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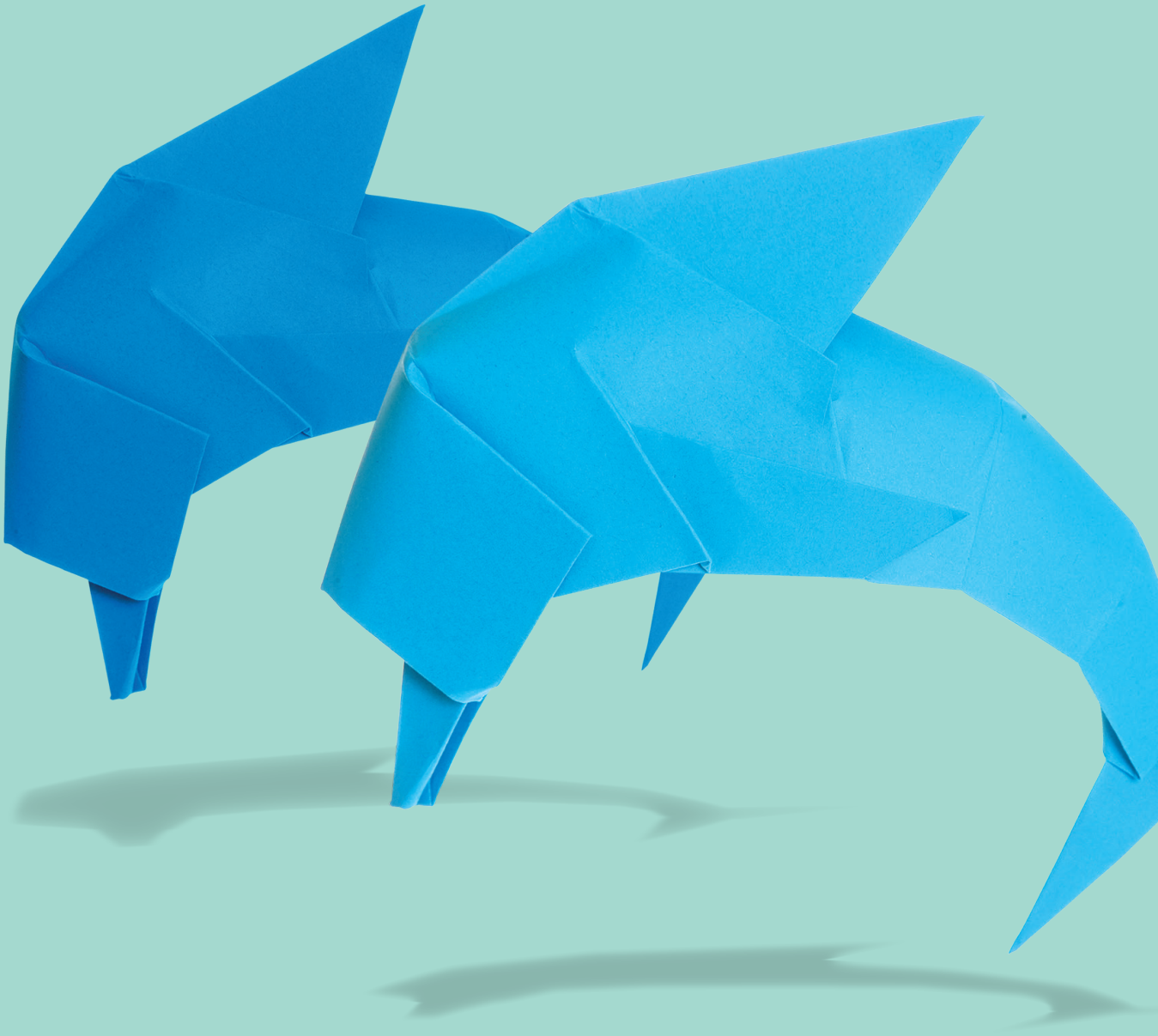
GCSE (9-1) Mathematics



Specification

Pearson Edexcel Level 1/Level 2 GCSE (9-1) in Mathematics (1MA1)

First teaching from September 2015

First certification from June 2017 | Issue 2

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Specification

First certification 2017

Issue 2

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From Pearson's Expert Panel for World Class Qualifications

"The reform of the qualifications system in England is a profoundly important change to the education system. Teachers need to know that the new qualifications will assist them in helping their learners make progress in their lives.

When these changes were first proposed we were approached by Pearson to join an 'Expert Panel' that would advise them on the development of the new qualifications.

We were chosen, either because of our expertise in the UK education system, or because of our experience in reforming qualifications in other systems around the world as diverse as Singapore, Hong Kong, Australia and a number of countries across Europe.

We have guided Pearson through what we judge to be a rigorous qualification development process that has included:

- Extensive international comparability of subject content against the highest-performing jurisdictions in the world
- Benchmarking assessments against UK and overseas providers to ensure that they are at the right level of demand
- Establishing External Subject Advisory Groups, drawing on independent subject-specific expertise to challenge and validate our qualifications
- Subjecting the final qualifications to scrutiny against the DfE content and Ofqual accreditation criteria in advance of submission.

Importantly, we have worked to ensure that the content and learning is future oriented. The design has been guided by what is called an 'Efficacy Framework', meaning learner outcomes have been at the heart of this development throughout.

We understand that ultimately it is excellent teaching that is the key factor to a learner's success in education. As a result of our work as a panel we are confident that we have supported the development of qualifications that are outstanding for their coherence, thoroughness and attention to detail and can be regarded as representing world-class best practice."

