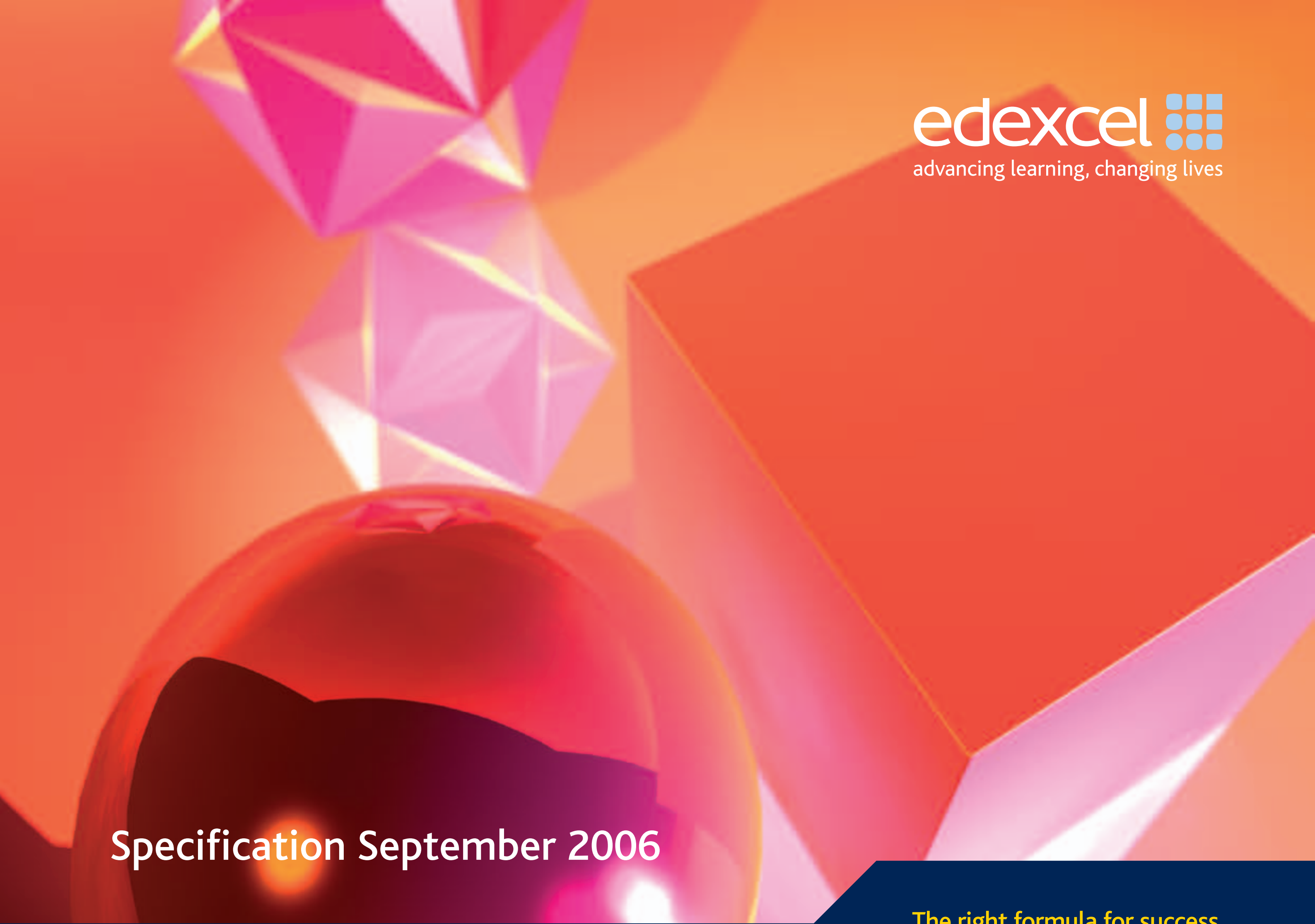

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Specification September 2006

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GCSE Maths

GCSE

Edexcel GCSE in Mathematics (Linear) (2540)

First examination June 2008 First certification June 2008

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Contents

Introduction

This specification offers a traditional, linear route to GCSE Mathematics, comprising of two terminal examination papers and coursework. Centres have the option of teacher-assessed, Edexcel-moderated coursework or Edexcel-marked coursework. Centres preferring a modular route should refer to Edexcel's GCSE in Mathematics B.

Key features

- Accessible assessment for all students
- Choice of options for coursework
- Advice from subject specialists
- Professional development support days
- Coursework tasks and assessment guidelines provided by Edexcel
- Support booklets on all aspects of the examination including coursework tasks, data-handling projects and ICT
- Endorsed textbooks and online resources

Summary of scheme of assessment

	Two parallel examination papers AO1–AO4		Internal assessment Option A Teacher-assessed coursework **or** Option B Edexcel-marked coursework
Weighting	40%	40%	20%
Foundation tier (G to C)	Paper 1 Non-calculator 1 hour 30 minutes	Paper 2 With-calculator 1 hour 30 minutes	Paper 7A or 7B (i) Project (AO4), 10% (ii) Task in context of Number and algebra or Shape, space and measures (AO1), 10%
Higher tier (D to A*)	Paper 3 Non-calculator 1 hour 45 minutes	Paper 4 With-calculator 1 hour 45 minutes	

Summary of the specification content

This GCSE specification has been written against the Key Stage 4 Programme of Study for England. Candidates entering for this GCSE in Northern Ireland and Wales must be taught all the material required by the National Curriculum in those countries.

Availability of external assessment

First assessment of this specification will be in June 2008.

Examinations will be available twice a year, in June and November.

Tiers of entry and papers available in each examination session are shown below:

Examination session	**Tier of entry and papers**	
	Foundation tier Papers 1, 2 and 7A or 7B (coursework)	Higher tier Papers 3, 4 and 7A or 7B (coursework)
June 2008 and all June sessions thereafter	✓	✓
November 2008 and all November sessions thereafter	✓	✓

Progression and prior learning

This specification builds on the content, knowledge and skills developed in the Key Stage 3 Programme of Study for Mathematics as defined by the National Curriculum Orders for England. This course is designed to meet the requirements for Key Stage 4. Grade C in GCSE Mathematics at the Higher tier forms a foundation for further study of the subject at Level 3 of the National Framework.

Forbidden combinations and links with other subjects

Every specification is assigned to a national classification code indicating the subject area to which it belongs.

Centres should be aware that students who enter for more than one GCSE qualification with the same classification code will have only one grade (the highest) counted for the purpose of the school and college performance tables.

The classification code for this specification is 2210.

Candidates entering for this specification may not, in the same series of examinations, enter for any other specification with the title 'Mathematics'.

National Qualifications Framework (NQF) criteria

The specification is based on the common criteria and the GCSE criteria, which are prescribed by the regulatory authorities, including QCA, and are mandatory for all awarding bodies. It is also derived from the prescribed subject criteria for Mathematics.

Specification content

Examination papers 1–4

The subject content for the examination papers is presented in two tiers: Foundation and Higher.

The subject content for the GCSE Foundation tier is drawn from the Foundation tier of the 'The Mathematics National Curriculum for England'.

The subject content for the GCSE Higher tier is drawn from the Higher tier of the 'The Mathematics National Curriculum for England'.

The content references in this specification match those given in 'The Mathematics National Curriculum for England'. When shown in italics in the specification for the Foundation tier, it means that the reference can also be found in the Higher tier in the Key Stage 4 Programme of Study within the National Curriculum document. When shown in italics in the specification for the Higher tier, it means that the reference can also be found in the Foundation tier in the Key Stage 4 Programme of Study within the National Curriculum document.

In both tiers the content is divided into two columns. The left-hand column is the programme of study as defined in 'The Mathematics National Curriculum for England' and the right hand column gives further guidance in the form of examples, also taken from 'The Mathematics National Curriculum for England'.

Material introduced in the Higher tier which is not included in the Foundation tier is shown in **bold**. The examples, in conjunction with the specimen papers, are intended to provide guidance in interpreting the subject content.

Foundation tier

Students should be taught the knowledge, skills and understanding contained in this specification through:

a) extending mental and written calculation strategies and using efficient procedures confidently to calculate with integers, fractions, decimals, percentages, ratio and proportion

b) solving a range of familiar and unfamiliar problems, including those drawn from real-life contexts and other areas of the curriculum

c) activities that provide frequent opportunities to discuss their work, to develop reasoning and understanding and to explain their reasoning and strategies

d) activities focused on developing short chains of deductive reasoning and correct use of the '=' sign

e) activities in which they carry out practical work with geometrical objects, visualise them and work with them mentally

f) practical work in which they draw inferences from data, consider how statistics are used in real life to make informed decisions, and recognise the difference between meaningful and misleading representations of data

g) activities focused on the major ideas of statistics, including using appropriate populations and representative samples, using different measurement scales, using probability as a measure of uncertainty, using randomness and variability, reducing bias in sampling and measuring, and using inference to make decisions

h) substantial use of tasks focused on using appropriate ICT (for example spreadsheets, databases, geometry or graphic packages), using calculators correctly and efficiently, and knowing when not to use a calculator.

