progressions, Fibonacci type sequences, quadratic sequences, and simple geometric progressions (r^n where n is an integer, and r is a rational number > 0 **or a surd**) **and other sequences**
HA25.	deduce expressions to calculate the nth term of linear **and quadratic** sequences

Ratio, proportion and rates of change

HR1.	change freely between related standard units (e.g. time, length, area, volume/capacity, mass) and compound units (e.g. speed, rates of pay, prices, density, pressure) in numerical and algebraic contexts
HR2.	understand the concept of density and be able to use the relationship between density, mass and volume; understand the concept of pressure and be able to use the relationship between pressure, force and area
HR3.	use scale factors, scale diagrams and maps
HR4.	express one quantity as a fraction of another, where the fraction is less than 1 or greater than 1
HR5.	use ratio notation, including reduction to simplest form
HR6.	divide a given quantity into two parts in a given part:part or part:whole ratio; divide a given quantity into more than two parts; express the division of a quantity into two parts as a ratio; apply ratio to real contexts and problems (such as those involving conversion, comparison, scaling, mixing, concentrations)
HR7.	express a multiplicative relationship between two quantities as a ratio or a fraction
HR8.	understand and use proportion as equality of ratios
HR9.	relate ratios to fractions and to linear functions
HR10.	define percentage as 'number of parts per hundred'; interpret percentages and percentage changes as a fraction or a decimal, and interpret these multiplicatively; express one quantity as a percentage of another; compare two quantities using percentages; work with percentages greater than 100%; solve problems involving percentage change, including percentage increase / decrease and original value problems, and simple interest including in financial mathematics
HR11.	solve problems involving direct and inverse proportion, including graphical and algebraic representations
HR12.	use compound units such as speed, rates of pay, unit pricing, density and pressure
HR13.	compare lengths, areas and volumes using ratio notation; make links to similarity (including trigonometric ratios) and scale factors
HR14.	understand that X is inversely proportional to Y is equivalent to X is proportional to $\frac{1}{Y}$; **construct and** interpret equations that describe direct and inverse proportion
HR15.	interpret the gradient of a straight line graph as a rate of change; recognise and interpret graphs that illustrate direct and inverse proportion
HR16.	**interpret the gradient at a point on a curve as the instantaneous rate of change; apply the concepts of average and instantaneous rate of change (gradients of chords and tangents) in numerical, algebraic and graphical contexts**
HR17.	set up, solve and interpret the answers in growth and decay problems, including compound interest **and work with general iterative processes**

Geometry and measures

Properties and constructions

HG1.	use conventional terms and notations: points, lines, vertices, edges, planes, parallel lines, perpendicular lines, right angles, polygons, regular polygons and polygons with reflection and/or rotation symmetries; use the standard conventions for labelling and referring to the sides and angles of triangles; draw diagrams from written description
HG2.	use the standard ruler and compass constructions (perpendicular bisector of a line segment, constructing a perpendicular to a given line from/at a given point, bisecting a given angle); use these to construct given figures and solve loci problems; know that the perpendicular distance from a point to a line is the shortest distance to the line
HG3.	apply the properties of angles at a point, angles at a point on a straight line, vertically opposite angles; understand and use alternate and corresponding angles on parallel lines; derive and use the sum of angles in a triangle (e.g. to deduce and use the angle sum in any polygon, and to derive properties of regular polygons)
HG4.	derive and apply the properties and definitions of: special types of triangles, quadrilaterals (including square, rectangle, parallelogram, trapezium, kite and rhombus) and other plane figures using appropriate language
HG5.	use the basic congruence criteria for triangles (SSS, SAS, ASA, RHS)
HG6.	apply angle facts, triangle congruence, similarity and properties of quadrilaterals to conjecture and derive results about angles and sides, including Pythagoras' Theorem and the fact that the base angles of an isosceles triangle are equal, and use known results to obtain simple proofs
HG7.	identify, describe and construct congruent and similar shapes, including on coordinate axes, by considering rotation, reflection, translation and enlargement (including fractional **and negative** scale factors)
HG8.	**describe the changes and invariance achieved by combinations of rotations, reflections and translations**
HG9.	identify and apply circle definitions and properties, including: centre, radius, chord, diameter, circumference, tangent, arc, sector and segment
HG10.	**apply and prove the standard circle theorems concerning angles, radii, tangents and chords, and use them to prove related results**
HG11.	solve geometrical problems on coordinate axes
HG12.	identify properties of the faces, surfaces, edges and vertices of: cubes, cuboids, prisms, cylinders, pyramids, cones and spheres
HG13.	construct and interpret plans and elevations of 3D shapes