Sir Michael Barber (Chair)

Chief Education Advisor, Pearson plc

Bahram Bekhradnia

President, Higher Education Policy Institute

Dame Sally Coates

Principal, Burlington Danes Academy

Professor Robin Coningham

Pro-Vice Chancellor, University of Durham

Dr Peter Hill

Former Chief Executive ACARA

Professor Sing Kong Lee

Director, National Institute of Education, Singapore

Professor Jonathan Osborne

Stanford University

Professor Dr Ursula Renold

Federal Institute of Technology, Switzerland

Professor Bob Schwartz

Harvard Graduate School of Education

Introduction

The Pearson Edexcel Level 1/Level 2 GCSE (9 to 1) in Mathematics is designed for use in schools and colleges. It is part of a suite of GCSE qualifications offered by Pearson.

Purpose of the specification

This specification sets out:

- the objectives of the qualification
- any other qualification that a student must have completed before taking the qualification
- any prior knowledge and skills that the student is required to have before taking the qualification
- any other requirements that a student must have satisfied before they will be assessed or before the qualification will be awarded
- the knowledge and understanding that will be assessed as part of the qualification
- the method of assessment and any associated requirements relating to it
- the criteria against which a student's level of attainment will be measured (such as assessment criteria).

Rationale

The Pearson Edexcel Level 1/Level 2 GCSE (9–1) in Mathematics meets the following purposes, which fulfil those defined by the Office of Qualifications and Examinations Regulation (Ofqual) for GCSE qualifications in their *GCSE (9 to 1) Qualification Level Conditions and Requirements* document, published in April 2014.

The purposes of this qualification are to:

- provide evidence of students' achievements against demanding and fulfilling content, to give students the confidence that the mathematical skills, knowledge and understanding that they will have acquired during the course of their study are as good as that of the highest performing jurisdictions in the world
- provide a strong foundation for further academic and vocational study and for employment, to give students the appropriate mathematical skills, knowledge and understanding to help them progress to a full range of courses in further and higher education. This includes Level 3 mathematics courses as well as Level 3 and undergraduate courses in other disciplines such as biology, geography and psychology, where the understanding and application of mathematics is crucial
- provide (if required) a basis for schools and colleges to be held accountable for the performance of all of their students.

Qualification aims and objectives

The aims and objectives of the Pearson Edexcel Level 1/Level 2 GCSE (9–1) in Mathematics are to enable students to:

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

The context for the development of this qualification

All our qualifications are designed to meet our World Class Qualification Principles[1] and our ambition to put the student at the heart of everything we do.

We have developed and designed this qualification by:

- reviewing other curricula and qualifications to ensure that it is comparable with those taken in high-performing jurisdictions overseas
- consulting with key stakeholders on content and assessment, including learned bodies, subject associations, higher-education academics, teachers and employers to ensure this qualification is suitable for a UK context
- reviewing the legacy qualification and building on its positive attributes.

This qualification has also been developed to meet criteria stipulated by Ofqual in their documents *GCSE (9 to 1) Qualification Level Conditions and Requirements* and *GCSE Subject Level Conditions and Requirements for Mathematics*, published in April 2014.

[1] Pearson's World Class Qualification principles ensure that our qualifications are:

- **demanding**, through internationally benchmarked standards, encouraging deep learning and measuring higher-order skills
- **rigorous**, through setting and maintaining standards over time, developing reliable and valid assessment tasks and processes, and generating confidence in end users of the knowledge, skills and competencies of certified students
- **inclusive**, through conceptualising learning as continuous, recognising that students develop at different rates and have different learning needs, and focusing on progression
- **empowering**, through promoting the development of transferable skills, see *Appendix 1*.

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Qualification at a glance

Pearson Edexcel Level 1/Level 2 GCSE (9–1) in Mathematics

- The assessments will cover the following content headings:
  1 Number
  2 Algebra
  3 Ratio, proportion and rates of change
  4 Geometry and measures
  5 Probability
  6 Statistics
- Two tiers are available: Foundation and Higher (content is defined for each tier).
- Each student is permitted to take assessments in either the Foundation tier or Higher tier.
- The qualification consists of three equally-weighted written examination papers at either Foundation tier or Higher tier.
- All three papers must be at the same tier of entry and must be completed in the same assessment series.
- Paper 1 is a non-calculator assessment and a calculator is allowed for Paper 2 and Paper 3.
- Each paper is 1 hour and 30 minutes long.
- Each paper has 80 marks.
- The content outlined for each tier will be assessed across all three papers.
- Each paper will cover all Assessment Objectives, in the percentages outlined for each tier. (See the section *Breakdown of Assessment Objectives* for more information.)
- Each paper has a range of question types; some questions will be set in both mathematical and non-mathematical contexts.
- See *Appendix 3* for a list of formulae that can be provided in the examination (as part of the relevant question).
- Two assessment series available per year: May/June and November*.
- First assessment series: May/June 2017.
- The qualification will be graded and certificated on a nine-grade scale from 9 to 1 using the total mark across all three papers where 9 is the highest grade. Individual papers are not graded.
- Foundation tier: grades 1 to 5.
- Higher tier: grades 4 to 9 (grade 3 allowed).

*See the *November resits* section for restrictions on November entry.

Knowledge, skills and understanding

Overview

The table below illustrates the topic areas covered in this qualification and the topic area weightings for the assessment of the Foundation tier and the assessment of the Higher tier.

Tier	Topic area	Weighting
Foundation	Number	22 - 28%
	Algebra	17 - 23%
	Ratio, Proportion and Rates of change	22 - 28%
	Geometry and Measures	12 - 18%
	Statistics & Probability	12 - 18%
Higher	Number	12 - 18%
	Algebra	27 - 33%
	Ratio, Proportion and Rates of change	17 - 23%
	Geometry and Measures	17 - 23%
	Statistics & Probability	12 - 18%

Content

- All students will develop confidence and competence with the content identified by standard type.
- All students will be assessed on the content identified by the standard and the underlined type; 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 by **bold** type. The highest attaining students will develop confidence and competence with the bold content.
- The distinction between standard, underlined and **bold** type applies to the content statements only, not to the Assessment Objectives or to the mathematical formulae.