Foundation tier

Ma2 Number and algebra

	Content	*Examples*
1	**Using and Applying Number and Algebra**	
	Students should be taught to:	
	Problem solving	
a	select and use suitable problem-solving strategies and efficient techniques to solve numerical and algebraic problems	includes choosing relevant information when some is redundant
	identify what further information may be required in order to pursue a particular line of enquiry and give reasons for following or rejecting particular approaches	
b	break down a complex calculation into simpler steps before attempting to solve it and justify their choice of methods	
c	use algebra to formulate and solve a simple problem — identifying the variable, setting up an equation, solving the equation and interpreting the solution in the context of the problem	
d	make mental estimates of the answers to calculations	
	use checking procedures, including use of inverse operations	
	work to stated levels of accuracy	
	Communicating	
e	interpret and discuss numerical and algebraic information presented in a variety of forms	
f	use notation and symbols correctly and consistently within a given problem	
g	use a range of strategies to create numerical, algebraic or graphical representations of a problem and its solution	
	move from one form of representation to another to get different perspectives on the problem	
h	present and interpret solutions in the context of the original problem	
i	review and justify their choice of mathematical presentation	

	Content	***Examples***
	Reasoning	
j	explore, identify, and use pattern and symmetry in algebraic contexts, investigating whether particular cases can be generalised further, and understanding the importance of a counter-example	using simple codes that substitute numbers for letters
	identify exceptional cases when solving problems	
k	show step-by-step deduction in solving a problem	
l	understand the difference between a practical demonstration and a proof	
m	recognise the importance of assumptions when deducing results	
	recognise the limitations of any assumptions that are made and the effect that varying the assumptions may have on the solution to a problem	
2	**Numbers and the Number System**	
	Students should be taught to:	
	Integers	
a	use their previous understanding of integers and place value to deal with arbitrarily large positive numbers and round them to a given power of 10	
	understand and use positive numbers and negative integers, both as positions and translations on a number line	
	order integers	
a	use the concepts and vocabulary of factor (divisor), multiple, common factor, highest common factor, least common multiple, prime number and prime factor decomposition	identification of prime numbers
	Powers and roots	
b	use the terms square, positive and negative square root, cube and cube root	
	use index notation for squares, cubes and powers of 10	simple integer powers (such as 2^4)
	use index laws for multiplication and division of integer powers	
	express standard index form both in conventional notation and on a calculator display	interpretation of calculator displays

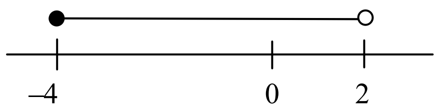
	Content	***Examples***
	Fractions	
c	understand equivalent fractions, simplifying a fraction by cancelling all common factors	
	order fractions by rewriting them with a common denominator	
	Decimals	
d	use decimal notation and recognise that each terminating decimal is a fraction	$0.137 = \frac{137}{1000}$
	order decimals	
d	recognise that recurring decimals are exact fractions, and that some exact fractions are recurring decimals	$\frac{1}{7} = 0.142857142857...$
	Percentages	
e	understand that 'percentage' means 'number of parts per 100' and use this to compare proportions	10% means 10 parts per 100
	interpret percentage as the operator 'so many hundredths of '	15% of Y means $\frac{15}{100} \times Y$
	use percentage in real-life situations	commerce and business, including rate of inflation, VAT and interest rates
	Ratio	
f	use ratio notation, including reduction to its simplest form and its various links to fraction notation	in maps and scale drawings, paper sizes and gears
3	**Calculations**	
	Students should be taught to:	
	Number operations and the relationships between them	
a	add, subtract, multiply and divide integers and then any number	including negative integers
	multiply or divide any number by powers of 10, and any positive number by a number between 0 and 1	
a	find the prime factor decomposition of positive integers	
	understand 'reciprocal' as multiplicative inverse, knowing that any non-zero number multiplied by its reciprocal is 1 (and that zero has no reciprocal, because division by zero is not defined)	

	Content	***Examples***
	multiply and divide by a negative number	
	use index laws to simplify and calculate the value of numerical expressions involving multiplication and division of integer powers	
	use inverse operations	
b	use brackets and the hierarchy of operations	
c	calculate a given fraction of a given quantity, expressing the answer as a fraction	for scale drawings and construction of models, down payments, discounts
	express a given number as a fraction of another	
	add and subtract fractions by writing them with a common denominator	
	perform short division to convert a simple fraction to a decimal	
d	understand and use unit fractions as multiplicative inverses	by thinking of multiplication by $\frac{1}{5}$ as division by 5, or multiplication by $\frac{6}{7}$ as multiplication by 6 followed by division by 7 (or vice versa)
		addition and subtraction of mixed numbers
d	multiply and divide a fraction by an integer, by a unit fraction and by a general fraction	
e	convert simple fractions of a whole to percentages of the whole and vice versa	analysing diets, budgets or the costs of running, maintaining and owning a car
	understand the multiplicative nature of percentages as operators	30% increase on £150 gives a total calculated as £(1.3 × 150) while a 20% discount gives a total calculated as £(0.8 × 150)
f	divide a quantity in a given ratio	share £15 in the ratio of 1:2
	Mental methods	
g	recall all positive integer complements to 100	37 + 63 = 100
	recall all multiplication facts to 10 × 10, and use them to derive quickly the corresponding division facts	
	recall integer squares from 11 × 11 to 15 × 15 and the corresponding square roots, recall the cubes of 2, 3, 4, 5 and 10, and the fraction-to-decimal conversion of familiar simple fractions	$\frac{1}{2}, \frac{1}{4}, \frac{1}{5}, \frac{1}{10}, \frac{1}{100}, \frac{1}{3}, \frac{2}{3}, \frac{1}{8}$

	Content	***Examples***
h	round to the nearest integer and to one significant figure	rounding to a given number of decimal places
	estimate answers to problems involving decimals	
i	develop a range of strategies for mental calculation	
	derive unknown facts from those they know	estimate $\sqrt{85}$
	add and subtract mentally numbers with up to two decimal places	13.76 – 5.21, 20.8 + 12.4
	multiply and divide numbers with no more than one decimal digit, using the commutative, associative, and distributive laws and factorisation where possible, or place value adjustments	14.3×4, $56.7 \div 7$
	Written methods	
j	use standard column procedures for addition and subtraction of integers and decimals	
k	use standard column procedures for multiplication of integers and decimals, understanding where to position the decimal point by considering what happens if they multiply equivalent fractions	
	solve a problem involving division by a decimal (up to 2 decimal places) by transforming it to a problem involving division by an integer	
l	use efficient methods to calculate with fractions, including cancelling common factors before carrying out the calculation, recognising that, in many cases, only a fraction can express the exact answer	
m	solve simple percentage problems, including increase and decrease	simple interest, VAT, annual rate of inflation, income tax, discounts
n	solve word problems about ratio and proportion, including using informal strategies and the unitary method of solution	given that m identical items cost £y, then one item costs £ $^{y}/_{m}$ and n items cost £$(n \times {}^{y}/_{m})$, the number of items that can be bought for £z is $z \times {}^{m}/_{y}$
n	use π in exact calculations, without a calculator	

	Content	***Examples***
	Calculator methods	
o	use calculators effectively and efficiently: know how to enter complex calculations and use function keys for reciprocals, squares and powers	
p	enter a range of calculations, including those involving standard index form and measures	time calculations in which fractions of an hour must be entered as fractions or as decimals
q	understand the calculator display, knowing when to interpret the display, when the display has been rounded by the calculator, and not to round during the intermediate steps of a calculation	in money calculations, or when the display has been rounded by the calculator
4	**Solving Numerical Problems**	
	Students should be taught to:	
a *a*	draw on their knowledge of operations, inverse operations and the relationships between them, and of simple integer powers and their corresponding roots, and of methods of simplification (including factorisation and the use of the commutative, associative and distributive laws of addition, multiplication and factorisation) in order to select and use suitable strategies and techniques to solve problems and word problems, including those involving ratio and proportion, a range of measures and compound measures, metric units, and conversion between metric and common imperial units, set in a variety of contexts	
b	select appropriate operations, methods and strategies to solve number problems, including trial and improvement where a more efficient method to find the solution is not obvious	
b	estimate answers to problems	
	use a variety of checking procedures, including working the problem backwards, and considering whether a result is of the right order of magnitude	
d	give solutions in the context of the problem to an appropriate degree of accuracy, interpreting the solution shown on a calculator display, and recognising limitations on the accuracy of data and measurements	

	Content	***Examples***
5	**Equations, Formulae and Identities**	
	Students should be taught to:	
	Use of symbols	
a	distinguish the different roles played by letter symbols in algebra, using the correct notational conventions for multiplying or dividing by a given number, and knowing that letter symbols represent definite unknown numbers in equations, defined quantities or variables in formulae, general, unspecified and independent numbers in identities, and in functions they define new expressions or quantities by referring to known quantities	$5x + 1 = 16$ V = IR $3x + 2x = 5x$ for all values of x $y = 2x$ $x^2 + 1 = 82$ $(x + 1)^2 = x^2 + 2x + 1$ for all x $y = 2 – 7x$ $y = 1/x$ with $x \neq 0$
b	understand that the transformation of algebraic expressions obeys and generalises the rules of generalised arithmetic	$a(b + c) = ab + ac$
	manipulate algebraic expressions by collecting like terms, by multiplying a single term over a bracket, and by taking out common factors	$x + 5 – 2x – 1 = 4 – x$ $5(2x + 3) = 10x + 15$ $x^2 + 3x = x(x + 3)$ $9x – 3 = 3(3x – 1)$ or $x^2 – 3x = x(x – 3)$
	distinguish in meaning between the words ‘equation’, ‘formula’, ‘identity’ and ‘expression’	
b	expand the product of two linear expressions	$(x + 2)(x – 5) = x^2 – 3x – 10$
	Index notation	
c	use index notation for simple integer powers	
	use simple instances of index laws	$x^2 \times x^3 = x^5$ $x^6 \div x^4 = x^2$
	substitute positive and negative numbers into expressions such as $3x^2 + 4$ and $2x^3$	

	Content	***Examples***
	Equations	
e	set up simple equations	find the angle a in a triangle with angles a, $a + 10$, $a + 20$
	solve simple equations by using inverse operations or by transforming both sides in the same way	$11 - 4x = 2$; $3(2x + 1) = 8$ $2(1 - x) = 6(2 + x)$; $3x^2 = 48$ $3 = 12/x$
	Linear equations	
e	solve linear equations, with integer coefficients, in which the unknown appears on either side or on both sides of the equation	
	solve linear equations that require prior simplification of brackets, including those that have negative signs occurring anywhere in the equation, and those with a negative solution	
	Formulae	
f	use formulae from mathematics and other subjects expressed initially in words and then using letters and symbols	formulae for the area of a triangle, the area enclosed by a circle wage earned = hours worked × rate per hour for area of a triangle or a parallelogram, area enclosed by a circle, volume of a prism find r given that $C = 2\pi r$ find x given $y = mx + c$
	substitute numbers into a formula	convert temperatures between degrees Fahrenheit and degrees Celsius
	derive a formula and change its subject	find the perimeter of a rectangle given its area A and the length l of one side use V = IR to generate a formula for R in terms of V and I
	Inequalities	
d	solve simple linear inequalities in one variable, and represent the solution set on a number line	notation $2 < x \leq 4$ represented on a number  line
	Numerical methods	
m	use systematic trial and improvement to find approximate solutions of equations where there is no simple analytical method of solving them	$x^3 = x - 900$, $\frac{1}{x} = x^2 - 5$

