AQA

GCSE MATHEMATICS

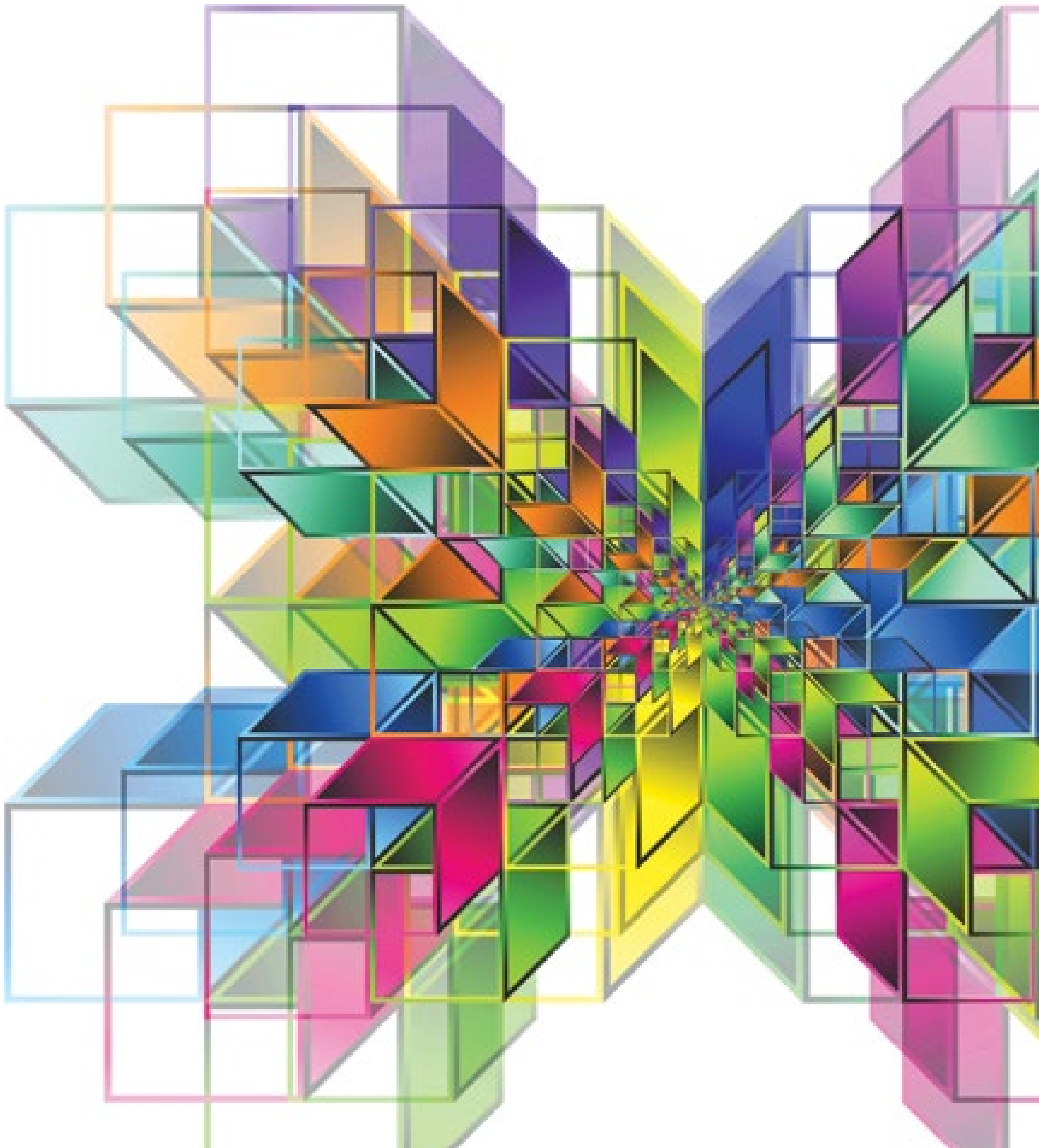
(8300)

Specification

For teaching from September 2015 onwards

For exams in May/June 2017 onwards

Version 1.0 12 September 2014



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1 Introduction

1.1 Why choose AQA for GCSE Mathematics

Maths is for everyone. It is diverse, engaging and essential in equipping students with the right skills to reach their future destination, whatever that may be. At AQA, we design qualifications and support to enable students to engage with, explore, enjoy and succeed in maths. By putting students at the heart of everything we do, our aim is to support teachers to shape what success in maths looks like for every student.

Our question papers are designed with students in mind. We're committed to ensuring that students are settled early in our exams and have the best possible opportunity to demonstrate their knowledge and understanding of maths, to ensure they achieve the results they deserve.