Foundation tier

Foundation tier students will be assessed on content identified by the standard and underlined type. Foundation tier students will **not** be assessed on content identified by **bold** type. Foundation tier content is on *pages 3–9*.

Higher tier

Higher tier students will be assessed on **all** the content which is identified by the standard, underlined and **bold** type. Higher tier content is on *pages 10–18*.

Foundation tier knowledge, skills and understanding

1. Number

Structure and calculation

What students need to learn:

N1 order positive and negative integers, decimals and fractions; use the symbols $=, \neq, <, >, \leq, \geq$

N2 apply the four operations, including formal written methods, to integers, decimals and simple fractions (proper and improper), and mixed numbers – all both positive and negative; understand and use place value (e.g. when working with very large or very small numbers, and when calculating with decimals)

N3 recognise and use relationships between operations, including inverse operations (e.g. cancellation to simplify calculations and expressions); use conventional notation for priority of operations, including brackets, powers, roots and reciprocals

N4 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

N5 apply systematic listing strategies

N6 use positive integer powers and associated real roots (square, cube and higher), recognise powers of 2, 3, 4, 5

N7 calculate with roots, and with integer indices

N8 calculate exactly with fractions and multiples of π

N9 calculate with and interpret standard form $A \times 10^n$, where $1 \leq A < 10$ and n is an integer

Fractions, decimals and percentages

What students need to learn:

N10 work interchangeably with terminating decimals and their corresponding fractions (such as 3.5 and $\frac{7}{2}$ or 0.375 or $\frac{3}{8}$)

N11 identify and work with fractions in ratio problems

N12 interpret fractions and percentages as operators

Measures and accuracy

What students need to learn:

N13 use standard units of mass, length, time, money and other measures (including standard compound measures) using decimal quantities where appropriate

N14 estimate answers; check calculations using approximation and estimation, including answers obtained using technology

N15 round numbers and measures to an appropriate degree of accuracy (e.g. to a specified number of decimal places or significant figures); use inequality notation to specify simple error intervals due to truncation or rounding

N16 apply and interpret limits of accuracy

2. Algebra

Notation, vocabulary and manipulation

What students need to learn:

A1 use and interpret algebraic manipulation, 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

A2 substitute numerical values into formulae and expressions, including scientific formulae

A3 understand and use the concepts and vocabulary of expressions, equations, formulae, identities, inequalities, terms and factors

A4 simplify and manipulate algebraic expressions (including those involving surds) by:

- collecting like terms
- multiplying a single term over a bracket
- taking out common factors
- expanding products of two binomials
- factorising quadratic expressions of the form $x^2 + bx + c$, including the difference of two squares;
- simplifying expressions involving sums, products and powers, including the laws of indices

A5 understand and use standard mathematical formulae; rearrange formulae to change the subject

A6 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

A7 where appropriate, interpret simple expressions as functions with inputs and outputs.

Graphs

What students need to learn:

A8 work with coordinates in all four quadrants

A9 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

A10 identify and interpret gradients and intercepts of linear functions graphically and algebraically

A11 identify and interpret roots, intercepts, turning points of quadratic functions graphically; deduce roots algebraically

A12 recognise, sketch and interpret graphs of linear functions, quadratic functions, simple cubic functions, the reciprocal function $y = \frac{1}{x}$ with $x \neq 0$

A14 plot and interpret graphs (including reciprocal graphs) and graphs of non-standard functions in real contexts to find approximate solutions to problems such as simple kinematic problems involving distance, speed and acceleration

Solving equations and inequalities

What students need to learn:

A17 solve linear equations in one unknown algebraically (including those with the unknown on both sides of the equation); find approximate solutions using a graph

A18 solve quadratic equations algebraically by factorising; find approximate solutions using a graph

A19 solve two simultaneous equations in two variables (linear/linear algebraically; find approximate solutions using a graph

A21 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

A22 solve linear inequalities in one variable; represent the solution set on a number line

Sequences

What students need to learn:

A23 generate terms of a sequence from either a term-to-term or a position-to-term rule

A24 recognise and use sequences of triangular, square and cube numbers, simple arithmetic progressions, Fibonacci type sequences, quadratic sequences, and simple geometric progressions (r^n where n is an integer, and r is a rational number > 0)

A25 deduce expressions to calculate the nth term of linear sequences

3. Ratio, proportion and rates of change

What students need to learn:

R1 change freely between related standard units (e.g. time, length, area, volume/capacity, mass) and compound units (e.g. speed, rates of pay, prices, density, pressure) in numerical and algebraic contexts

R2 use scale factors, scale diagrams and maps

R3 express one quantity as a fraction of another, where the fraction is less than 1 or greater than 1

R4 use ratio notation, including reduction to simplest form

R5 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)

R6 express a multiplicative relationship between two quantities as a ratio or a fraction

R7 understand and use proportion as equality of ratios

R8 relate ratios to fractions and to linear functions

R9 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

R10 solve problems involving direct and inverse proportion, including graphical and algebraic representations

R11 use compound units such as speed, rates of pay, unit pricing, density and pressure

R12 compare lengths, areas and volumes using ratio notation; make links to similarity (including trigonometric ratios) and scale factors

R13 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

R14 interpret the gradient of a straight line graph as a rate of change; recognise and interpret graphs that illustrate direct and inverse proportion

R16 set up, solve and interpret the answers in growth and decay problems, including compound interest

4. Geometry and measures

Properties and constructions

What students need to learn:

G1 use conventional terms and notation: 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

G2 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

G3 apply the properties of angles at a point, angles at a point on a straight line, vertically opposite angles; understand and use alternate and corresponding angles on parallel lines; derive and use the sum of angles in a triangle (e.g. to deduce and use the angle sum in any polygon, and to derive properties of regular polygons)

G4 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

G5 use the basic congruence criteria for triangles (SSS, SAS, ASA, RHS)

G6 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 identify, describe and construct congruent and similar shapes, including on coordinate axes, by considering rotation, reflection, translation and enlargement (including fractional scale factors)

G9 identify and apply circle definitions and properties, including: centre, radius, chord, diameter, circumference, tangent, arc, sector and segment

G11 solve geometrical problems on coordinate axes

G12 identify properties of the faces, surfaces, edges and vertices of: cubes, cuboids, prisms, cylinders, pyramids, cones and spheres

G13 construct and interpret plans and elevations of 3D shapes

Mensuration and calculation

What students need to learn:

G14 use standard units of measure and related concepts (length, area, volume/capacity, mass, time, money, etc.)