	Content	*Examples*
6	**Sequences, Functions and Graphs**	
	Students should be taught to:	
	Sequences	
a	generate terms of a sequence using term-to-term and position-to-term definitions of the sequence	generating simple sequence of odd or even numbers squared integers and sequences derived from diagrams
	use linear expressions to describe the nth term of an arithmetic sequence, justifying its form by referring to the activity or context from which it was generated	
a	generate common integer sequences (including sequences of odd or even integers, squared integers, powers of 2, powers of 10, triangular numbers)	
	Graphs of linear functions	
b	use the conventions for coordinates in the plane	
	plot points in all four quadrants	
	recognise (when values are given for m and c) that equations of the form $y = mx + c$ correspond to straight-line graphs in the coordinate plane	
	plot graphs of functions in which y is given explicitly in terms of x, or implicitly	$y = 2x + 3$, $x + y = 7$
c	construct linear functions from real-life problems and plot their corresponding graphs	
	discuss and interpret graphs modelling real situations	
	understand that the point of intersection of two different lines in the same two variables that simultaneously describe a real situation is the solution to the simultaneous equations represented by the lines	
	draw line of best fit through a set of linearly related points and find its equation	
	Gradients	
d	find the gradient of lines given by equations of the form $y = mx + c$ (when values are given for m and c)	
	investigate the gradients of parallel lines	

	Content	***Examples***
	Interpret graphical information	
e	interpret information presented in a range of linear and non-linear graphs	graphs describing trends, conversion graphs, distance-time graphs, graphs of height or weight against age, graphs of quantities that vary against time, such as employment distance-time graph for a particle moving with constant speed, the depth of water in a container as it empties
	Quadratic equations	
	generate points and plot graphs of simple quadratic functions, then more general quadratic functions	$y = x^2$; $y = 3x^2 + 4$ $y = x^2 - 2x + 1$
	find approximate solutions of a quadratic equation from the graph of the corresponding quadratic function	

Ma3 Shape, space and measures

	Content	*Examples*
1	**Using and Applying Shape, Space and Measures**	
	Students should be taught to:	
	Problem solving	
a	select problem-solving strategies and resources, including ICT tools, to use in geometrical work, and monitor their effectiveness	
a	consider and explain the extent to which the selections they made were appropriate	
b	select and combine known facts and problem-solving strategies to solve complex problems	
c	identify what further information is needed to solve a geometrical problem	
	break complex problems down into a series of tasks	
c	develop and follow alternative lines of enquiry	
	Communicating	
d	interpret, discuss and synthesise geometrical information presented in a variety of forms	
d	communicate mathematically with emphasis on a critical examination of the presentation and organisation of results, and on effective use of symbols and geometrical diagrams	
f	use geometrical language appropriately	
g	review and justify their choices of mathematics presentation	
	Reasoning	
h	distinguish between practical demonstrations and proofs	
i	apply mathematical reasoning, explaining and justifying inferences and deductions	
j	show step-by-step deduction in solving a geometrical problem	
k	state constraints and give starting points when making deductions	
l	recognise the limitations of any assumptions that are made	
	understand the effects that varying the assumptions may have on the solution	

	Content	Examples
m	identify exceptional cases when solving geometrical problems	
2	**Geometrical Reasoning**	
	Students should be taught to:	
	Angles	
a	recall and use properties of angles at a point, angles on a straight line (including right angles), perpendicular lines, and opposite angles at a vertex	
b	distinguish between acute, obtuse, reflex and right angles	
	estimate the size of an angle in degrees	
	Properties of triangles and other rectilinear shapes	
a	distinguish between lines and line segments	
c	use parallel lines, alternate angles and corresponding angles	
	understand the consequent properties of parallelograms and a proof that the angle sum of a triangle is 180 degrees	
	understand a proof that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices	
d	use angle properties of equilateral, isosceles and right-angled triangles	
	understand congruence	
	explain why the angle sum of a quadrilateral is 360 degrees	
e	use their knowledge of rectangles, parallelograms and triangles to deduce formulae for the area of a parallelogram, and a triangle, from the formula for the area of a rectangle	
f	recall the essential properties and definitions of special types of quadrilateral, including square, rectangle, parallelogram, trapezium and rhombus	includes kite
	classify quadrilaterals by their geometric properties	
g	calculate and use the sums of the interior and exterior angles of quadrilaterals, pentagons and hexagons	includes octagons and decagons
	calculate and use the angles of regular polygons	

	Content	*Examples*
h	understand, recall and use Pythagoras' theorem	
	Properties of circles	
i	recall the definition of a circle and the meaning of related terms, including centre, radius, chord, diameter, circumference, tangent, arc, sector and segment	
	understand that inscribed regular polygons can be constructed by equal division of a circle	
	3-D shapes	
j	explore the geometry of cuboids (including cubes), and shapes made from cuboids	isometric drawing of cuboids (including cubes) and shapes made from cuboids
k	use 2-D representations of 3-D shapes and analyse 3-D shapes through 2-D projections and cross-sections, including plan and elevation	
i	solve problems involving surface areas and volumes of prisms	
3	**Transformations and Coordinates**	
	Students should be taught to:	
	Specifying transformations	
a	understand that rotations are specified by a centre and an (anticlockwise) angle	the order of rotational symmetry of a shape and includes tessellations
	rotate a shape about the origin, or any other point	
	measure the angle of rotation using right angles, simple fractions of a turn or degrees	
	understand that reflections are specified by a mirror line, at first using a line parallel to an axis, then a mirror line such as $y = x$ or $y = –x$	reflection in the x-axis or y-axis or in a given mirror line
	understand that translations are specified by a distance and direction (or a vector), and enlargements by a centre and positive scale factor	
	Properties of transformations	
b	recognise and visualise rotations, reflections and translations, including reflection symmetry of 2-D and 3-D shapes, and rotation symmetry of 2-D shapes	

	Content	***Examples***
	transform triangles and other 2-D shapes by translation, rotation and reflection and combinations of these transformations, recognising that these transformations preserve length and angle, so that any figure is congruent to its image under any of these transformations	reflection in $x = c$, $y = c$, $y = x$ or $y = -x$ describe the single transformation equivalent to a combination of transformations
	distinguish properties that are preserved under particular transformations	
c	recognise, visualise and construct enlargements of objects using positive scale factors greater than one, then positive scale factors less than one	enlarging a shape on a grid enlarging a shape by shape factor 3, given the centre of enlargement
	understand from this that any two circles and any two squares are mathematically similar, while, in general, two rectangles are not	
d	recognise that enlargements preserve angle but not length	
	identify the scale factor of an enlargement as the ratio of the lengths of any two corresponding line segments and apply this to triangles	
	understand the implications of enlargement for perimeter	
	use and interpret maps and scale drawings	
	understand the implications of enlargement for area and for volume	
	distinguish between formulae for perimeter, area and volume by considering dimensions	
	understand and use simple examples of the relationship between enlargement and areas and volumes of shapes and solids	
	Coordinates	
e	understand that one coordinate identifies a point on a number line, two coordinates identify a point in a plane and three coordinates identify a point in space, using the terms '1-D', '2-D' and '3-D'	
	use axes and coordinates to specify points in all four quadrants	
	locate points with given coordinates	

	Content	*Examples*
	find the coordinates of points identified by geometrical information	find the coordinates of the fourth vertex of a parallelogram with vertices at (2, 1), (–7, 3) and (5, 6)
		identify the coordinates of the vertex of a cuboid drawn on a 3-D grid
	find the coordinates of the midpoint of the line segment AB, given points A and B, then calculate the length AB	
	Vectors	
f	understand and use vector notation for translations	column vector notation
4	**Measures and Construction**	
	Students should be taught to:	
	Measures	
a	interpret scales on a range of measuring instruments, including those for time and mass	
	know that measurements using real numbers depend on the choice of unit	
	recognise that measurements given to the nearest whole unit may be inaccurate by up to one half in either direction	
	convert measurements from one unit to another	
	know rough metric equivalents of pounds, feet, miles, pints and gallons	
	make sensible estimates of a range of measures in everyday settings	
b	understand angle measure using the associated language	use bearings to specify direction
c	understand and use compound measures, including speed and density	how far do you go if you travel at 40 mph for 3 hours?
	Construction	
d	measure and draw lines to the nearest millimetre, and angles to the nearest degree	
	draw triangles and other 2-D shapes using a ruler and protractor, given information about their side lengths and angles	
	understand, from their experience of constructing them, that triangles satisfying SSS, SAS, ASA and RHS are unique, but SSA triangles are not	

	Content	***Examples***
	construct cubes, regular tetrahedra, square-based pyramids and other 3-D shapes from given information	
e	use straight edge and compasses to do standard constructions, including an equilateral triangle with a given side, the midpoint and perpendicular bisector of a line segment, the perpendicular from a point to a line, the perpendicular from a point on a line, and the bisector of an angle	
	Mensuration	
f	find areas of rectangles, recalling the formula, understanding the connection to counting squares and how it extends this approach	perimeter of simple shapes
	recall and use the formulae for the area of a parallelogram and a triangle	
	find the surface area of simple shapes using the area formulae for triangles and rectangles	areas of parallelograms and trapeziums, half-circles and quarter circles
	calculate perimeters and areas of shapes made from triangles and rectangles	
g	find volumes of cuboids, recalling the formula and understanding the connection to counting cubes and how it extends this approach	
	calculate volumes of right prisms and of shapes made from cubes and cuboids	
h	find circumferences of circles and areas enclosed by circles, recalling relevant formulae	
i	convert between area measures, including square centimetres and square metres, and volume measures, including cubic centimetres and cubic metres	
	Loci	
j	find loci, both by reasoning and by using ICT to produce shapes and paths	a region bounded by a circle and an intersecting line

Ma4 Handling data

Content	*Examples*

1 Using and Applying Handling Data

Students should be taught to:

Problem solving

a carry out each of the four aspects of the handling data cycle to solve problems:

(i) specify the problem and plan: formulate questions in terms of the data needed, and consider what inferences can be drawn from the data

decide what data to collect (including sample size and data format) and what statistical analysis is needed

(ii) collect data from a variety of suitable sources, including experiments and surveys, and primary and secondary sources