You can find out about all our Mathematics qualifications at aqa.org.uk/maths

1.2 Support and resources to help you teach

We know that support and resources are vital for your teaching and that you have limited time to find or develop good quality materials. So we've worked with experienced teachers to provide you with a range of resources that will help you confidently plan, teach and prepare for exams.

Teaching resources

We have too many Mathematics resources to list here so visit aqa.org.uk/8300 to see them all. They include:

- route maps to allow you to plan how to deliver the specification in the way that will best suit you and your students
- teaching guidance to outline clearly the possible scope of teaching and learning
- lesson plans and homework sheets tailored to this specification
- tests and assessments that will allow you to measure the development of your students as they work through the content
- textbooks that are approved by AQA
- training courses to help you deliver AQA Mathematics qualifications
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Preparing for exams

Visit aqa.org.uk/8300 for everything you need to prepare for our exams, including:

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You can talk directly to the Mathematics subject team

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2 Specification at a glance

Subject content

1 [Number]
2 [Algebra]
3 [Ratio, proportion and rates of change]
4 [Geometry and measures]
5 [Probability]
6 [Statistics]

Assessments

GCSE Mathematics has a Foundation tier (grades 1 – 5) and a Higher tier (grades 4 – 9). Students must take three question papers at the same tier. All question papers must be taken in the same series.

The information in the table below is the same for both Foundation and Higher tiers.

The Subject content section shows the content that is assessed in each tier.

Paper 1: non-calculator	+	Paper 2: calculator	+	Paper 3: calculator
What's assessed Content from any part of the specification may be assessed		**What's assessed** Content from any part of the specification may be assessed		**What's assessed** Content from any part of the specification may be assessed
How it's assessed • written exam: 1 hour 30 minutes • 80 marks • non-calculator • 33⅓% of the GCSE Mathematics assessment		**How it's assessed** • written exam: 1 hour 30 minutes • 80 marks • calculator allowed • 33⅓% of the GCSE Mathematics assessment		**How it's assessed** • written exam: 1 hour 30 minutes • 80 marks • calculator allowed • 33⅓% of the GCSE Mathematics assessment
Questions A mix of question styles, from short, single-mark questions to multi-step problems. The mathematical demand increases as a student progresses through the paper.		**Questions** A mix of question styles, from short, single-mark questions to multi-step problems. The mathematical demand increases as a student progresses through the paper.		**Questions** A mix of question styles, from short, single-mark questions to multi-step problems. The mathematical demand increases as a student progresses through the paper.

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3 Subject content

The subject content of this specification matches that set out in the Department for Education's *Mathematics GCSE subject content and assessment objectives* document. This content is common to all exam boards.

The content has been organised into broad topic areas and given a reference as follows:

- Number references start with N
- Algebra references start with A
- Ratio, proportion and rates of change references start with R
- Geometry and measures references start with G
- Probability references start with P
- Statistics references start with S.

All content can be assessed on any of the three question papers. As such, some questions will draw together elements of maths from different topic areas.

The weighting of the topic areas has been prescribed by Ofqual and is common to all exam boards. The table below shows the approximate weightings of the topic areas for the overall tier of assessment, **not** for each individual question paper.

Topic Area	Foundation Tier (%)	Higher Tier (%)
Number	25	15
Algebra	20	30
Ratio	25	20
Geometry	15	20
Probability and statistics (combined)	15	15

The subject content, aims and learning outcomes, and assessment objectives sections of this specification set out the knowledge, skills and understanding common to all GCSE Mathematics exams.

Within this specification, the assessment will reflect the key concepts of the subject as articulated in the *subject content and assessment objectives* document.

In line with the requirements set by the Department for Education, the expectation is that:

- all students will develop confidence and competence with the content identified in the "basic foundation content" column
- all students will be assessed on the content identified by the "basic foundation content" and "additional foundation content" columns; more highly attaining students will develop confidence and competence with all of this content
- only the more highly attaining students will be assessed on the content identified in the "higher content" column. The highest attaining students will develop confidence and competence with this content.

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

The content in the "basic foundation content" column and "additional foundation content" column can be assessed on Foundation tier question papers.

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All content can be assessed on Higher tier question papers.

Notes are added to exemplify some of the specification references.

In addition to this subject content, students should be able to recall, select and apply mathematical formulae. See the Appendix for a list of the DfE prescribed formulae.

3.1 Number

3.1.1 Structure and calculation

N1

Basic foundation content	Additional foundation content	Higher content only
order positive and negative integers, decimals and fractions use the symbols =, ≠, <, >, ≤, ≥		

Notes: including use of a number line. See also A22

N2

Basic foundation content	Additional foundation content	Higher content only
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 (eg when working with very large or very small numbers, and when calculating with decimals)		

Notes: including questions set in context.