G15 measure line segments and angles in geometric figures, including interpreting maps and scale drawings and use of bearings

G16 know and apply formulae to calculate: area of triangles, parallelograms, trapezia; volume of cuboids and other right prisms (including cylinders)

G17 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

G18 calculate arc lengths, angles and areas of sectors of circles

G19 apply the concepts of congruence and similarity, including the relationships between lengths, in similar figures

G20 know the formulae for: Pythagoras' theorem $a^2 + b^2 = c^2$, and the trigonometric ratios, $\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$, $\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$ and $\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$; apply them to find angles and lengths in right-angled triangles in two-dimensional figures

G21 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 $\theta = 0°, 30°, 45°$ and $60°$

Vectors

What students need to learn:

G24 describe translations as 2D vectors

G25 apply addition and subtraction of vectors, multiplication of vectors by a scalar, and diagrammatic and column representations of vectors

5. Probability

What students need to learn:

P1 record, describe and analyse the frequency of outcomes of probability experiments using tables and frequency trees

P2 apply ideas of randomness, fairness and equally likely events to calculate expected outcomes of multiple future experiments

P3 relate relative expected frequencies to theoretical probability, using appropriate language and the 0-1 probability scale

P4 apply the property that the probabilities of an exhaustive set of outcomes sum to one; apply the property that the probabilities of an exhaustive set of mutually exclusive events sum to one

P5 understand that empirical unbiased samples tend towards theoretical probability distributions, with increasing sample size

P6 enumerate sets and combinations of sets systematically, using tables, grids, Venn diagrams and tree diagrams

P7 construct theoretical possibility spaces for single and combined experiments with equally likely outcomes and use these to calculate theoretical probabilities

P8 calculate the probability of independent and dependent combined events, including using tree diagrams and other representations, and know the underlying assumptions

6. Statistics

What students need to learn:

S1 infer properties of populations or distributions from a sample, while knowing the limitations of sampling

S2 interpret and construct tables, charts and diagrams, including frequency tables, bar charts, pie charts and pictograms for categorical data, vertical line charts for ungrouped discrete numerical data, tables and line graphs for time series data and know their appropriate use

S4 interpret, analyse and compare the distributions of data sets from univariate empirical distributions through:

- appropriate graphical representation involving discrete, continuous and grouped data
- appropriate measures of central tendency (median, mean, mode and modal class) and spread (range, including consideration of outliers)

S5 apply statistics to describe a population

S6 use and interpret scatter graphs of bivariate data; recognise correlation and know that it does not indicate causation; draw estimated lines of best fit; make predictions; interpolate and extrapolate apparent trends while knowing the dangers of so doing

Higher tier knowledge, skills and understanding

1. Number

Structure and calculation

What students need to learn:

N1 order positive and negative integers, decimals and fractions; use the symbols $=, \neq, <, >, \leq, \geq$

N2 apply the four operations, including formal written methods, to integers, decimals and simple fractions (proper and improper), and mixed numbers – all both positive and negative; understand and use place value (e.g. when working with very large or very small numbers, and when calculating with decimals)

N3 recognise and use relationships between operations, including inverse operations (e.g. cancellation to simplify calculations and expressions); use conventional notation for priority of operations, including brackets, powers, roots and reciprocals

N4 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

N5 apply systematic listing strategies, **including use of the product rule for counting (i.e. if there are m ways of doing one task and for each of these, there are n ways of doing another task, then the total number of ways the two tasks can be done is $m \times n$ ways)**

N6 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**

N7 calculate with roots, and with integer **and fractional** indices

N8 calculate exactly with fractions, **surds** and multiples of π*;*
simplify surd expressions involving squares (e.g. $\sqrt{12} = \sqrt{(4 \times 3)} = \sqrt{4} \times \sqrt{3} = 2\sqrt{3}$) and rationalise denominators

N9 calculate with and interpret standard form $A \times 10^n$, where $1 \leq A < 10$ and n is an integer

Fractions, decimals and percentages

What students need to learn:

N10 work interchangeably with terminating decimals and their corresponding fractions (such as 3.5 and $\frac{7}{2}$ or 0.375 or $\frac{3}{8}$); **change recurring decimals into their corresponding fractions and vice versa**

N11 identify and work with fractions in ratio problems

N12 interpret fractions and percentages as operators

Measures and accuracy

What students need to learn:

N13 use standard units of mass, length, time, money and other measures (including standard compound measures) using decimal quantities where appropriate

N14 estimate answers; check calculations using approximation and estimation, including answers obtained using technology

N15 round numbers and measures to an appropriate degree of accuracy (e.g. to a specified number of decimal places or significant figures); use inequality notation to specify simple error intervals due to truncation or rounding

N16 apply and interpret limits of accuracy, **including upper and lower bounds**

2. Algebra

Notation, vocabulary and manipulation

What students need to learn:

A1 use and interpret algebraic manipulation, 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

A2 substitute numerical values into formulae and expressions, including scientific formulae

A3 understand and use the concepts and vocabulary of expressions, equations, formulae, identities, inequalities, terms and factors

A4 simplify and manipulate algebraic expressions (including those involving surds **and algebraic fractions**) by:

- collecting like terms
- multiplying a single term over a bracket
- taking out common factors
- expanding products of two **or more** binomials
- factorising quadratic expressions of the form $x^2 + bx + c$, including the difference of two squares; **factorising quadratic expressions of the form $ax^2 + bx + c$**
- simplifying expressions involving sums, products and powers, including the laws of indices