(iii) process and represent the data: turn the raw data into usable information that gives insight into the problem

(iv) interpret and discuss the data: answer the initial question by drawing conclusions from the data

b identify what further information is needed to pursue a particular line of enquiry

b select the problem-solving strategies to use in statistical work, and monitor their effectiveness (these strategies should address the scale and manageability of the tasks, and should consider whether the mathematics and approach used are delivering the most appropriate solutions)

c select and organise the appropriate mathematics and resources to use for a task

d review progress while working

check and evaluate solutions

Communicating

e interpret, discuss and synthesise information presented in a variety of forms

f communicate mathematically, including using ICT, making use of diagrams and related explanatory text

Content		***Examples***
g	examine critically, and justify, their choices of mathematical presentation of problems involving data	
	Reasoning	
h	apply mathematical reasoning, explaining and justifying inferences and deductions	
e	identify exceptional or unexpected cases when solving statistical problems	
i	explore connections in mathematics and look for relationships between variables when analysing data	
j	recognise the limitations of any assumptions and the effects that varying the assumptions could have on the conclusions drawn from data analysis	
2	**Specifying the Problem and Planning**	
	Students should be taught to:	
a	see that random processes are unpredictable	
b	identify key questions that can be addressed by statistical methods	
c	discuss how data relate to a problem, identify possible sources of bias and plan to minimise it	
d	identify which primary data they need to collect and in what format, including grouped data, considering appropriate equal class intervals	
e	design an experiment or survey	
	decide what primary and secondary data to use	
3	**Collecting Data**	
	Students should be taught to:	
a	design and use data-collection sheets for grouped discrete and continuous data	
	collect data using various methods, including observation, controlled experiment, data logging, questionnaires and surveys	
b	gather data from secondary sources, including printed tables and lists from ICT-based sources	
c	design and use two-way tables for discrete and grouped data	

	Content	*Examples*
4	**Processing and Representing Data**	
	Students should be taught to:	
a	draw and produce, using paper and ICT, pie charts for categorical data, and diagrams for continuous data, including line graphs for time series, scatter graphs, frequency diagrams and stem-and-leaf diagrams	pictograms and bar charts frequency polygons, histograms with equal class intervals and frequency diagrams for grouped discrete data
b	calculate mean, range and median of small data sets with discrete then continuous data identify the modal class for grouped data	the mode
c	understand and use the probability scale	
d	understand and use estimates or measures of probability from theoretical models (including equally likely outcomes), or from relative frequency	addition of simple probabilities
e	list all outcomes for single events, and for two successive events, in a systematic way	
f	identify different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1	
g	find the median for large data sets and calculate an estimate of the mean for large data sets with grouped data	
h	draw lines of best fit by eye, understanding what these represent	using a line of best fit
j	use relevant statistical functions on a calculator or spreadsheet	
5	**Interpreting and Discussing Results**	
	Students should be taught to:	
a	relate summarised data to the initial questions	
b	interpret a wide range of graphs and diagrams and draw conclusions	interpreting a stem-and-leaf diagram
c	look at data to find patterns and exceptions	
d	compare distributions and make inferences, using the shapes of distributions and measures of average and range	
e	consider and check results and modify their approach if necessary	

	Content	***Examples***
f	appreciate that correlation is a measure of the strength of the association between two variables	
	distinguish between positive, negative and zero correlation using lines of best fit	
	appreciate that zero correlation does not necessarily imply 'no relationship' but merely 'no linear relationship'	
g	use the vocabulary of probability to interpret results involving uncertainty and prediction	'there is some evidence from this sample that …'
h	compare experimental data and theoretical probabilities	
i	understand that if they repeat an experiment, they may — and usually will — get different outcomes, and that increasing sample size generally leads to better estimates of probability and population characteristics	
j	discuss implications of findings in the context of the problem	
k	interpret social statistics including index numbers	the General Index of Retail Prices
	time series	population growth
	and survey data	the National Census

Higher tier

Students should be taught the knowledge, skills and understanding contained in this specification through:

a) activities that ensure they become familiar with and confident using standard procedures for the range of calculations appropriate to this level of study

b) solving familiar and unfamiliar problems in a range of numerical, algebraic and graphical contexts and in open-ended and closed form

c) using standard notations for decimals, fractions, percentages, ratio and indices

d) activities that show how algebra, as an extension of number using symbols, gives precise form to mathematical relationships and calculations

e) activities in which they progress from using definitions and short chains of reasoning to understanding and formulating proofs in algebra and geometry

f) a sequence of practical activities that address increasingly demanding statistical problems in which they draw inferences from data and consider the uses of statistics in society

g) choosing appropriate ICT tools and using these to solve numerical and graphical problems, to represent and manipulate geometrical configurations and to present and analyse data.

Higher tier

Ma2 Number and algebra

Content		*Examples*
1	**Using and Applying Number and Algebra**	
	Students should be taught to:	
	Problem solving	
a	select and use appropriate and efficient techniques and strategies to solve problems **of increasing complexity, involving numerical and algebraic manipulation**	
b	identify what further information may be required in order to pursue a particular line of enquiry and give reasons for following or rejecting particular approaches	
c	break down a complex calculation into simpler steps before attempting to solve it and justify their choice of methods	
d	make mental estimates of the answers to calculations	
	present answers to sensible levels of accuracy	
	understand how errors are compounded in certain calculations	
	Communicating	
e	discuss their work and explain their reasoning **using an increasing range of mathematical language and notation**	
f	use a **variety** of strategies **and diagrams for establishing** algebraic or graphical representations of a problem and its solution	
	move from one form of representation to another to get different perspectives on the problem	
g	present and interpret solutions in the context of the original problem	
h	use notation and symbols correctly and consistently within a given problem	
i	examine critically, improve, then justify their choice of mathematical presentation, present a concise, reasoned argument	

	Content	***Examples***
	Reasoning	
j	explore, identify, and use pattern and symmetry in algebraic contexts, investigating whether particular cases can be generalised further, and understanding the importance of a counter-example	
	identify exceptional cases when solving problems	
k	understand the difference between a practical demonstration and a proof	
l	show step-by-step deduction in solving a problem	
	derive proofs using short chains of deductive reasoning	
m	recognise the significance of stating constraints and assumptions when deducing results	
	recognise the limitations of any assumptions that are made and the effect that varying the assumptions may have on the solution to a problem	
2	**Numbers and the Number System**	
	Students should be taught to:	
	Integers	
a	use their previous understanding of integers and place value to deal with arbitrarily large positive numbers and round them to a given power of 10	
	understand and use negative integers both as positions and translations on a number line	
	order integers	
	use the concepts and vocabulary of factor (divisor), multiple, common factor, highest common factor, least common multiple, prime number and prime factor decomposition	
	Powers and roots	
b	use the terms square, positive and negative square root, cube and cube root	
	use index notation and index laws for multiplication and division of integer powers	
	use standard index form, expressed in conventional notation and on a calculator display	interpretation of calculator displays

	Content	***Examples***
	Fractions	
c	understand equivalent fractions, simplifying a fraction by cancelling all common factors	
	order fractions by rewriting them with a common denominator	
	Decimals	
d	recognise that each terminating decimal is a fraction	$0.137 = \frac{137}{1000}$
	recognise that recurring decimals are exact fractions, and that some exact fractions are recurring decimals	$\frac{1}{7} = 0.142857142857...$
	order decimals	
	Percentages	
e	understand that ‘percentage’ means ‘number of parts per 100’ and use this to compare proportions	10% means 10 parts per 100
	interpret percentage as the operator ‘so many hundredths of’	15% of Y means $\frac{15}{100} \times Y$
e	use percentage in real-life situations	commerce and business, including rate of inflation, VAT and interest rates
	Ratio	
f	use ratio notation, including reduction to its simplest form and its various links to fraction notation	
3	**Calculations**	
	Students should be taught to:	
	Number operations and the relationships between them	
a	multiply or divide any number by powers of 10, and any positive number by a number between 0 and 1	
	find the prime factor decomposition of positive integers	
	understand ‘reciprocal’ as multiplicative inverse, knowing that any non-zero number multiplied by its reciprocal is 1 (and that zero has no reciprocal, because division by zero is not defined)	
	multiply and divide by a negative number	

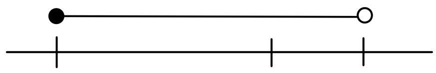
	Content	***Examples***
	use index laws to simplify and calculate the value of numerical expressions involving multiplication and division of integer, **fractional and negative** powers	
	use inverse operations, **understanding that the inverse operation of raising a positive number to power *n* is raising the result of this operation to power** $\mathbf{\frac{1}{n}}$	
b	use brackets and the hierarchy of operations	
c	calculate a given fraction of a given quantity, expressing the answer as a fraction	
	express a given number as a fraction of another	
	add and subtract fractions by writing them with a common denominator	
	perform short division to convert a simple fraction to a decimal	
	distinguish between fractions with denominators that have only prime factors of 2 and 5 (which are represented by terminating decimals), and other fractions (which are represented by recurring decimals)	
	convert a recurring decimal to a fraction	**0.142857142857... =** $\frac{1}{7}$
d	understand and use unit fractions as multiplicative inverses	by thinking of multiplication by $\frac{1}{5}$ as division by 5, or multiplication by $\frac{6}{7}$ as multiplication by 6 followed by division by 7 (or vice versa) addition, subtraction, **multiplication and division** of mixed numbers
	multiply and divide a given fraction by an integer, by a unit fraction and by a general fraction	
e	convert simple fractions of a whole to percentages of the whole and vice versa	
	then understand the multiplicative nature of percentages as operators	a 15% increase in value *Y*, followed by a 15% decrease is calculated as $1.15 \times Y \times 0.85$
	calculate an original amount when given the transformed amount after a percentage change	**given that a meal in a restaurant costs £36 with VAT at 17.5%, its price before VAT is calculated as £** $\frac{36}{1.175}$
	reverse percentage problems	
f	divide a quantity in a given ratio	

