# GCSE
# MATHEMATICS
(8300)

**Specification**
For teaching from September 2015 onwards
For exams in May/June 2017 onwards

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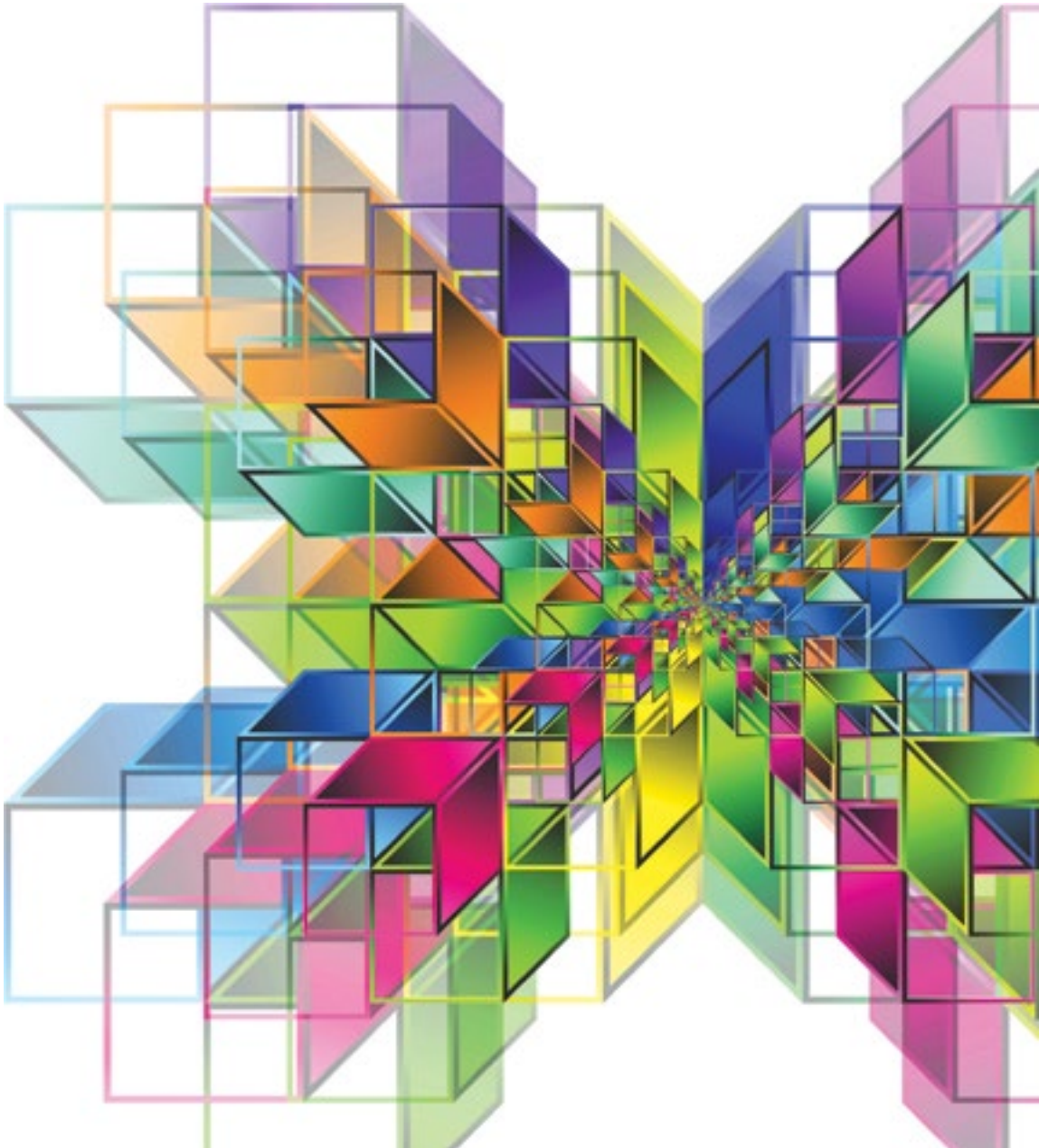

# Contents

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- We will write to you if there are significant changes to this specification.