Knowledge and understanding of terms used in household finance, for example profit, loss, cost price, selling price, debit, credit, balance, income tax, VAT and interest rate. See also R9

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N3

Basic foundation content	Additional foundation content	Higher content only
recognise and use relationships between operations, including inverse operations (eg cancellation to simplify calculations and expressions) use conventional notation for priority of operations, including brackets, powers, roots and reciprocals		

N4

Basic foundation content	Additional foundation content	Higher content only
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		

Notes: prime factor decomposition including product of prime factors written in index form.

N5

Basic foundation content	Additional foundation content	Higher content only
apply systematic listing strategies		including use of the product rule for counting

Notes: including using lists, tables and diagrams.

N6

Basic foundation content	Additional foundation content	Higher content only
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

Notes: including square numbers up to 15 × 15

Students should know that 1000 = 10^3 and 1 million = 10^6

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N7

Basic foundation content	Additional foundation content	Higher content only
	calculate with roots, and with integer indices	calculate with fractional indices

N8

Basic foundation content	Additional foundation content	Higher content only
calculate exactly with fractions	calculate exactly with multiples of π	calculate exactly with surds simplify surd expressions involving squares (eg $\sqrt{12} = \sqrt{4 \times 3} = \sqrt{4} \times \sqrt{3} = 2\sqrt{3}$) and rationalise denominators

Notes: see also G17 and G18

N9

Basic foundation content	Additional foundation content	Higher content only
calculate with and interpret standard form $A \times 10^n$, where $1 \leq A < 10$ and n is an integer		

Notes: with and without a calculator.

Interpret calculator displays.

3.1.2 Fractions, decimals and percentages

N10

Basic foundation content	Additional foundation content	Higher content only
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

Notes: including ordering.

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N11

Basic foundation content	Additional foundation content	Higher content only
identify and work with fractions in ratio problems		

Notes: See also R8

N12

Basic foundation content	Additional foundation content	Higher content only
interpret fractions and percentages as operators		

Notes: including interpreting percentage problems using a multiplier. See also R9

3.1.3 Measures and accuracy

N13

Basic foundation content	Additional foundation content	Higher content only
use standard units of mass, length, time, money and other measures (including standard compound measures) using decimal quantities where appropriate		

Notes: know and use metric conversion factors for length, area, volume and capacity.

Imperial/metric conversions will be given in the question.

N14

Basic foundation content	Additional foundation content	Higher content only
estimate answers check calculations using approximation and estimation, including answers obtained using technology		

Notes: including evaluation of results obtained. See also N15

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N15

Basic foundation content	Additional foundation content	Higher content only
round numbers and measures to an appropriate degree of accuracy (eg to a specified number of decimal places or significant figures)	use inequality notation to specify simple error intervals due to truncation or rounding	

Notes: including appropriate rounding for questions set in context.

Students should know not to round values during intermediate steps of a calculation. See also N14

N16

Basic foundation content	Additional foundation content	Higher content only
	apply and interpret limits of accuracy	including upper and lower bounds

3.2 Algebra

3.2.1 Notation, vocabulary and manipulation

A1

Basic foundation content	Additional foundation content	Higher content only
• 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		

Notes: it is expected that answers will be given in their simplest form without an explicit instruction to do so.

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A2

Basic foundation content	Additional foundation content	Higher content only
substitute numerical values into formulae and expressions, including scientific formulae		

Notes: unfamiliar formulae will be given in the question.

See the Appendix for a full list of the prescribed formulae. See also A5

A3

Basic foundation content	Additional foundation content	Higher content only
understand and use the concepts and vocabulary of expressions, equations, formulae, inequalities, terms and factors	to include identities	

Notes: this will be implicitly and explicitly assessed.

A4

Basic foundation content	Additional foundation content	Higher content only
simplify and manipulate algebraic expressions by:	simplify and manipulate algebraic expressions (including those involving surds) by:	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 • simplifying expressions involving sums, products and powers, including the laws of indices		
	• expanding products of two binomials • factorising quadratic expressions of the form $x^2 + bx + c$, including the difference of two squares	• expanding products of two or more binomials • factorising quadratic expressions of the form $ax^2 + bx + c$

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A5

Basic foundation content	Additional foundation content	Higher content only
understand and use standard mathematical formulae rearrange formulae to change the subject		

Notes: including use of formulae from other subjects in words and using symbols.

See the Appendix for a full list of the prescribed formulae. See also A2

A6

Basic foundation content	Additional foundation content	Higher content only
	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	to include proofs

A7

Basic foundation content	Additional foundation content	Higher content only
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'

Notes: understanding and use of $f(x)$, $fg(x)$ and $f^{-1}(x)$ notation is expected at Higher tier.