	Content	***Examples***
	Mental methods	
g	recall integer squares from **2 × 2** to 15 × 15 and the corresponding square roots, the cubes of 2, 3, 4, 5 and 10, **the fact that** $n^0 = 1$ **and** $n^{-1} = \frac{1}{n}$ **for positive integers *n*, the corresponding rule for negative numbers,** $n^{\frac{1}{2}} = \sqrt{n}$ **and** $n^{\frac{1}{3}} = \sqrt[3]{n}$ **for any positive number *n***	$10^0 = 1; 9^{-1} = \frac{1}{9}$ $5^{-2} = \frac{1}{5^2} = \frac{1}{25}$ $25^{1/2} = 5$ **and** $64^{1/3} = 4$
h	round to **a given number** of significant figures	
	derive unknown facts from those they know	
	convert between ordinary and standard index form representations, converting to standard index form to make sensible estimates for calculations involving multiplication and/or division	$0.1234 = 1.234 \times 10^{-1}$
i	develop a range of strategies for mental calculation	13.76 – 5.21, 20.08 + 12.4
	add and subtract mentally numbers with up to one decimal place	
	multiply and divide numbers with no more than one decimal digit, using the commutative, associative, and distributive laws and factorisation where possible, or place value adjustments	1.8 × 2, 3.6 ÷ 4
	Written methods	
k	division by decimal (up to 2 decimal places) by division using an integer	
	understand where to position the decimal point by considering what happens if they multiply equivalent fractions	given that…work out…
i	use efficient methods to calculate with fractions, including cancelling common factors before carrying out the calculation, recognising that, in many cases, only a fraction can express the exact answer	
j	solve percentage problems, including **percentage** increase and decrease	simple interest, VAT, annual rate of inflation, income tax, discounts
	reverse percentages	
n	solve word problems about ratio and proportion, including using informal strategies and the unitary method of solution	given that *m* identical items cost £*y*, then one item costs £ $^{y}/_{m}$ and *n* items cost £($n \times {}^{y}/_{m}$), the number of items that can be bought for £*z* is $z \times {}^{m}/_{y}$

	Content	***Examples***
k	**represent repeated proportional change using a multiplier raised to a power**	**compound interest**
l	**calculate an unknown quantity from quantities that vary in direct or inverse proportion**	
m	**calculate with standard index form**	**$2.4 \times 10^7 \times 5 \times 10^3 = 12 \times 10^{10} = 1.2 \times 10^{11}$, $(2.4 \times 10^7) \div (5 \times 10^3) = 4.8 \times 10^3$**
n	use surds and π in exact calculations, without a calculator	
	rationalise a denominator such as $\frac{1}{\sqrt{3}} = \frac{\sqrt{3}}{3}$	
	Calculator methods	
o	use calculators effectively and efficiently, knowing how to enter complex calculations	
	use an extended range of function keys, including trigonometrical and statistical functions relevant across this programme of study	
p	enter a range of calculations, including those involving measures	time calculations in which fractions of an hour must be entered as fractions or as decimals
p	understand the calculator display, knowing when to interpret the display, when the display has been rounded by the calculator, and not to round during the intermediate steps of a calculation	
q	**use calculators, or written methods, to calculate the upper and lower bounds of calculations, particularly when working with measurements**	
r	**use standard index form display and know how to enter numbers in standard index form**	
s	**use calculators for reverse percentage calculations by doing an appropriate division**	
t	**use calculators to explore exponential growth and decay, using a multiplier and the power key**	**for example, in science or geography**

Content	*Examples*
4 Solving Numerical Problems	
Students should be taught to:	
a draw on their knowledge of operations and inverse operations **(including powers and roots)**, and of methods of simplification (including factorisation and the use of the commutative, associative and distributive laws of addition, multiplication and factorisation) in order to select and use suitable strategies and techniques to solve problems and word problems, including those involving ratio and proportion, **repeated proportional change**, fractions, percentages and **reverse percentages, inverse proportion, surds**, measures and conversion between measures, and compound measures defined within a particular situation	
b **check** and estimate answers to problems	
select and justify appropriate degrees of accuracy for answers to problems	
recognise limitations on the accuracy of data and measurements	
5 Equations, Formulae and Identities	
Students should be taught to:	
Use of symbols	
a distinguish the different roles played by letter symbols in algebra, using the correct notational conventions for multiplying or dividing by a given number, and knowing that letter symbols represent definite unknown numbers in equations, defined quantities or variables in formulae, general, unspecified and independent numbers in identities, and in functions they define new expressions or quantities by referring to known quantities	$x^2 + 1 = 82$ $(x + 1)^2 = x^2 + 2x + 1$ for all values of x $y = 2 - 7x$ $y = 1/x$ with $x \neq 0$ f(x) notation may be used
b understand that the transformation of algebraic entities obeys and generalises the **well-defined** rules of generalised arithmetic	$a(b + c) = ab + bc$
expand the product of two linear expressions	$(x + 2)(x - 5) = x^2 - 3x - 10$

	Content	***Examples***
	manipulate algebraic expressions by collecting like terms, multiplying a single term over a bracket, taking out common factors, **factorising quadratic expressions including the difference of two squares and cancelling common factors in rational expressions**	simplify $\frac{1}{x} + \frac{3}{2-x}$ $\frac{2(x+1)^2}{(x+1)} = 2(x + 1)$ $x^2 - 9 = (x + 3)(x - 3)$ $4x^2 + 6xy = 2x(2x + 3y)$ $9x - 3 = 3(x - 1)$ or $x^2 - 3x = x(x - 3)$
c	**know the meaning of and use** the words 'equation', 'formula', 'identity' and 'expression'	
	Index notation	
d	use index notation for simple integer powers	
	use simple instances of index laws	$x^2 \times x^3 = x^5$, $x^6 \div x^4 = x^2$, $x^2 \div x^3 = x^{-1}$, $(x^2)^3 = x^6$
	substitute positive and negative numbers into expressions such as $3x^2 + 4$ and $2x^3$	
	Equations	
e	set up simple equations	find the angle a in a triangle with angles a, $a + 10$, $a + 20$
	solve simple equations by using inverse operations or by transforming both sides in the same way	$11 - 4x = 2$; $3(2x + 1) = 8$ $2(1 - x) = 6(2 + x)$; $3x^2 = 48$ $3 = 12/x$
	Linear equations	
f	solve linear equations in one unknown, with integer or fractional coefficients, in which the unknown appears on either side or on both sides of the equation	$\frac{2x-3}{6} + \frac{x+2}{3} = \frac{5}{2}$; $\frac{17-x}{4} = 2 - x$
	solve linear equations that require prior simplification of brackets, including those that have negative signs occurring anywhere in the equation, and those with a negative solution	
	Formulae	
g	use formulae from mathematics and other subjects	area of a triangle or a parallelogram, area enclosed by a circle, volume of a prism, volume of a cone
	substitute numbers into a formula	find r, given that $C = 2\pi r$ find x, given $y = mx + c$

	Content	***Examples***
	change the subject of a formula **including cases where the subject occurs twice, or where a power of the subject appears**	
	generate a formula	find the perimeter of a rectangle given its area *A* and the length *l* of one side
	Direct and inverse proportion	
h	**set up and use equations to solve word and other problems involving direct proportion or inverse proportion and relate algebraic solutions to graphical representation of the equations**	$\boldsymbol{y \propto x,\ y \propto x^2,\ y \propto \frac{1}{x},\ y \propto \frac{1}{x^2}}$
	Simultaneous linear equations	
i	**find exact solutions of two simultaneous equations in two unknowns by eliminating a variable and interpret the equations as lines and their common solution as the point of intersection**	
	Inequalities	
j	solve linear inequalities in one variable, and represent the solution set on a number line	notation $2 < x \le 4$ represented on a number line 
	solve several linear inequalities in two variables and find the solution set	
	Quadratic equations	
k	**solve simple quadratic equations by factorisation, completing the square and using the quadratic formula**	
	Simultaneous linear and quadratic equations	
l	**solve exactly, by elimination of an unknown, two simultaneous equations in two unknowns, one of which is linear in each unknown, and the other is linear in one unknown and quadratic in the other, or where the second is of the form** $\boldsymbol{x^2 + y^2 = r^2}$	**solve the simultaneous equations** $\boldsymbol{y = 11x - 2}$ **and** $\boldsymbol{y = 5x^2}$
	Numerical methods	
m	use systematic trial and improvement to find approximate solutions of equations where there is no simple analytical method of solving them	$x^3 = x - 900$, $\frac{1}{x} = x^2 - 5$

	Content	***Examples***
6	**Sequences, Functions and Graphs**	
	Students should be taught to:	
	Sequences	
a	generate terms of a sequence using term-to-term and position-to-term definitions of the sequence	
	use linear expressions to describe the *n*th term of an arithmetic sequence, justifying its form by reference to the activity or context from which it was generated	
	generate common integer sequences (including sequences of odd or even integers, squared integers, powers of 2, powers of 10, triangular numbers)	
	Graphs of linear functions	
b	use the conventions for coordinates in the plane	
	plot points in all four quadrants	
	recognise (when values are given for m and c) that equations of the form $y = mx + c$ correspond to straight-line graphs in the coordinate plane	
	plot graphs of functions in which y is given explicitly in terms of x, or implicitly	
c	find the gradient of lines given by equations of the form $y = mx + c$ (when values are given for m and c)	
	understand that the form $y = mx + c$ represents a straight line and that m is the gradient of the line and c is the value of the y- intercept	
	explore the gradients of parallel lines and lines perpendicular to each other	**know that the lines represented by the equations $y = –5x$ and $y = 3 – 5x$ are parallel, each having gradient (–5) and know that the line with equation $y = \frac{x}{5}$ is perpendicular to these lines and has gradient $\frac{1}{5}$**
	Interpreting graphical information	
d	construct linear functions and **plot the corresponding** graphs arising from real-life problems	