Mensuration and calculation

HG14.	use standard units of measure and related concepts (length, area, volume/capacity, mass, time, money, etc.)
HG15.	measure line segments and angles in geometric figures, including interpreting maps and scale drawings and use of bearings
HG16.	know and apply formulae to calculate: area of squares, rectangles, triangles, parallelograms, trapezia; volume of cuboids and other right prisms (including cylinders)
HG17.	know the formulae: circumference of a circle = $2\pi r = \pi d$, area of a circle = πr^2; calculate: perimeters of 2D shapes, including circles; areas of circles and composite shapes; surface area and volume of spheres, pyramids, cones and composite solids
HG18.	calculate arc lengths, angles and areas of sectors of circles
HG19.	apply the concepts of congruence and similarity, including the relationships between lengths, **areas and volumes** in similar figures
HG20.	know the formulae for: Pythagoras' theorem, $a^2 + b^2 = c^2$, and the trigonometric ratios, $\sin\theta = \frac{opposite}{hypotenuse}$, $\cos\theta = \frac{adjacent}{hypotenuse}$, $\tan\theta = \frac{opposite}{adjacent}$, apply them to find angles and lengths in right-angled triangles in two dimensional figures **and, where possible, general triangles** in two **and three** dimensional figures
HG21.	know the exact values of $\sin\theta$ and $\cos\theta$ for θ = 0°, 30°, 45° , 60° and 90°; know the exact value of $\tan\theta$ for θ = 0°, 30°, 45° and 60°
HG22.	**know and apply the sine rule, $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$, and cosine rule, $a^2 = b^2 + c^2 - 2bc\cos A$, to find unknown lengths and angles**
HG23.	**know and apply Area = $\frac{1}{2}ab\sin C$ to calculate the area, sides or angles of any triangle**

Vectors

HG24	describe translations as 2D vectors
HG25	apply addition and subtraction of vectors, multiplication of vectors by a scalar, and diagrammatic and column representations of vectors; **use vectors to construct geometric arguments and proofs**

Probability

HP1.	record describe and analyse the frequency of outcomes of probability experiments using tables and frequency trees
HP2.	apply ideas of randomness, fairness and equally likely events to calculate expected outcomes of multiple future experiments
HP3.	relate relative expected frequencies to theoretical probability, using appropriate language and the 0 - 1 probability scale
HP4.	apply the property that the probabilities of an exhaustive set of outcomes sum to one; apply the property that the probabilities of an exhaustive set of mutually exclusive events sum to one
HP5.	understand that empirical unbiased samples tend towards theoretical probability distributions, with increasing sample size
HP6.	enumerate sets and combinations of sets systematically, using tables, grids, Venn diagrams and tree diagrams
HP7.	construct theoretical possibility spaces for single and combined experiments with equally likely outcomes and use these to calculate theoretical probabilities
HP8.	calculate the probability of independent and dependent combined events, including using tree diagrams and other representations, and know the underlying assumptions
HP9.	**calculate and interpret conditional probabilities through representation using expected frequencies with two-way tables, tree diagrams and Venn diagrams**

Statistics

HS1.	infer properties of populations or distributions from a sample, whilst knowing the limitations of sampling
HS2.	designing and criticising questions for a questionnaire, including notion of fairness.
HS3.	interpret and construct tables, charts and diagrams, including frequency tables, bar charts, pie charts and pictograms for categorical data, vertical line charts for ungrouped discrete numerical data, tables and line graphs for time series data and know their appropriate use
HS4.	**construct and interpret diagrams for grouped discrete data and continuous data, i.e. histograms with equal and unequal class intervals and cumulative frequency graphs, and know their appropriate use**
HS5.	interpret, analyse and compare the distributions of data sets from univariate empirical distributions through: • appropriate graphical representation involving discrete, continuous and grouped data, **including box plots** • appropriate measures of central tendency (median, mean, mode and modal class) and spread (range, including consideration of outliers**, quartiles and inter-quartile range**)
HS6.	apply statistics to describe a population
HS7.	use and interpret scatter graphs of bivariate data; recognise correlation and know that it does not indicate causation; draw estimated lines of best fit; make predictions; interpolate and extrapolate apparent trends whilst knowing the dangers of so doing

3 ASSESSMENT

3.1 Assessment objectives and weightings

Below are the assessment objectives for this specification.
There are no weightings prescribed for individual components.

Assessment Objectives		Weighting	
		Higher	Foundation
AO1	**Use and apply standard techniques** Learners should be able to: • accurately recall facts, terminology and definitions • use and interpret notation correctly • accurately carry out routine procedures or set tasks requiring multi-step solutions	40%	50%
AO2	**Reason, interpret and communicate mathematically** Learners should be able to: • 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 • assess the validity of an argument and critically evaluate a given way of presenting information Where problems require learners to 'use and apply standard techniques' or to independently 'solve problems' a proportion of those marks should be attributed to the corresponding assessment objective.	30%	25%
AO3	**Solve problems within mathematics and in other contexts** Learners should be able to: • 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 the given problem • evaluate methods used and results obtained • evaluate solutions to identify how they may have been affected by assumptions made Where problems require learners to 'use and apply standard techniques' or to 'reason, interpret and communicate mathematically' a proportion of those marks should be attributed to the corresponding assessment objective.	30%	25%

3.2 Use of formulae and calculators

Formulae: advice is provided at **Appendix A** in relation to (1) the formulae included in the subject content that learners are expected to know and memorise as these will not be given in the examination, (2) the formulae which, although not specified in the content, should be derived or informally understood by learners, (3) the formulae that will be provided in the examination and that learners should be able to use but do not need to memorise.