# 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.

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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
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You can talk directly to the Mathematics subject team

E: maths@aqa.org.uk

T: 0161 957 3852

# 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**<br>Content from any part of the specification may be assessed | **What's assessed**<br>Content from any part of the specification may be assessed | **What's assessed**<br>Content from any part of the specification may be assessed |
| **How it's assessed**<br>• written exam: 1 hour 30 minutes<br>• 80 marks<br>• non-calculator<br>• 33⅓% of the GCSE Mathematics assessment | **How it's assessed**<br>• written exam: 1 hour 30 minutes<br>• 80 marks<br>• calculator allowed<br>• 33⅓% of the GCSE Mathematics assessment | **How it's assessed**<br>• written exam: 1 hour 30 minutes<br>• 80 marks<br>• calculator allowed<br>• 33⅓% of the GCSE Mathematics assessment |
| **Questions**<br>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**<br>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**<br>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. |

# 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.

**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<br><br>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<br><br>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

## 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)<br><br>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 = $10^6$

### 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 $\pi$ | calculate exactly with surds<br><br>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.

### 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<br><br>check calculations using approximation and estimation, including answers obtained using technology | | |

**Notes**: including evaluation of results obtained. See also N15

### 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:<br>• $ab$ in place of $a \times b$<br>• $3y$ in place of $y + y + y$ and $3 \times y$<br>• $a^2$ in place of $a \times a$, $a^3$ in place of $a \times a \times a$, $a^2b$ in place of $a \times a \times b$<br>• $\frac{a}{b}$ in place of $a \div b$<br>• coefficients written as fractions rather than as decimals<br>• brackets | | |

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

## 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<br>• multiplying a single term over a bracket<br>• taking out common factors<br>• simplifying expressions involving sums, products and powers, including the laws of indices | | |
| | • expanding products of two binomials<br>• factorising quadratic expressions of the form $x^2 + bx + c$, including the difference of two squares | • expanding products of two or more binomials<br>• factorising quadratic expressions of the form $ax^2 + bx + c$ |

### A5

| Basic foundation content | Additional foundation content | Higher content only |
|---|---|---|
| understand and use standard mathematical formulae<br><br>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'<br><br>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 | | |

## 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<br><br>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

## 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<br><br>find the equation of a tangent to a circle at a given point |

## 3.2.3 Solving equations and inequalities

### A17

| Basic foundation content | Additional foundation content | Higher content only |
|---|---|---|
| solve linear equations in one unknown algebraically<br><br>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<br><br>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<br><br>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.

### A21

| Basic foundation content | Additional foundation content | Higher content only |
|---|---|---|
| | translate simple situations or procedures into algebraic expressions or formulae<br><br>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.

### 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<br>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 $n$th 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)<br>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 | | |

## 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<br><br>express the division of a quantity into two parts as a ratio<br><br>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

## R9

| Basic foundation content | Additional foundation content | Higher content only |
|---|---|---|
| define percentage as 'number of parts per hundred'<br><br>interpret percentages and percentage changes as a fraction or a decimal, and interpret these multiplicatively<br><br>express one quantity as a percentage of another<br><br>compare two quantities using percentages<br><br>work with percentages greater than 100%<br><br>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.

## R12

| Basic foundation content | Additional foundation content | Higher content only |
|---|---|---|
| compare lengths, areas and volumes using ratio notation<br><br>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<br><br>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<br><br>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

### 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<br><br>use the standard conventions for labelling and referring to the sides and angles of triangles<br><br>draw diagrams from written description | | |

## 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)<br><br>use these to construct given figures and solve loci problems<br><br>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<br><br>understand and use alternate and corresponding angles on parallel lines<br><br>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.

## 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<br><br>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 | |

## 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.

### 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.

## G16

| Basic foundation content | Additional foundation content | Higher content only |
|---|---|---|
| know and apply formulae to calculate: area of triangles, parallelograms, trapezia;<br><br>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 = $2\pi r = \pi d$<br><br>area of a circle = $\pi r^2$<br><br>calculate perimeters of 2D shapes, including circles<br><br>areas of circles and composite shapes | surface area and volume of spheres, pyramids, cones and composite solids | |

**Notes**: including frustums.

Solutions in terms of $\pi$ 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

## 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 $90°$<br><br>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, $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$<br><br>and cosine rule,<br><br>$a^2 = b^2 + c^2 - 2bc\cos A$<br><br>to find unknown lengths and angles |

### G23

| Basic foundation content | Additional foundation content | Higher content only |
|---|---|---|
| | | know and apply<br>Area = $\frac{1}{2}ab\sin C$<br>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.

## 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<br><br>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 | |

## 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 |

# 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 |

## 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<br><br>draw estimated lines of best fit<br><br>make predictions<br><br>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.

# 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.

## 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.

## 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 |

# 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.

## 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

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.

# 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 $= \pi r^2$

**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

**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 = $\pi rl$

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:

$v = u + at$

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

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

# 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

aqa.org.uk



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