	Content	***Examples***
	discuss and interpret graphs modelling real situations	distance-time graph for a particle moving with constant speed depth of water in a container as it empties velocity-time graph for a particle moving with constant acceleration
	Quadratic functions	
e	generate points and plot graphs of simple quadratic functions, then more general quadratic functions	$y = x^2$; $y = 3x^2 + 4$ $y = x^2 - 2x + 1$
	find approximate solutions of a quadratic equation from the graph of the corresponding quadratic function	
	find the intersection points of the graphs of a linear and quadratic function, knowing that these are the approximate solutions of the corresponding simultaneous equations representing the linear and quadratic functions	
	Other functions	
f	**plot graphs of simple cubic functions, the reciprocal function $y = \frac{1}{x}$ with $x \neq 0$, the exponential function $y = k^x$ for integer values of x and simple positive values of k, the circular functions $y = \sin x$ and $y = \cos x$, using a spreadsheet or graph plotter as well as pencil and paper**	$y = x^3$ $y = 2^x$; $y = (½)^x$
	recognise the characteristic shapes of all these functions	
	Transformation of functions	
g	**apply to the graph of $y = f(x)$ the transformations $y = f(x) + a$, $y = f(ax)$, $y = f(x + a)$, $y = af(x)$ for linear, quadratic, sine and cosine functions f(x)**	
	Loci	
h	**construct the graphs of simple loci including the circle $x^2 + y^2 = r^2$ for a circle of radius r centred at the origin of coordinates**	
	find graphically the intersection points of a given straight line with this circle and know that this corresponds to solving the two simultaneous equations representing the line and the circle	

Ma3 Shape, space and measures

	Content	*Examples*
1	**Using and Applying Shape, Space and Measures**	
	Students should be taught to:	
	Problem solving	
a	select the problem-solving strategies **to use in geometrical work**, and consider and explain the extent to which the selections they made were appropriate	
b	select and combine known facts and problem-solving strategies to solve **more complex geometrical** problems	
c	develop and follow alternative lines of enquiry, **justifying their decisions to follow or reject particular approaches**	
	Communicating	
d	communicate mathematically, with emphasis on a critical examination of the presentation and organisation of results, and on effective use of symbols and geometrical diagrams	
e	**use precise formal language and exact methods for analysing geometrical configurations**	
g	review and justify their choices of mathematics presentation	
	Reasoning	
h	distinguish between practical demonstrations and proofs	
f	apply mathematical reasoning, **progressing from brief mathematical explanations towards full justifications in more complex contexts**	
g	**explore connections in geometry**	
	pose conditional constraints of the type 'If… then…'	
	ask questions 'What if…?' or 'Why?'	
h	show step-by-step deduction in solving a geometrical problem	
i	state constraints and give starting points when making deductions	
j	**understand the necessary and sufficient conditions under which generalisations, inferences and solutions to geometrical problems remain valid**	

	Content	***Examples***
2	**Geometrical Reasoning**	
	Students should be taught to:	
	Properties of triangles and other rectilinear shapes	
a	distinguish between lines and line segments	
	use parallel lines, alternate angles and corresponding angles	
	understand the consequent properties of parallelograms and a proof that the angle sum of a triangle is 180 degrees	
	understand a proof that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices	
b	use angle properties of equilateral, isosceles and right-angled triangles	
	explain why the angle sum of a quadrilateral is 360 degrees	
e	use their knowledge of rectangles, parallelograms and triangles to deduce formulae for the area of a parallelogram, and a triangle, from the formula for the area of a rectangle	
c	recall the definitions of special types of quadrilateral, including square, rectangle, parallelogram, trapezium and rhombus	
	classify quadrilaterals by their geometric properties	
d	calculate and use the sums of the interior and exterior angles of quadrilaterals, pentagons and hexagons	
	calculate and use the angles of regular polygons	
e	**understand and use SSS, SAS, ASA and RHS conditions to prove the congruence of triangles using formal arguments, and to verify standard ruler and compass constructions**	
f	understand, recall and use Pythagoras' theorem in 2-D, **then 3-D problem**s	
	investigate the geometry of cuboids including cubes, and shapes made from cuboids, **including the use of Pythagoras' theorem to calculate lengths in three dimensions**	

	Content	***Examples***
g	**understand similarity of triangles and of other plane figures, and use this to make geometric inferences**	
	understand, recall and use trigonometrical relationships in right-angled triangles, and use these to solve problems, including those involving bearings, then use these relationships in 3-D contexts, including finding the angles between a line and a plane (but not the angle between two planes or between two skew lines)	
	calculate the area of a triangle using $\frac{1}{2}ab \sin C$	
	draw, sketch and describe the graphs of trigonometric functions for angles of any size, including transformations involving scalings in either or both the *x* and *y* directions	
	use the sine and cosine rules to solve 2-D and 3-D problems	
	Properties of circles	
h	recall the definition of a circle and the meaning of related terms, including centre, radius, chord, diameter, circumference, tangent, arc, sector and segment	
	understand that the tangent at any point on a circle is perpendicular to the radius at that point	
	understand and use the fact that tangents from an external point are equal in length	
	explain why the perpendicular from the centre to a chord bisects the chord	
	understand that inscribed regular polygons can be constructed by equal division of a circle	
	prove and use the facts that the angle subtended by an arc at the centre of a circle is twice the angle subtended at any point on the circumference, the angle subtended at the circumference by a semicircle is a right angle, that angles in the same segment are equal, and that opposite angles of a cyclic quadrilateral sum to 180 degrees	
	prove and use the alternate segment theorem	

	Content	***Examples***
	3-D shapes	
i	use 2-D representations of 3-D shapes and analyse 3-D shapes through 2-D projections and cross-sections, including plan and elevation	
	solve problems involving surface areas and volumes of prisms, pyramids, cylinders, **cones and spheres**	
	solve problems involving more complex shapes and solids, including segments of circles and frustums of cones	
3	**Transformations and Coordinates**	
	Students should be taught to:	
	Specifying transformations	
a	understand that rotations are specified by a centre and an (anticlockwise) angle	
	use any point as the centre of rotation	
	measure the angle of rotation, using right angles, fractions of a turn or degrees	
	understand that reflections are specified by a (mirror) line	
	understand that translations are specified by a distance and direction (or a vector), and enlargements by a centre and a positive scale factor	
	Properties of transformations	
b	recognise and visualise rotations, reflections and translations including reflection symmetry of 2-D and 3-D shapes, and rotation symmetry of 2-D shapes	
	transform triangles and other 2-D shapes by translation, rotation and reflection and combinations of these transformations	reflection in $x = c$, $y = c$, $y = x$ or $y = -x$
	use congruence to show that translations, rotations and reflections preserve length and angle, so that any figure is congruent to its image under any of these transformations	describe the single transformation equivalent to a combination of transformations
	distinguish properties that are preserved under particular transformations	

	Content	*Examples*
c	recognise, visualise and construct enlargements of objects	
	understand from this that any two circles and any two squares are mathematically similar, while, in general, two rectangles are not, **then use positive fractional and negative scale factors**	
d	recognise that enlargements preserve angle but not length	
	identify the scale factor of an enlargement as the ratio of the lengths of any two corresponding line segments	
	understand the implications of enlargement for perimeter	
	use and interpret maps and scale drawings	
	understand the difference between formulae for perimeter, area and volume by considering dimensions	
	understand and **use the effect of** enlargement on areas and volumes of shapes and solids	
	Coordinates	
e	understand that one coordinate identifies a point on a number line, that two coordinates identify a point in a plane and three coordinates identify a point in space, using the terms '1-D', '2-D' and '3-D'	
	use axes and coordinates to specify points in all four quadrants	
	locate points with given coordinates	
	find the coordinates of points identified by geometrical information	
	find the coordinates of the midpoint of the line segment AB, given the points A and B, calculate the length AB	**identify the coordinates of the midpoint of a line segment in 3-D**
	Vectors	
f	understand and use vector notation	column vector notation
	calculate, and represent graphically, the sum of two vectors, the difference of two vectors and a scalar multiple of a vector	
	calculate the resultant of two vectors	
	understand and use the commutative and associative properties of vector addition	
	solve simple geometrical problems in 2-D using vector methods	

	Content	***Examples***
4	**Measures and Construction**	
	Students should be taught to:	
	Measures	
a	use angle measure	use bearings to specify direction
	know that measurements using real numbers depend on the choice of unit	
	recognise that measurements given to the nearest whole unit may be inaccurate by up to one half in either direction	
	convert measurements from one unit to another	
	understand and use compound measures, including speed and density	
	Construction	
d	draw **approximate constructions** of triangles and other 2-D shapes, using a ruler and protractor, given information about their side lengths and angles	
b	understand, from their experience of constructing them, that triangles satisfying SSS, SAS, ASA and RHS are unique, but SSA triangles are not	
	construct **specified** cubes, regular tetrahedra, square-based pyramids and other 3-D shapes	
c	use straight edge and compasses to do standard constructions including an equilateral triangle with a given side, the midpoint and perpendicular bisector of a line segment, the perpendicular from a point to a line, the perpendicular from a point on a line, and the bisector of an angle	
	Mensuration	
f	calculate perimeters and areas of shapes made from triangles and rectangles	
d	find the surface area of simple shapes using the formulae for the areas of triangles and rectangles	areas of parallelograms and trapeziums, half-circles and quarter circles
	find volumes of cuboids, recalling the formula and understanding the connection to counting cubes and how it extends this approach	
	calculate volumes of right prisms and of shapes made from cubes and cuboids	

	Content	***Examples***
	convert between area measures, including square centimetres and square metres, and volume measures, including cubic centimetres and cubic metres	
	find circumferences of circles and areas enclosed by circles, recalling relevant formulae	
	calculate the lengths of arcs and the areas of sectors of circles	
	Loci	
e	find loci, both by reasoning and by using ICT to produce shapes and paths	a region bounded by a circle and an intersecting line

Ma4 Handling data

Content	*Examples*

1 Using and Applying Handling Data

Students should be taught to:

Problem solving

a carry out each of the four aspects of the handling data cycle to solve problems:

(i) specify the problem and plan: formulate questions in terms of the data needed, and consider what inferences can be drawn from the data

decide what data to collect (including sample size and data format) and what statistical analysis is needed

(ii) collect data from a variety of suitable sources, including experiments and surveys, and primary and secondary sources

(iii) process and represent the data: turn the raw data into usable information that gives insight into the problem

(iv) interpret and discuss the data: answer the initial question by drawing conclusions from the data

b select the problem-solving strategies to use in statistical work, and monitor their effectiveness (these strategies should address the scale and manageability of the tasks, and should consider whether the mathematics and approach used are delivering the most appropriate solutions)

Communicating

c communicate mathematically, **with emphasis on the use of an increasing range** of diagrams and related explanatory text, **on the selection of their mathematical presentation, explaining its purpose and approach, and on the use of symbols to convey statistical meaning**