3.2.2 Graphs

A8

Basic foundation content	Additional foundation content	Higher content only
work with coordinates in all four quadrants		

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A9

Basic foundation content	Additional foundation content	Higher content only
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	use the form $y = mx + c$ to identify perpendicular lines

A10

Basic foundation content	Additional foundation content	Higher content only
identify and interpret gradients and intercepts of linear functions graphically and algebraically		

A11

Basic foundation content	Additional foundation content	Higher content only
	identify and interpret roots, intercepts and turning points of quadratic functions graphically	
	deduce roots algebraically	deduce turning points by completing the square

Notes: including the symmetrical property of a quadratic. See also A18

A12

Basic foundation content	Additional foundation content	Higher content only
recognise, sketch and interpret graphs of linear functions and quadratic functions	including simple cubic functions and the reciprocal function $y = \frac{1}{x}$ with $x \neq 0$	including 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

Notes: see also G21

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A13

Basic foundation content	Additional foundation content	Higher content only
		sketch translations and reflections of a given function

A14

Basic foundation content	Additional foundation content	Higher content only
plot and interpret 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	including reciprocal graphs	including exponential graphs

Notes: including problems requiring a graphical solution. See also A15

A15

Basic foundation content	Additional foundation content	Higher content only
		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

Notes: see also A14, R14 and R15

A16

Basic foundation content	Additional foundation content	Higher content only
		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

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3.2.3 Solving equations and inequalities

A17

Basic foundation content	Additional foundation content	Higher content only
solve linear equations in one unknown algebraically find approximate solutions using a graph	including those with the unknown on both sides of the equation	

Notes: including use of brackets.

A18

Basic foundation content	Additional foundation content	Higher content only
	solve quadratic equations algebraically by factorising	including those that require rearrangement including completing the square and by using the quadratic formula
	find approximate solutions using a graph	

Notes: see also A11

A19

Basic foundation content	Additional foundation content	Higher content only
	solve two simultaneous equations in two variables (linear/linear) algebraically find approximate solutions using a graph	including linear/quadratic

A20

Basic foundation content	Additional foundation content	Higher content only
		find approximate solutions to equations numerically using iteration

Notes: including the use of suffix notation in recursive formulae.

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A21

Basic foundation content	Additional foundation content	Higher content only
	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	

Notes: including the solution of geometrical problems and problems set in context.

A22

Basic foundation content	Additional foundation content	Higher content only
	solve linear inequalities in one variable	solve linear inequalities in one or two variable(s), and quadratic inequalities in one variable
	represent the solution set on a number line	represent the solution set on a number line, using set notation and on a graph

Notes: students should know the conventions of an open circle on a number line for a strict inequality and a closed circle for an included boundary. See also N1

In graphical work the convention of a dashed line for strict inequalities and a solid line for an included inequality will be required.

3.2.4 Sequences

A23

Basic foundation content	Additional foundation content	Higher content only
generate terms of a sequence from either a term-to-term or a position-to-term rule		

Notes: including from patterns and diagrams.

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A24

Basic foundation content	Additional foundation content	Higher content only
recognise and use sequences of triangular, square and cube numbers and simple arithmetic progressions	including Fibonacci-type sequences, quadratic sequences, and simple geometric progressions (r^n where n is an integer and r is a rational number > 0)	including other sequences including where r is a surd

Notes: other recursive sequences will be defined in the question.

A25

Basic foundation content	Additional foundation content	Higher content only
deduce expressions to calculate the nth term of linear sequences		including quadratic sequences

3.3 Ratio, proportion and rates of change

R1

Basic foundation content	Additional foundation content	Higher content only
change freely between related standard units (eg time, length, area, volume/capacity, mass) and compound units (eg speed, rates of pay, prices) in numerical contexts	compound units (eg density, pressure) in numerical and algebraic contexts	

R2

Basic foundation content	Additional foundation content	Higher content only
use scale factors, scale diagrams and maps		

Notes: including geometrical problems.

R3

Basic foundation content	Additional foundation content	Higher content only
express one quantity as a fraction of another, where the fraction is less than 1 or greater than 1		

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R4

Basic foundation content	Additional foundation content	Higher content only
use ratio notation, including reduction to simplest form		

R5

Basic foundation content	Additional foundation content	Higher content only
divide a given quantity into two parts in a given part : part or part : whole ratio 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)		

Notes: including better value or best-buy problems.

R6

Basic foundation content	Additional foundation content	Higher content only
express a multiplicative relationship between two quantities as a ratio or a fraction		

R7

Basic foundation content	Additional foundation content	Higher content only
understand and use proportion as equality of ratios		

R8

Basic foundation content	Additional foundation content	Higher content only
relate ratios to fractions and to linear functions		

Notes: see also N11, R14

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R9

Basic foundation content	Additional foundation content	Higher content only
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		

Notes: see also N2, N12

R10

Basic foundation content	Additional foundation content	Higher content only
solve problems involving direct and inverse proportion, including graphical and algebraic representations		

R11

Basic foundation content	Additional foundation content	Higher content only
use compound units such as speed, rates of pay, unit pricing	use compound units such as density and pressure	

Notes: including making comparisons.