A5 understand and use standard mathematical formulae; rearrange formulae to change the subject

A6 know the difference between an equation and an identity; argue mathematically to show algebraic expressions are equivalent, and use algebra to support and construct arguments **and proofs**

A7 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' (the use of formal function notation is expected)**

Graphs

What students need to learn:

A8 work with coordinates in all four quadrants

A9 plot graphs of equations that correspond to straight-line graphs in the coordinate plane; use the form $y = mx + c$ to identify parallel **and perpendicular lines**; find the equation of the line through two given points or through one point with a given gradient

A10 identify and interpret gradients and intercepts of linear functions graphically and algebraically

A11 identify and interpret roots, intercepts, turning points of quadratic functions graphically; deduce roots algebraically **and turning points by completing the square**

A12 recognise, sketch and interpret graphs of linear functions, quadratic functions, simple cubic functions, the reciprocal function $y = \frac{1}{x}$ with $x \neq 0$, **exponential functions $y = k^x$ for positive values of k, and the trigonometric functions (with arguments in degrees) $y = \sin x$, $y = \cos x$ and $y = \tan x$ for angles of any size**

A13 **sketch translations and reflections of a given function**

A14 plot and interpret graphs (including reciprocal graphs **and exponential graphs**) and graphs of non-standard functions in real contexts to find approximate solutions to problems such as simple kinematic problems involving distance, speed and acceleration

A15 **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 (this does not include calculus)**

A16 **recognise and use the equation of a circle with centre at the origin; find the equation of a tangent to a circle at a given point**

Solving equations and inequalities

What students need to learn:

A17 solve linear equations in one unknown algebraically (including those with the unknown on both sides of the equation); find approximate solutions using a graph

A18 solve quadratic equations (**including those that require rearrangement**) algebraically by factorising, **by completing the square and by using the quadratic formula**; find approximate solutions using a graph

A19 solve two simultaneous equations in two variables (linear/linear **or linear/quadratic**) algebraically; find approximate solutions using a graph

A20 **find approximate solutions to equations numerically using iteration**

A21 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

A22 solve linear inequalities in one **or two** variable**(s)**, **and quadratic inequalities in one variable;** represent the solution set on a number line, **using set notation and on a graph**

Sequences

What students need to learn:

A23 generate terms of a sequence from either a term-to-term or a position-to-term rule

A24 recognise and use sequences of triangular, square and cube numbers, simple arithmetic progressions, Fibonacci type sequences, quadratic sequences, and simple geometric progressions (r^n where n is an integer, and r is a rational number > 0 **or a surd**) **and other sequences**

A25 deduce expressions to calculate the nth term of linear **and quadratic** sequences

3. Ratio, proportion and rates of change

What students need to learn:

R1 change freely between related standard units (e.g. time, length, area, volume/capacity, mass) and compound units (e.g. speed, rates of pay, prices, density, pressure) in numerical and algebraic contexts

R2 use scale factors, scale diagrams and maps

R3 express one quantity as a fraction of another, where the fraction is less than 1 or greater than 1

R4 use ratio notation, including reduction to simplest form

R5 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)

R6 express a multiplicative relationship between two quantities as a ratio or a fraction

R7 understand and use proportion as equality of ratios

R8 relate ratios to fractions and to linear functions

R9 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

R10 solve problems involving direct and inverse proportion, including graphical and algebraic representations

R11 use compound units such as speed, rates of pay, unit pricing, density and pressure

R12 compare lengths, areas and volumes using ratio notation; make links to similarity (including trigonometric ratios) and scale factors

R13 understand that X is inversely proportional to Y is equivalent to X is proportional to $\frac{1}{Y}$; **construct and** interpret equations that describe direct and inverse proportion

R14 interpret the gradient of a straight line graph as a rate of change; recognise and interpret graphs that illustrate direct and inverse proportion

R15 **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 (this does not include calculus)**

R16 set up, solve and interpret the answers in growth and decay problems, including compound interest **and work with general iterative processes**

4. Geometry and measures

Properties and constructions

What students need to learn:

G1 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

G2 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

G3 apply the properties of angles at a point, angles at a point on a straight line, vertically opposite angles; understand and use alternate and corresponding angles on parallel lines; derive and use the sum of angles in a triangle (e.g. to deduce and use the angle sum in any polygon, and to derive properties of regular polygons)

G4 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

G5 use the basic congruence criteria for triangles (SSS, SAS, ASA, RHS)

G6 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 identify, describe and construct congruent and similar shapes, including on coordinate axes, by considering rotation, reflection, translation and enlargement (including fractional **and negative** scale factors)

G8 **describe the changes and invariance achieved by combinations of rotations, reflections and translations**

G9 identify and apply circle definitions and properties, including: centre, radius, chord, diameter, circumference, tangent, arc, sector and segment

G10 **apply and prove the standard circle theorems concerning angles, radii, tangents and chords, and use them to prove related results**

G11 solve geometrical problems on coordinate axes

G12 identify properties of the faces, surfaces, edges and vertices of: cubes, cuboids, prisms, cylinders, pyramids, cones and spheres

G13 construct and interpret plans and elevations of 3D shapes

Mensuration and calculation

What students need to learn:

G14 use standard units of measure and related concepts (length, area, volume/capacity, mass, time, money, etc.)