Reasoning

d apply mathematical reasoning, explaining and justifying inferences and deductions, **justifying arguments and solutions**

e identify exceptional or unexpected cases when solving statistical problems

Content		***Examples***
f	explore connections in mathematics and look for relationships between variables when analysing data	
g	recognise the limitations of any assumptions and the effects that varying the assumptions could have on the conclusions drawn from data analysis	
2	**Specifying the Problem and Planning**	
	Students should be taught to:	
a	see that random processes are unpredictable	
b	identify key questions that can be addressed by statistical methods	
c	discuss how data relate to a problem, identify possible sources of bias and plan to minimise it	
d	identify which primary data they need to collect and in what format, including grouped data, considering appropriate equal class intervals	
	select and justify a sampling scheme and a method to investigate a population, including random and stratified sampling	
e	design an experiment or survey	
	decide what primary and secondary data to use	
3	**Collecting Data**	
	Students should be taught to:	
a	collect data using various methods, including observation, controlled experiment, data logging, questionnaires and surveys	
b	gather data from secondary sources, including printed tables and lists from ICT-based sources	
c	design and use two-way tables for discrete and grouped data	
d	**deal with practical problems such as non-response or missing data**	

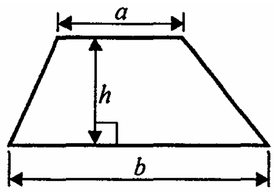
	Content	*Examples*
4	**Processing and Representing Data**	
	Students should be taught to:	
a	draw and produce, using paper and ICT, pie charts for categorical data, and diagrams for continuous data, including line graphs (time series), scatter graphs, frequency diagrams, stem-and-leaf diagrams, **cumulative frequency tables and diagrams, box plots and histograms for grouped continuous data**	frequency polygons, histograms with equal class intervals and frequency diagrams for grouped discrete data
b	understand and use estimates or measures of probability from theoretical models, or from relative frequency	addition of simple probabilities
c	list all outcomes for single events, and for two successive events, in a systematic way	
d	identify different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1	
e	find the median, **quartiles and interquartile range** for large data sets and calculate the mean for large data sets with grouped data	
f	**calculate an appropriate moving average**	
g	**know when to add or multiply two probabilities: if *A* and *B* are mutually exclusive, then the probability of *A* or *B* occurring is P(*A*) + P(*B*), whereas if *A* and *B* are independent events, the probability of *A* and *B* occurring is P(*A*) × P(*B*)**	**conditional probabilities**
h	**use tree diagrams to represent outcomes of compound events, recognising when events are independent**	
i	draw lines of best fit by eye, understanding what these represent	use of line of best fit
j	use relevant statistical functions on a calculator or spreadsheet	
5	**Interpreting and Discussing Results**	
	Students should be taught to:	
a	relate summarised data to the initial questions	
b	interpret a wide range of graphs and diagrams and draw conclusions	
	identify seasonality and trends in time series	using a moving average graph
c	look at data to find patterns and exceptions	

	Content	***Examples***
d	compare distributions and make inferences, using shapes of distributions and measures of average and **spread, including median and quartiles**	
	understand frequency density	
e	consider and check results, and modify their approach if necessary	
f	appreciate that correlation is a measure of the strength of the association between two variables	
	distinguish between positive, negative and zero correlation using lines of best fit	
	appreciate that zero correlation does not necessarily imply 'no relationship' but merely 'no linear relationship'	
g	use the vocabulary of probability to interpret results involving uncertainty and prediction	'there is some evidence from this sample that …'
h	compare experimental data and theoretical probabilities	
i	understand that if they repeat an experiment, they may — and usually will — get different outcomes, and that increasing sample size generally leads to better estimates of probability and population **parameters**	
k	interpret social statistics including index numbers	the General Index of Retail Prices
	time series	population growth
	and survey data	the National Census

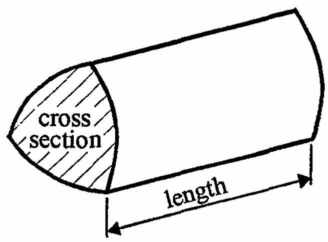
Formulae sheets

EDEXCEL
GCSE Mathematics 2540/2544
Formulae sheet — Foundation tier

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



Volume of prism = area of cross-section × length

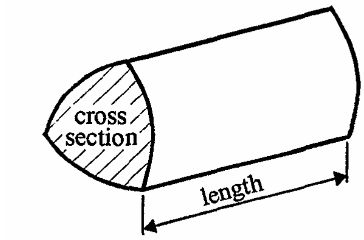


EDEXCEL

GCSE Mathematics 2540/2544

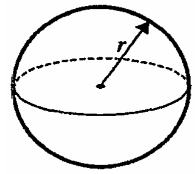
Formulae sheet — Higher tier

Volume of prism = area of cross-section × length



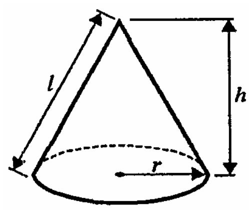
Volume of sphere = $\frac{4}{3}\pi r^3$

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

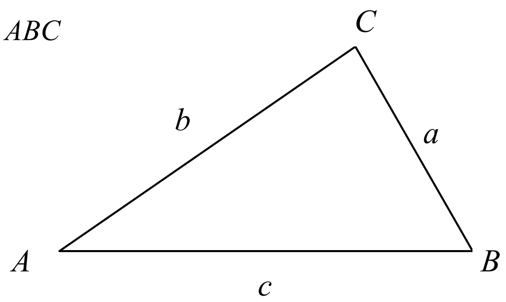


Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$



In any triangle *ABC*



Sine Rule: $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

Cosine Rule: $a^2 = b^2 + c^2 - 2bc \cos A$

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

The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$, where $a \neq 0$, are given by $x = \dfrac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

Specification aims and assessment objectives

Aims

This specification is consistent with the requirements of the English National Curriculum Orders for Mathematics. Additionally, it entirely meets the GCSE criteria for Mathematics, the general criteria for GCSE as well as the GCSE Mandatory Code of Practice. The aims of this specification are that students:

Using and applying mathematics

- use and apply mathematics in practical tasks, in real-life problems and within mathematics itself
- work on problems that pose a challenge
- encounter and consider different lines of mathematical argument.

Number

- use calculators and computer software, eg spreadsheets
- develop and use flexibly a range of methods of computation, and apply these to a variety of problems.

Algebra

- explore a variety of situations that lead to the expression of relationships
- consider how relationships between number operations underpin the techniques for manipulating algebraic expressions
- consider how algebra can be used to model real-life situations and solve problems.

Shape, space and measures

- use a variety of different representations
- explore shape and space through drawing and practical work using a wide range of materials
- use computers to generate and transform graphic images and to solve problems.

Handling data

- formulate questions that can be considered using statistical methods
- undertake purposeful enquiries based on data analysis
- use computers as a source of large samples, a tool for exploring graphical representations and as a means to simulate events
- engage in practical and experimental work in order to appreciate some of the principles which govern random events
- look critically at some of the ways in which representations of data can be misleading and conclusions uncertain.

Some of the aims are reflected in the assessment objectives, whilst others are not as they cannot be readily assessed. However, mental calculation without the aid of a calculator, estimation, understanding of 3-D shape, practical activities, use of ICT and data collection need to be incorporated into schemes of work.

NOTE

Mental calculation should be encouraged as it will be assumed that during coursework and written papers mental calculations are being performed to solve problems. Calculations without the aid of a calculator will be tested in a written paper where candidates are not allowed the use of a calculator.

Estimation will be tested through questions on written papers.

Questions testing candidates' understanding of 3-D shape will be tested on written papers.

Coursework tasks will be set which encourage candidates to make full use of ICT.

Methods of data collection will be tested through written papers. Data collection, its synthesis and communication, will form part of the coursework activities.

Knowledge, skills and understanding

The knowledge, skills and understanding required for GCSE Mathematics is contained in the National Curriculum Key Stage 4 Programme of Study for Mathematics.

Assessment objectives

The specification requires candidates to demonstrate their knowledge understanding and skills in the following:

AO1 Using and applying mathematics

Problem solving

Communicating

Reasoning

AO2 Number and algebra

Numbers and the number system

Calculations

Solving numerical problems

Equations, formulae and identities

Sequences, functions and graphs

AO3 Shape, space and measures

Geometrical reasoning

Transformation and coordinates

Measures and construction

AO4 Handling data

Specifying the problem and planning

Collecting data

Processing and representing data

Interpreting and discussing results

Assessment objective AO1, Using and applying mathematics, will be assessed in contexts provided by the other assessment objectives.

Scheme of assessment

Entry tiers

Candidates for this qualification must be entered for one of two tiers.

The grades available for each tier are as follows:

Tier	Grades available
Foundation	G to C
Higher	D to A* (E)

(E) indicates that grade E is allowed for Higher tier candidates. Candidates achieving a mark below the minimum for the award of the lowest grade in each tier will be ungraded.

Assessment of the specification consists of:

For Foundation tier candidates:

Paper	Weighting	Time	Calculator
Paper 1	40%	1 hour 30 minutes	no
Paper 2	40%	1 hour 30 minutes	yes
Coursework			
Paper 7A or 7B (coursework)	20%	Coursework consists of a handling data project and an investigational task	yes

For Higher tier candidates:

Paper	Weighting	Time	Calculator
Paper 3	40%	1 hour 45 minutes	no
Paper 4	40%	1 hour 45 minutes	yes
Coursework			
Paper 7A or 7B (coursework)	20%	Coursework consists of a handling data project and an investigational task	yes

Relationship of assessment objectives to external assessment

The weighting for each attainment targets as shown below:

	Assessment objective		Weighting
Two parallel examination papers	AO1	Using and applying mathematics	10%
	AO2	Number and algebra	40%
	AO3	Shape, space and measures	20%
	AO4	Handling data	10%
Coursework	AO1	Using and applying mathematics	10%
	AO4	Handling data	10%

The distribution of the weightings given for the written papers will be broadly balanced across all examination papers.

External assessment

Examination papers 1–4

Examination papers 1–4 will be combined question/answer books containing both shorter and longer questions.

Examination papers 1 and 3 will be timetabled in one session and examination papers 2 and 4 in another.

Examination papers 1 and 3 will be non-calculator papers. In these papers calculators, slide rules, logarithm tables and all other calculating aids are forbidden.

The non-calculator examination papers may test any topic in the subject content appropriate to the tier of entry, except those that expressly require the use of a calculator.