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R12

Basic foundation content	Additional foundation content	Higher content only
compare lengths, areas and volumes using ratio notation scale factors	make links to similarity (including trigonometric ratios)	

Notes: see also G19, G20

R13

Basic foundation content	Additional foundation content	Higher content only
	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	construct and interpret equations that describe direct and inverse proportion

R14

Basic foundation content	Additional foundation content	Higher content only
	interpret the gradient of a straight-line graph as a rate of change recognise and interpret graphs that illustrate direct and inverse proportion	

Notes: see also A15, R8

R15

Basic foundation content	Additional foundation content	Higher content only
		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

Notes: see also A15

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R16

Basic foundation content	Additional foundation content	Higher content only
	set up, solve and interpret the answers in growth and decay problems, including compound interest	and work with general iterative processes

3.4 Geometry and measures

3.4.1 Properties and constructions

G1

Basic foundation content	Additional foundation content	Higher content only
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		

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G2

Basic foundation content	Additional foundation content	Higher content only
	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	

Notes: including constructing an angle of 60°.

G3

Basic foundation content	Additional foundation content	Higher content only
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 (eg to deduce and use the angle sum in any polygon, and to derive properties of regular polygons)		

Notes: colloquial terms such as Z angles are not acceptable and should not be used.

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G4

Basic foundation content	Additional foundation content	Higher content only
derive and apply the properties and definitions of: special types of quadrilaterals, including square, rectangle, parallelogram, trapezium, kite and rhombus and triangles and other plane figures using appropriate language		

Notes: including knowing names and properties of isosceles, equilateral, scalene, right-angled, acute-angled, obtuse-angled triangles. Including knowing names and using the polygons: pentagon, hexagon, octagon and decagon.

G5

Basic foundation content	Additional foundation content	Higher content only
	use the basic congruence criteria for triangles (SSS, SAS, ASA, RHS)	

G6

Basic foundation content	Additional foundation content	Higher content only
	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	

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G7

Basic foundation content	Additional foundation content	Higher content only
identify, describe and construct congruent and similar shapes, including on coordinate axes, by considering rotation, reflection, translation and enlargement	including fractional scale factors	including negative scale factors

G8

Basic foundation content	Additional foundation content	Higher content only
		describe the changes and invariance achieved by combinations of rotations, reflections and translations

Notes: including using column vector notation for translations. See also G24

G9

Basic foundation content	Additional foundation content	Higher content only
identify and apply circle definitions and properties, including: centre, radius, chord, diameter, circumference	including: tangent, arc, sector and segment	

G10

Basic foundation content	Additional foundation content	Higher content only
		apply and prove the standard circle theorems concerning angles, radii, tangents and chords, and use them to prove related results

Notes: including angle subtended by an arc at the centre is equal to twice the angle subtended at any point on the circumference, angle subtended at the circumference by a semicircle is 90°, angles in the same segment are equal, opposite angles in a cyclic quadrilateral sum to 180°, tangent at any point on a circle is perpendicular to the radius at that point, tangents from an external point are equal in length, the perpendicular from the centre to a chord bisects the chord, alternate segment theorem.

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G11

Basic foundation content	Additional foundation content	Higher content only
solve geometrical problems on coordinate axes		

G12

Basic foundation content	Additional foundation content	Higher content only
identify properties of the faces, surfaces, edges and vertices of: cubes, cuboids, prisms, cylinders, pyramids, cones and spheres		

G13

Basic foundation content	Additional foundation content	Higher content only
interpret plans and elevations of 3D shapes	construct and interpret plans and elevations of 3D shapes	

3.4.2 Mensuration and calculation

G14

Basic foundation content	Additional foundation content	Higher content only
use standard units of measure and related concepts (length, area, volume/capacity, mass, time, money etc.)		

G15

Basic foundation content	Additional foundation content	Higher content only
measure line segments and angles in geometric figures, including interpreting maps and scale drawings and use of bearings		

Notes: including the eight compass point bearings and three-figure bearings.

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G16

Basic foundation content	Additional foundation content	Higher content only
know and apply formulae to calculate: area of triangles, parallelograms, trapezia; volume of cuboids and other right prisms (including cylinders)		

G17

Basic foundation content	Additional foundation content	Higher content only
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	

Notes: including frustums.