G15 measure line segments and angles in geometric figures, including interpreting maps and scale drawings and use of bearings

G16 know and apply formulae to calculate: area of triangles, parallelograms, trapezia; volume of cuboids and other right prisms (including cylinders)

G17 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

G18 calculate arc lengths, angles and areas of sectors of circles

G19 apply the concepts of congruence and similarity, including the relationships between lengths, **areas and volumes** in similar figures

G20 know the formulae for: Pythagoras' theorem $a^2 + b^2 = c^2$, and the trigonometric ratios, $\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$, $\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$ and $\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$; apply them to find angles and lengths in right-angled triangles **and, where possible, general triangles** in two **and three** dimensional figures

G21 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 $\theta = 0°, 30°, 45°$ and $60°$

G22 **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**

G23 **know and apply Area = $\frac{1}{2}ab\sin C$ to calculate the area, sides or angles of any triangle**

Vectors

What students need to learn:

G24 describe translations as 2D vectors

G25 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**

5. Probability

What students need to learn:

P1 record, describe and analyse the frequency of outcomes of probability experiments using tables and frequency trees

P2 apply ideas of randomness, fairness and equally likely events to calculate expected outcomes of multiple future experiments

P3 relate relative expected frequencies to theoretical probability, using appropriate language and the 0-1 probability scale

P4 apply the property that the probabilities of an exhaustive set of outcomes sum to one; apply the property that the probabilities of an exhaustive set of mutually exclusive events sum to one

P5 understand that empirical unbiased samples tend towards theoretical probability distributions, with increasing sample size

P6 enumerate sets and combinations of sets systematically, using tables, grids, Venn diagrams and tree diagrams

P7 construct theoretical possibility spaces for single and combined experiments with equally likely outcomes and use these to calculate theoretical probabilities

P8 calculate the probability of independent and dependent combined events, including using tree diagrams and other representations, and know the underlying assumptions

P9 **calculate and interpret conditional probabilities through representation using expected frequencies with two-way tables, tree diagrams and Venn diagrams**

6. Statistics

What students need to learn:

S1 infer properties of populations or distributions from a sample, while knowing the limitations of sampling

S2 interpret and construct tables, charts and diagrams, including frequency tables, bar charts, pie charts and pictograms for categorical data, vertical line charts for ungrouped discrete numerical data, tables and line graphs for time series data and know their appropriate use

S3 **construct and interpret diagrams for grouped discrete data and continuous data, i.e. histograms with equal and unequal class intervals and cumulative frequency graphs, and know their appropriate use**

S4 interpret, analyse and compare the distributions of data sets from univariate empirical distributions through:

- appropriate graphical representation involving discrete, continuous and grouped data, **including box plots**
- appropriate measures of central tendency (median, mean, mode and modal class) and spread (range, including consideration of outliers, **quartiles and inter-quartile range**)

S5 apply statistics to describe a population

S6 use and interpret scatter graphs of bivariate data; recognise correlation and know that it does not indicate causation; draw estimated lines of best fit; make predictions; interpolate and extrapolate apparent trends while knowing the dangers of so doing

Assessment

Assessment summary

The Pearson Edexcel Level 1/Level 2 GCSE (9 to 1) in Mathematics is a tiered qualification. There are two tiers:

- Foundation tier - grades 1 to 5 available
- Higher tier grades – 4 to 9 available (grade 3 allowed).

The assessment for each tier of entry consists of three externally-examined papers, all three must be from the same tier of entry. Students must complete all three papers in the same assessment series.

Summary of table of assessment

Paper 1	***Paper code: 1MA1/1F or 1MA1/1H**
• Externally assessed • Availability: May/June and November** • First assessment: May/June 2017	**33.33% of the total GCSE**
Overview of content 1. Number 2. Algebra 3. Ratio, proportion and rates of change 4. Geometry and measures 5. Probability 6. Statistics	
Overview of assessment • Written examination papers with a range of question types • No calculator is allowed • 1 hour and 30 minutes (both Foundation and Higher tier papers) • 80 marks available	

The sample assessment materials can be found in the *Pearson Edexcel Level 1/ Level 2 GCSE (9–1) in Mathematics Sample Assessment Materials* document.

*See *Appendix 2: Codes* for a description of this code and all other codes relevant to this qualification.

**See the *November resits* section for restrictions on November entry.

Paper 2	***Paper code: 1MA1/2F or 1MA1/2H**
• Externally assessed • Availability: May/June and November** • First assessment: May/June 2017	**33.33% of the total GCSE**
Overview of content 1. Number 2. Algebra 3. Ratio, proportion and rates of change 4. Geometry and measures 5. Probability 6. Statistics	
Overview of assessment • Written examination papers with a range of question types • Calculator allowed • 1 hour and 30 minutes (both Foundation and Higher tier papers) • 80 marks available	

*See *Appendix 2: Codes* for a description of this code and all other codes relevant to this qualification.

**See the *November resits* section for restrictions on November entry.

Paper 3	***Paper code: 1MA1/3F or 1MA1/3H**
• Externally assessed • Availability: May/June and November** • First assessment: May/June 2017	**33.33% of the total GCSE**
Overview of content 1. Number 2. Algebra 3. Ratio, proportion and rates of change 4. Geometry and measures 5. Probability 6. Statistics	
Overview of assessment • Written examination papers with a range of question types • Calculator allowed • 1 hour and 30 minutes (both Foundation and Higher tier papers) • 80 marks available	

*See *Appendix 2: Codes* for a description of this code and all other codes relevant to this qualification.

**See the *November resits* section for restrictions on November entry.

Assessment Objectives and weightings

		% Foundation	% Higher
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.	50	40
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. Where problems require students to 'use and apply standard techniques' or to independently 'solve problems' a proportion of those marks should be attributed to the corresponding Assessment Objective.	25	30

		% Foundation	% Higher
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. Where problems require students to 'use and apply standard techniques' or to 'reason, interpret and communicate mathematically' a proportion of those marks should be attributed to the corresponding Assessment Objective.	25	30
	Total	**100%**	**100%**

Breakdown of Assessment Objectives into strands and elements

The strands and elements shown below will be assessed in every examination series, the marks allocated to these strands and elements are shown in the mark schemes.