Calculators: advice is provided at **Appendix B** in relation to the characteristics of calculators that are permitted for use in Component 2 at both foundation and higher tiers.

4 TECHNICAL INFORMATION

4.1 Making entries

This is a linear qualification in which all assessments must be taken at the end of the course. Assessment opportunities will be available in the summer and November series each year, until the end of the life of this specification. Summer 2017 will be the first assessment opportunity.

Where candidates wish to re-sit the qualification, all components must be re-taken.

The November series is only available to candidates who are re-sitting the qualification. Candidates who take an assessment in the November series must have reached at least the age of 16 on or before 31 August in the same calendar year as the assessment.

The entry code appears below.

WJEC Eduqas GCSE Mathematics (foundation tier): C300PF
WJEC Eduqas GCSE Mathematics (higher tier): C300PH

The current edition of our *Entry Procedures and Coding Information* gives up-to-date entry procedures.

4.2 Grading, awarding and reporting

GCSE qualifications are reported on a nine point scale from 1 to 9, where 9 is the highest grade.

A learner who takes higher tier assessments will be awarded a grade within the range of 4 to 9, or be unclassified. However, if the mark achieved by such a learner is a small number of marks below the 3/4 grade boundary that learner may be awarded a grade 3.

A learner who takes foundation tier assessments will be awarded a grade within the range of 1 to 5, or be unclassified.

APPENDIX A

Formula pages

1. Formulae included in the subject content. Learners are **expected to know** these formulae; they must **not** be given in the assessment.

The quadratic formula

The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Circumference and area of a circle

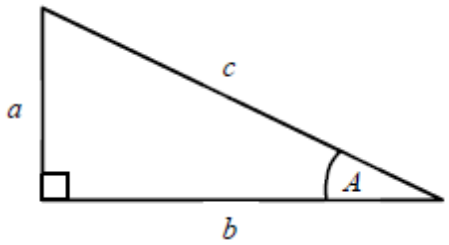
Where r is the radius and d is the diameter:

Circumference of a circle = $2\pi r = \pi d$
Area of a circle = πr^2

Pythagoras's theorem

In any right-angled triangle, where a, b and c are the length of the sides and c is the hypotenuse:

$$a^2 + b^2 = c^2$$



Trigonometry formulae

In any right-angled triangle ABC, where a, b and c are the length of the sides and c is the hypotenuse:

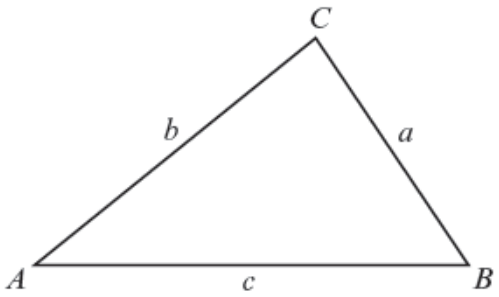
$$\sin A = \frac{a}{c}, \cos A = \frac{b}{c}, \tan A = \frac{a}{b}$$

In any triangle ABC, where a, b and c are the length of the sides

$$\text{Sine rule: } \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\text{Cosine rule: } a^2 = b^2 + c^2 - 2bc\cos A$$

$$\text{Area} = \frac{1}{2}ab\sin C$$



2. <u>The following formulae are not specified in the content but should be derived or informally understood by learners.
These formulae must **not** be given in the examination.</u>

Perimeter, area, surface area and volume formulae

Where a and b are the lengths of the parallel sides and h is their perpendicular separation:

$$\text{Area of a trapezium} = \frac{1}{2}(a+b)h$$

$$\text{Volume of a prism} = \text{area of cross section} \times \text{length}$$

Compound interest

Where P is the principal amount, r is the interest rate over a given period and n is number of times that the interest is compounded:

$$\text{Total accrued} = P\left(1+\frac{r}{100}\right)^n$$

Probability

Where $P(A)$ is the probability of outcome A and $P(B)$ is the probability of outcome B:

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$
$$P(A \text{ and } B) = P(A \text{ given } B)P(B)$$

3. Formulae that learners should be able to use, but need not memorise.
These can be given in the exam, either in the relevant question, or in a list from which learners select and apply as appropriate.

Perimeter, area, surface area and volume formulae

Where r is the radius of the sphere or cone, l is the slant height of a cone and h is the perpendicular height of a cone:

$$\text{Curved surface area of a cone} = \pi rl$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

Kinematics formulae

Where a is constant acceleration, u is initial velocity, v is final velocity, s is displacement from the position when $t = 0$ and t is time taken:

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

APPENDIX B

Use of calculators

In the examination the following rules will apply.

Calculators must be:	**Calculators must not:**
• of a size suitable for use on the desk; • either battery or solar powered; and • free of lids, cases and covers which have printed instructions or formulas.	• be designed or adapted to offer any of these facilities: o language translators, o symbolic algebra manipulation, o symbolic differentiation or integration, o communication with other machines or the internet. • be borrowed from another learner during an examination for any reason. • have retrievable information stored in them including, (but not limited to): o databanks, o dictionaries, o mathematical formulae, o text.