Solutions in terms of π may be asked for. See also N8, G18

G18

Basic foundation content	Additional foundation content	Higher content only
	calculate arc lengths, angles and areas of sectors of circles	

Notes: see also N8, G17

G19

Basic foundation content	Additional foundation content	Higher content only
	apply the concepts of congruence and similarity, including the relationships between lengths in similar figures	including the relationships between lengths, areas and volumes in similar figures

Notes: see also R12

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G20

Basic foundation content	Additional foundation content	Higher content only
	know the formulae for: Pythagoras' theorem, $a^2 + b^2 = c^2$ and the trigonometric ratios, $\sin\theta = \frac{opposite}{hypotenuse}$, $\cos\theta = \frac{adjacent}{hypotenuse}$ and $\tan\theta = \frac{opposite}{adjacent}$	
	apply them to find angles and lengths in right-angled triangles in two dimensional figures	apply them to find angles and lengths in right-angled triangles and, where possible, general triangles in two and three dimensional figures

Notes: see also R12

G21

Basic foundation content	Additional foundation content	Higher content only
	know the exact values of $\sin\theta$ and $\cos\theta$ for $\theta = 0°, 30°, 45°, 60°$ and $90°$ know the exact value of $\tan\theta$ for $\theta = 0°, 30°, 45°, 60°$	

Notes: see also A12

G22

Basic foundation content	Additional foundation content	Higher content only
		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

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G23

Basic foundation content	Additional foundation content	Higher content only
		know and apply Area = $\frac{1}{2}ab\sin C$ to calculate the area, sides or angles of any triangle

3.4.3 Vectors

G24

Basic foundation content	Additional foundation content	Higher content only
describe translations as 2D vectors		

Notes: see also G8

G25

Basic foundation content	Additional foundation content	Higher content only
	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

3.5 Probability

P1

Basic foundation content	Additional foundation content	Higher content only
record, describe and analyse the frequency of outcomes of probability experiments using tables and frequency trees		

Notes: probabilities should be written as fractions, decimals or percentages.

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P2

Basic foundation content	Additional foundation content	Higher content only
apply ideas of randomness, fairness and equally likely events to calculate expected outcomes of multiple future experiments		

P3

Basic foundation content	Additional foundation content	Higher content only
relate relative expected frequencies to theoretical probability, using appropriate language and the 0 to 1 probability scale		

P4

Basic foundation content	Additional foundation content	Higher content only
apply the property that the probabilities of an exhaustive set of outcomes sum to 1 apply the property that the probabilities of an exhaustive set of mutually exclusive events sum to 1		

P5

Basic foundation content	Additional foundation content	Higher content only
	understand that empirical unbiased samples tend towards theoretical probability distributions, with increasing sample size	

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P6

Basic foundation content	Additional foundation content	Higher content only
enumerate sets and combinations of sets systematically, using tables, grids, Venn diagrams	including using tree diagrams	

P7

Basic foundation content	Additional foundation content	Higher content only
construct theoretical possibility spaces for single and combined experiments with equally likely outcomes and use these to calculate theoretical probabilities		

P8

Basic foundation content	Additional foundation content	Higher content only
	calculate the probability of independent and dependent combined events, including using tree diagrams and other representations, and know the underlying assumptions	

Notes: including knowing when to add and when to multiply two or more probabilities.

P9

Basic foundation content	Additional foundation content	Higher content only
		calculate and interpret conditional probabilities through representation using expected frequencies with two-way tables, tree diagrams and Venn diagrams

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3.6 Statistics

S1

Basic foundation content	Additional foundation content	Higher content only
	infer properties of populations or distributions from a sample, whilst knowing the limitations of sampling	

S2

Basic foundation content	Additional foundation content	Higher content only
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, and know their appropriate use	including tables and line graphs for time series data	

Notes: including choosing suitable statistical diagrams.

S3

Basic foundation content	Additional foundation content	Higher content only
		construct and interpret diagrams for grouped discrete data and continuous data, ie histograms with equal and unequal class intervals and cumulative frequency graphs, and know their appropriate use

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S4

Basic foundation content	Additional foundation content	Higher content only
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)		• including quartiles and inter-quartile range

Notes: students should know and understand the terms: primary data, secondary data, discrete data and continuous data.

S5

Basic foundation content	Additional foundation content	Higher content only
apply statistics to describe a population		

S6

Basic foundation content	Additional foundation content	Higher content only
use and interpret scatter graphs of bivariate data		
recognise correlation	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	

Notes: students should know and understand the terms: positive correlation, negative correlation, no correlation, weak correlation and strong correlation.

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4 Scheme of assessment

Find past papers and mark schemes, and specimen papers for new courses, on our website at aqa.org.uk/pastpapers

This specification is designed to be taken over two years with all assessments taken at the end of the course.

GCSE exams and certification for this specification are available for the first time in May/June 2017 and then every May/June and November for the life of the specification.