AO1 Use and apply standard techniques	
Strands	***Elements***
1 – Accurately recall facts, terminology and definitions	1 – accurately recall facts, terminology and definitions Should be no more than 10% of AO1
2 – Use and interpret notation correctly	2 – use and interpret notation correctly
3 – Accurately carry out routine procedures or set tasks requiring multi-step solutions	3a – accurately carry out routine procedures
	3b – accurately carry out set tasks requiring multi-step solutions
AO2 Reason, interpret and communicate mathematically	
Strands	***Elements***
1 – Make deductions, inferences and draw conclusions from mathematical information	1a – make deductions to draw conclusions from mathematical information
	1b – make inferences to draw conclusions from mathematical information
2 – Construct chains of reasoning to achieve a given result	*2 – construct chains of reasoning to achieve a given result*
3 – Interpret and communicate information accurately	3a – interpret information accurately
	3b – communicate information accurately
4 – Present arguments and proofs	4a – present arguments
	4b – present proofs **(higher tier only)**
5 – Assess the validity of an argument and critically evaluate a given way of presenting information	5a – assess the validity of an argument
	5b – critically evaluate a given way of presenting information

AO3 Solve problems within mathematics and in other contexts	
Strands	***Elements***
1 – Translate problems in mathematical or non-mathematical contexts into a process or a series of mathematical processes	1a – translate problems in mathematical contexts into a process
	1b – translate problems in mathematical contexts into a series of processes
	1c – translate problems in non-mathematical contexts into a mathematical process
	1d – translate problems in non-mathematical contexts into a series of mathematical processes
2 – Make and use connections between different parts of mathematics	*2 – make and use connections between different parts of mathematics*
3 – Interpret results in the context of the given problem	*3 – interpret results in the context of the given problem*
4 – Evaluate methods used and results obtained	4a – evaluate methods used
	4b – evaluate results obtained
5 – Evaluate solutions to identify how they may have been affected by assumptions made	*5 – evaluate solutions to identify how they may have been affected by assumptions made*

Entry and assessment information

Student entry

Details of how to enter students for the examinations for this qualification can be found in our *UK Information Manual*. A copy is made available to all examinations officers and is available on our website at: www.edexcel.com/iwantto/Pages/uk-information-manual.aspx

Forbidden combinations and discount code

There are two tiers of entry available. Each student is permitted to take assessments in either the Foundation tier or Higher tier. All three papers must be from the same tier of entry and must be completed in the same assessment series.

Centres should be aware that students who enter for more than one GCSE or other Level 2 qualifications with the same discount code will have only the grade for their 'first entry' counted for the purpose of the School and College Performance Tables (please see *Appendix 2: Codes*). For further information about what constitutes 'first entry' and full details of how this policy is applied, please refer to the DfE website: www.education.gov.uk

Students should be advised that, if they take two GCSEs with the same discount code, schools and colleges to which they wish to progress are very likely to take the view that they have achieved only one of the two GCSEs. The same view may be taken if students take two GCSE or other Level 2 qualifications that have different discount codes but have significant overlap of content. Students or their advisers who have any doubts about their subject combinations should check with the institution to which they wish to progress before embarking on their programmes.

November resits

This qualification is available in both summer and November series. Entry to the November series is restricted. Students who take GCSE Mathematics in a November series must be at least 16 years of age on the preceding 31st August.

Please go to our website www.edexcel.com for further information.

Access arrangements, reasonable adjustments and special consideration

Access arrangements

Access arrangements are agreed before an assessment. They allow students with special educational needs, disabilities or temporary injuries to:

- access the assessment
- show what they know and can do without changing the demands of the assessment.

The intention behind an access arrangement is to meet the particular needs of an individual disabled student without affecting the integrity of the assessment. Access arrangements are the principal way in which awarding bodies comply with the duty under the Equality Act 2010 to make 'reasonable adjustments'.

Access arrangements should always be processed at the start of the course. Students will then know what is available and have the access arrangement(s) in place for assessment.

Reasonable adjustments

The Equality Act 2010 requires an awarding organisation to make reasonable adjustments where a person with a disability would be at a substantial disadvantage in undertaking an assessment. The awarding organisation is required to take reasonable steps to overcome that disadvantage.

A reasonable adjustment for a particular person may be unique to that individual and therefore might not be in the list of available access arrangements.

Whether an adjustment will be considered reasonable will depend on a number of factors, which will include:

- the needs of the student with the disability
- the effectiveness of the adjustment
- the cost of the adjustment; and
- the likely impact of the adjustment on the student with the disability and other students.

An adjustment will not be approved if it involves unreasonable costs to the awarding organisation, timeframes or affects the security or integrity of the assessment. This is because the adjustment is not 'reasonable'.

Special consideration

Special consideration is a post-examination adjustment to a student's mark or grade to reflect temporary injury, illness or other indisposition at the time of the examination/assessment, which has had, or is reasonably likely to have had, a material effect on a candidate's ability to take an assessment or demonstrate his or her level of attainment in an assessment.

Further information

Please see our website for further information about how to apply for access arrangements and special consideration.

For further information about access arrangements, reasonable adjustments and special consideration, please refer to the JCQ website: www.jcq.org.uk.

Equality Act 2010 and Pearson equality policy

Equality and fairness are central to our work. Our equality policy requires all students to have equal opportunity to access our qualifications and assessments, and our qualifications to be awarded in a way that is fair to every student.

We are committed to making sure that:

- students with a protected characteristic (as defined by the Equality Act 2010) are not, when they are undertaking one of our qualifications, disadvantaged in comparison to students who do not share that characteristic
- all students achieve the recognition they deserve for undertaking a qualification and that this achievement can be compared fairly to the achievement of their peers.

You can find details on how to make adjustments for students with protected characteristics in the policy document *Access Arrangements, Reasonable Adjustments and Special Considerations*, which is on our website, www.edexcel.com/Policies.

Awarding and reporting

This qualification will be graded, awarded and certificated to comply with the requirements of the current GCSE and GCE Code of Practice, published by the Office of Qualifications and Examinations Regulation (Ofqual).