This is a linear qualification. In order to achieve the award, students must complete all exams in November or May/June in a single year. All assessments must be taken in the same series. November entries will only be available to students who were at least 16 on the previous 31 August. See Resits and shelf life in the General administration section for November entry restrictions.

All GCSE exams in mathematics must include questions that allow students to draw on elements from within and across different topic areas, and questions that allow students to provide extended responses.

All materials are available in English only.

4.1 Aims and learning outcomes

Courses based on this specification in mathematics should provide a broad, coherent, satisfying and worthwhile course of study. They should encourage students to develop confidence in, and a positive attitude towards, mathematics and to recognise the importance of mathematics in their own lives and to society. They should also provide a strong mathematical foundation for students who go on to study mathematics at a higher level post-16.

Courses based on this specification in mathematics should enable students to:

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

Students should be aware that mathematics can be used to develop models of real situations and that these models may be more or less effective depending on how the situation has been simplified and the assumptions that have been made. Students should also be able to recall, select and apply mathematical formulae.

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4.2 Assessment objectives

Assessment objectives (AOs) are set by Ofqual and are the same across all GCSE Mathematics specifications and all exam boards.

The exams will assess the following AOs in the context of the content set out in the Subject content section.

- AO1: Use and apply standard techniques
  Students 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.
- AO2: Reason, interpret and communicate mathematically
  Students 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.
- AO3: Solve problems within mathematics and in other contexts
  Students 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.

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Weighting of assessment objectives for GCSE Mathematics

Foundation tier

Assessment objectives (AOs)	Component weightings (approx %)			Overall weighting (approx %)
	Paper 1	Paper 2	Paper 3	
AO1	40–60	40–60	40–60	50
AO2	15–35	15–35	15–35	25
AO3	15–35	15–35	15–35	25
Overall weighting of components	33⅓	33⅓	33⅓	100

Higher tier

Assessment objectives (AOs)	Component weightings (approx %)			Overall weighting (approx %)
	Paper 1	Paper 2	Paper 3	
AO1	30–50	30–50	30–50	40
AO2	20–40	20–40	20–40	30
AO3	20–40	20–40	20–40	30
Overall weighting of components	33⅓	33⅓	33⅓	100

4.3 Assessment weightings

The marks awarded on the papers will be scaled to meet the weighting of the components. Students' final marks will be calculated by adding together the scaled marks for each component. Grade boundaries will be set using this total scaled mark. The scaling and total scaled marks are shown in the table below.

Component	Maximum raw mark	Scaling factor	Maximum scaled mark
Paper 1	80	x1	80
Paper 2	80	x1	80
Paper 3	80	x1	80
		Total scaled mark:	240

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5 General administration

You can find information about all aspects of administration, as well as all the forms you need, at aqa.org.uk/examsadmin

5.1 Entries and codes

You only need to make one entry for each qualification – this will cover all the question papers and certification.

Every specification is given a national discount (classification) code by the Department for Education (DfE), which indicates its subject area.

If a student takes two specifications with the same discount code, Further and Higher Education providers are likely to take the view that they have only achieved one of the two qualifications. Please check this before your students start their course. Where two specifications have the same discount code, only one of them will be counted for the purpose of the School and College Performance tables – the DfE's rules on 'early entry' will determine which one.

Students can only be entered for one tier in any exam series.

Qualification title	Tier	AQA entry code	DfE discount code
AQA Level 1/2 GCSE in Mathematics	Foundation	8300F	RB1
	Higher	8300H	RB1

This specification complies with Ofqual's:

- *General Conditions of Recognition* that apply to all regulated qualifications
- GCSE qualification conditions that apply to all GCSEs
- GCSE Mathematics conditions that apply to all GCSEs in this subject.

The Ofqual qualification accreditation number (QAN) is 601/4608/4.

5.2 Overlaps with other qualifications

There is some overlap betweeen this specification and AQA's GCSE Statistics and with AQA's Functional Skills qualifications in Mathematics at Level 1 and Level 2. Some overlap also exists with this specification and AQA's Level 2 Certificate in Further Mathematics.

5.3 Awarding grades and reporting results

The qualification will be graded on a nine-point scale: 1 to 9 – where 9 is the best grade.

Students who fail to reach the minimum standard for grade 1 will be recorded as U (unclassified) and will not receive a qualification certificate.

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5.4 Re-sits and shelf life

Students can re-sit the qualification as many times as they wish, within the shelf life of the qualification. November entries will only be available to students who were at least 16 on the previous 31 August, as set out in Ofqual's GCSE subject level conditions and requirements for Mathematics, and we will make reasonable checks to ensure schools and colleges comply with this requirement.

5.5 Previous learning and prerequisites

Students are not required to have taken any particular qualifications before taking this course. Any requirements for entry to a course based on this specification are at the discretion of schools and colleges.

However, as mathematics is taught in progressively greater depth over the course of Key Stage 3 and Key Stage 4, GCSE outcomes may reflect or build upon subject content that is typically taught at Key Stage 3. There is no expectation that teaching of such content should be repeated during the GCSE course where it has already been taught effectively at an earlier stage.

5.6 Access to assessment: diversity and inclusion

General qualifications are designed to prepare students for a wide range of occupations and further study. Therefore our qualifications must assess a wide range of competences.

The subject criteria have been assessed to see if any of the skills or knowledge required present any possible difficulty to any students, whatever their ethnic background, religion, sex, age, disability or sexuality. If any difficulties were encountered, the criteria were reviewed again to make sure that tests of specific competences were only included if they were important to the subject.

As members of the Joint Council for Qualifications (JCQ) we participate in the production of the JCQ document *Access Arrangements and Reasonable Adjustments: General and Vocational qualifications*. We follow these guidelines when assessing the needs of individual students who may require an access arrangement or reasonable adjustment. This document is published on the JCQ website at jcq.org.uk

Students with disabilities and special needs

We can make arrangements for disabled students and students with special needs to help them access the assessments, as long as the competences being tested are not changed. Access arrangements must be agreed **before** the assessment. For example, a Braille paper would be a reasonable adjustment for a Braille reader but not for a student who does not read Braille.

We are required by the Equality Act 2010 to make reasonable adjustments to remove or lessen any disadvantage that affects a disabled student.

If you have students who need access arrangements or reasonable adjustments, you can apply using the Access arrangements online service at aqa.org.uk/eaqa

Special consideration

We can give special consideration to students who have been disadvantaged at the time of the exam through no fault of their own – for example a temporary illness, injury or serious problem such as the death of a relative. We can only do this **after** the exam.

Your exams officer should apply online for special consideration at aqa.org.uk/eaqa

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For more information and advice about access arrangements, reasonable adjustments and special consideration please see aqa.org.uk/access or email accessarrangementsqueries@aqa.org.uk

5.7 Working with AQA for the first time

If your school or college has not previously offered any AQA specification, you need to register as an AQA centre to offer our exams to your students. Find out how at aqa.org.uk/becomeacentre

If your school or college is new to this specification, please let us know by completing an Intention to enter form. The easiest way to do this is via e-AQA at aqa.org.uk/eaqa

5.8 Private candidates

A private candidate is someone who enters for exams through an AQA-approved school or college but is not enrolled as a student there.

If you are a private candidate you may be self-taught, home-schooled or have private tuition, either with a tutor or through a distance learning organisation. You must be based in the UK.

If you have any queries as a private candidate, you can:

- speak to the exams officer at the school or college where you intend to take your exams
- visit our website at aqa.org.uk/examsadmin
- email: privatecandidates@aqa.org.uk

5.9 Materials for use in the examination

For all question papers, students are expected to have mathematical instruments available for use in the exam. These instruments are defined as:

- pencil (for use in diagrams only)
- ruler
- pair of compasses
- protractor.

A calculator is required for use in paper 2 and paper 3 of this specification. Details of the requirements for calculators can be found in the Joint Council for General Qualifications document *Instructions for conducting examinations*. For GCSE Mathematics exams, calculators should have the following as a minimum requirement:

- four rules and square
- square root
- reciprocal and power function
- brackets
- a memory facility
- appropriate exponential, trigonometric and statistical functions.

For the purposes of this specification, a ‘calculator’ is any electronic or mechanical device which may be used for the performance of mathematical computations. However, only those permissible in the guidance in the *Instructions for conducting examinations* are allowed in GCSE mathematics examinations.

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6 Appendix: mathematical formulae

1. Students are expected to know the following formulae included in the subject content; they will **not** be given in the exam. Refer to the Subject content section to determine the tier at which these formulae could be used.

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' theorem

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

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

cosine rule: $a^2 = b^2 + c^2 - 2bc \cos A$

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

2. Students are expected to know the following formulae or be able to derive them; they will **not** be given in the exam. Refer to the Subject content section to determine the tier at which these formulae could be used.

Perimeter, area, surface area and volume formulae

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

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

Volume of a prism = area of cross section x length

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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:

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. Students are **not** expected to memorise the following formulae; they will be given in the exam in the relevant question. Refer to the Subject content section to determine the tier at which these formulae could be used.

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:

Curved surface area of a cone = πrl

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

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

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:

$v = u + at$

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

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

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Get help and support

Visit our website for information, guidance, support and resources at aqa.org.uk/8300

You can talk directly to the Mathematics subject team

E: maths@aqa.org.uk

T: 0161 957 3852

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