The GCSE (9 to 1) qualification will be graded and certificated on a nine-grade scale from 9 to 1 using the total subject mark where 9 is the highest grade. Individual components are not graded. For Foundation tier grades 1 – 5 are available, and for Higher tier grades 4 – 9 are available (grade 3 allowed).

The first certification opportunity for the Pearson Edexcel Level 1/Level 2 GCSE (9–1) in Mathematics will be in 2017.

Students whose level of achievement is below the minimum judged by Pearson to be of sufficient standard to be recorded on a certificate will receive an unclassified U result.

Language of assessment

Assessment of this qualification will be available in English. All student work must be in English.

Grade descriptions

The grade descriptions for this qualification are published by Ofqual and will be available on its website.

Other information

Student recruitment

Pearson follows the JCQ policy concerning recruitment to our qualifications in that:

- they must be available to anyone who is capable of reaching the required standard
- they must be free from barriers that restrict access and progression
- equal opportunities exist for all students.

Prior learning

The qualification builds on the content, knowledge and skills developed in the *Key Stage 3 Programme of Study for Mathematics* (published by the Department for Education in September 2013).

Progression

Students can progress from this qualification to Level 3 qualifications in numerate disciplines, such as:

- Core Mathematics
- GCE Mathematics and GCE Further Mathematics
- GCEs in the sciences
- GCE Geography
- GCE Psychology
- GCE Economics
- other qualifications that require mathematical skills, knowledge and understanding.

There is a clear progression path from Foundation tier to Higher tier within this qualification.

This qualification also supports further training and employment where mathematical skills are required.

Progression from GCSE

This qualification prepares students for progression to further study of mathematics at AS and A level, and also to the study of Core Mathematics. These Level 3 qualifications prepare students for a variety of further progression routes. Students should seek advice about which of these qualifications best prepares them for their intended progression routes.

GCSE Mathematics is a requirement for progression to a wide range of courses at Level 3. Students are expected to continue with their study of GCSE Mathematics after the age of 16 if they have not achieved the qualification at Key Stage 4.

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Appendix 1: Transferable skills

The need for transferable skills

In recent years, higher education institutions and employers have consistently flagged the need for students to develop a range of transferable skills to enable them to respond with confidence to the demands of undergraduate study and the world of work.

The Organisation for Economic Co-operation and Development (OECD) defines skills, or competencies, as 'the bundle of knowledge, attributes and capacities that can be learned and that enable individuals to successfully and consistently perform an activity or task and can be built upon and extended through learning.'[1]

To support the design of our qualifications, the Pearson Research Team selected and evaluated seven global 21st-century skills frameworks. Following on from this process, we identified the National Research Council's (NRC) framework as the most evidence-based and robust skills framework. We adapted the framework slightly to include the Program for International Student Assessment (PISA) ICT Literacy and Collaborative Problem Solving (CPS) Skills.

The adapted National Research Council's framework of skills involves:[2]

Cognitive skills

- **Non-routine problem solving** – expert thinking, metacognition, creativity.
- **Systems thinking** – decision making and reasoning.
- **Critical thinking** – definitions of critical thinking are broad and usually involve general cognitive skills such as analysing, synthesising and reasoning skills.
- **ICT literacy** - access, manage, integrate, evaluate, construct and communicate[3].

Interpersonal skills

- **Communication** – active listening, oral communication, written communication, assertive communication and non-verbal communication.
- **Relationship-building skills** – teamwork, trust, intercultural sensitivity, service orientation, self-presentation, social influence, conflict resolution and negotiation.
- **Collaborative problem solving** – establishing and maintaining shared understanding, taking appropriate action, establishing and maintaining team organisation.

[1] OECD (2012), Better Skills, Better Jobs, Better Lives (2012): http://skills.oecd.org/documents/OECDSkillsStrategyFINALENG.pdf

[2] Koenig, J. A. (2011) Assessing 21st Century Skills: Summary of a Workshop, National Research Council

[3] PISA (2011) The PISA Framework for Assessment of ICT Literacy, PISA

Intrapersonal skills

- **Adaptability** – ability and willingness to cope with the uncertain, handling work stress, adapting to different personalities, communication styles and cultures, and physical adaptability to various indoor and outdoor work environments.
- **Self-management and self-development** – ability to work remotely in virtual teams, work autonomously, be self-motivating and self-monitoring, willing and able to acquire new information and skills related to work.

Transferable skills enable young people to face the demands of further and higher education, as well as the demands of the workplace, and are important in the teaching and learning of this qualification. We will provide teaching and learning materials, developed with stakeholders, to support our qualifications.

Appendix 2: Codes

Type of code	Use of code	Code number
Discount codes	Every qualification is assigned to a discount code indicating the subject area to which it belongs. This code may change. Please refer to our website (www.edexcel.com) for details of any changes.	RB1
National Qualifications Framework (NQF) codes	Each qualification title is allocated an Ofqual National Qualifications Framework (NQF) code. The NQF code is known as a Qualification Number (QN). This is the code that features in the DfE Section 96 and on the LARA as being eligible for 16–18 and 19+ funding, and is to be used for all qualification funding purposes. The QN is the number that will appear on the student's final certification documentation.	The QN for the qualification in this publication is: GCSE (9 to 1) – 601/4700/3
Subject codes	The subject code is used by centres to enter students for a qualification. Centres will need to use the entry codes only when claiming students' qualifications.	GCSE (9–1) – 1MA1
Paper/component code	These codes are provided for reference purposes. Students do not need to be entered for individual papers/components.	Paper 1: 1MA1/1F or 1MA1/1H Paper 2: 1MA1/2F or 1MA1/2H Paper 3: 1MA1/3F or 1MA1/3H

Appendix 3: Mathematical formulae

The following formulae will be provided for students within the relevant examination questions.

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 $= \frac{1}{3}\pi r^2 h$

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