The with-calculator examination papers may test any topic in the subject content appropriate to the tier of entry, except those that expressly prohibit the use of a calculator.

There will be a number of questions demanding the unprompted solution of multi-step problems.

There will be a number of questions requiring the use of manipulative algebra.

Each examination paper will carry a maximum mark of 100.

There will be two parallel examination papers for each tier. Each examination paper will assess the full range of grades at each tier.

There will be common questions across examination papers to aid standardisation and comparability of awards between tiers.

Questions on the Higher tier examination papers will assume knowledge from the Foundation tier. However, material related to grades below the range of the tier will not be the focus of assessment.

Diagrams will not necessarily be drawn to scale and measurements should not be taken from diagrams unless instructions to this effect are given.

Each candidate may be required to use mathematical instruments, for example pair of compasses, ruler, protractor.

Tracing paper may be used.

Formulae sheets will be provided for both Foundation and Higher tiers (see pages 50–51).

Calculators

Candidates will be expected to have access to a suitable electronic calculator for all the unit tests and examination papers 2 and 4.

Electronic calculators to be used by candidates attempting Foundation tier unit tests and examination paper 13 should have, as a minimum, the following functions:

$+, -, \times, \div, x^2, \sqrt{x}$, memory, brackets, x^y, $x^{\frac{1}{y}}$, $\bar{x}$, Σx, Σfx, standard form

Electronic calculators to be used by candidates attempting Higher tier unit tests and examination paper 15 should have, as a minimum, the following functions:

$+, -, \times, \div, x^2, \sqrt{x}$, memory, constant function, brackets, x^y, $x^{\frac{1}{y}}$, $\bar{x}$, Σx, Σfx, standard form, sine, cosine, tangent and their inverses.

Calculators with any of the following facilities are prohibited from any unit test or examination paper:

- databanks
- retrieval of text or formulae
- QWERTY keyboards
- built-in symbolic algebra manipulations
- symbolic differentiation or integration, language translators
- communication with other machines or the internet.

Coursework

The minimum coursework requirement is a data-handling project assessing AO4 and one task assessing AO1 in the context of AO2 or AO3.

In order to meet this requirement, candidates will be required to submit two pieces of work:

- a project, using the knowledge, skills and understanding contained in AO4 (handling data)

  and

- **at least one** task, using the knowledge skills and understanding contained in AO1 (using and applying mathematics) in the context of AO2 (number and algebra) or AO3 (shape, space and measures).

Candidates may only submit **one** data-handling project.

Candidates may submit more than one task to provide evidence of their attainment in AO1. In this case the best performance in each strand of AO1 will be counted in whichever task it occurs.

During the tasks and project evidence will be collected of the candidate's ability to:

(i) respond orally to mathematics

(ii) undertake practical work.

Brief notes of each candidate's achievements will be made on the *Coursework Record Form* (see *Appendix 3*, page 85) or in the relevant place on the candidate's work.

Some coursework assessment must be conducted in the classroom under the direct supervision of the teacher. Although candidates may conduct research in the field, in museums or in public libraries, they must undertake some of the associated or development work under circumstances in which teachers can see them at work, discuss their findings, and thus authenticate each candidate's work with confidence.

For Option A, coursework is centre-assessed using the criteria contained in *Appendices 1* and *2* and is externally moderated by Edexcel.

For Option B, coursework is assessed by Edexcel using the criteria contained in *Appendices 1* and *2*.

Further guidance on coursework will be published in a coursework guide and published on our website (www.edexcel.org.uk).

Tasks

During the course students should be provided with tasks that give them the opportunity to use the knowledge, skills and understanding in AO2 and AO3 to demonstrate their ability to use and apply mathematics as specified in AO1. The tasks could be practical and/or investigational and should involve the use of ICT, as appropriate.

Edexcel will provide tasks that centres can select and integrate into their own schemes of work. Centres taking Option A may choose to use these tasks, generate their own tasks or use a mixture of centre and Edexcel-set tasks. Centres taking Option B **must** submit task(s) from those set by Edexcel.

The general coursework assessment criteria will be used to assess tasks (see *Appendix 1*).

Use of assessment criteria for using and applying mathematics tasks

The general coursework criteria for AO1 are subdivided into the following three strands:

Strand 1 – Making and monitoring decisions to solve problems

Strand 2 – Communicating mathematically

Strand 3 – Developing skills of mathematical reasoning.

Mark descriptions comprising a number of statements are provided for each strand. Each description within a strand is assigned one of the marks between one and eight. A candidate who fails to satisfy the description for a mark of one in a strand should be awarded a mark of 0 (zero) for that strand.

Whenever assessments are made, the mark descriptions given in the general coursework criteria for AO1 (together with the elaboration of AO1) should be used to judge which mark within each strand best fits the candidate's performance. The statements within a description should not be taken as discrete and literal hurdles of which all must be fulfilled for a mark to be awarded.

The mark descriptions within a strand are designed to be broadly hierarchical. This means that, in general, a description at a particular mark subsumes those at the lower marks. Therefore the mark awarded may not be supported by direct evidence of achievement of lower marks for each strand.

It is assumed that tasks accessing the higher marks will involve a more sophisticated approach and/or a more complex treatment.

The tasks used for each candidate must provide evidence of performance in Using and Applying Mathematics (AO1) through contexts provided by the other assessment objectives (AO2 or AO3).

Arrival at mark for the task(s) (Option A only)

Teachers are required to award a mark between one and eight for each of the three strands. In the case where a candidate has submitted more than one task these marks should represent a candidate's best performance within a strand across all the tasks submitted.

Marks in these three strands should be totalled to give a mark for the task(s) out of 24.

For 2007, the 22 tasks set by Edexcel for the specification 1387/1388 are valid for this specification. Some of these tasks will be suitable for candidates entered at any tier. Some will be suitable only for candidates entered at the Foundation tier. Some tasks will be suitable only for candidates entered at the Higher tier.

Projects

During the course, students should be given the opportunity to develop the knowledge skills and understanding contained in AO4 (handling data) through project work.

Edexcel will provide generic starting points, assessment guidance and sample data for these projects. Centres taking Option A may choose to use this material, generate their own projects or use a mixture of centre and Edexcel material. Centres taking Option B must submit projects based on the starting points and/or sample data set by Edexcel.

The general marking criteria for data handling will be used to assess projects (see *Appendix 3*).

Use of assessment criteria for data-handling projects

The assessment criteria for data-handling projects for AO4 are subdivided into the following three areas:

Area 1 – Specify the problem and plan

Area 2 – Collect, process and represent data

Area 3 – Interpret and discuss results.

Mark descriptions comprising a number of statements are provided for each area of the project. Each of the three areas are marked out of 8. Descriptions are given for mark bands (eg 1–2, 3–4) within each area. A candidate who fails to satisfy the description for a mark of one in an area should be awarded a mark of 0 (zero) for that area.

Whenever assessments are made, the mark descriptions given in the assessment criteria for data-handling projects (together with elaboration of AO4) should be used to judge which mark within each area best fits the candidate's performance. The statements within a description should not be taken as discrete and literal hurdles of which all must be fulfilled for a mark to be awarded.

The mark descriptions within an area are designed to be broadly hierarchical. This means that, in general, a description at a particular mark subsumes those at lower marks. Therefore the mark awarded may not be supported by direct evidence of achievement of lower marks in each area.

It is assumed that projects accessing the higher marks will involve a more sophisticated approach and/or a more complex treatment.

Arrival at mark for the project (Option A only)

Teacher assessors are required to award marks in each of the three areas of the AO4 assessment criteria (see *Appendix 2*).

Marks in these three areas should be totalled to give a mark for the project out of 24.

Arrival at a total mark for coursework (Option A only)

The marks for the task and project should be added together to give an overall total mark for coursework out of 48. This mark should be recorded on the candidate's *Coursework Record Form*.

Unit and resit rules

Students may resit any module test once only and the better result will count towards the final award. The shelf-life of individual modules is limited only by the shelf-life of the specification. The full qualification may be retaken more than once.

Results of units will be held in Edexcel's unit bank for as many years as this specification remains available. Once the qualification has been certificated, all unit results are deemed to be used up. These units cannot be used again towards a further award of the same qualification at the same level.

Transfer of internal assessment score

Students can transfer internal assessment marks as many times as they wish during the shelf life of this specification. For information, refer to the Edexcel Information Manual.

Internal assessment moderation procedures

To assist centres, detailed information on internal assessment moderation procedures is given in the Edexcel Information Manual, which is published separately. Centres will receive separate notification of any amendments to these procedures.

Quality of written communication

This specification does not formally assess the quality of written communication. Many of the elements of the key skill of communication may be delivered through this specification by the use of appropriate teaching and learning styles.

Awarding, reporting and equivalence

The grading, awarding and certification of this specification will comply with the requirements of the GCSE Code of Practice for courses starting in September 2006, which is published by QCA. Qualifications will be graded and certificated on an eight-grade scale from A* to G.

Overall differentiation is achieved within the specification by allowing levels of entry in two overlapping tiers. These tiers of entry allow a full and balanced opportunity for candidates at all levels of attainment to show what they know, understand and can do. Coursework provides differentiation by outcome. The unit tests and examination papers 1–4 provide differentiation by task.

Language of assessment

Assessment of this specification will be available in English only. Assessment materials will be published in English only and all written and spoken work submitted for examination and moderation must be produced in English.

Access arrangements and special considerations

Edexcel's policy on access arrangements and special considerations for GCE, VCE, GCSE, GNVQ, Entry Level and Key Skills aims to enhance access to the qualifications for learners with disabilities and other difficulties (as defined by the Disability Discrimination Act 1995 and the amendments to the act) without compromising the assessment of skills, knowledge, understanding or competence.

Please visit the Edexcel website (www.edexcel.org.uk/sfc) for details on:

- the latest JQC policy Access Arrangements and Special Considerations, Regulations and Guidance Relating to Candidates who are eligible for Adjustments in Examinations
- the forms to submit for requests for access arrangements and special considerations
- dates for submission of the forms.

Requests for access arrangements and special considerations must be addressed to:

Special Requirements
Edexcel
One90 High Holborn
London WC1V 7BH

Grade descriptions

Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by candidates awarded particular grades. The descriptions must be interpreted in relation to the content in the specification; they are not designed to define that content. The grade awarded will depend in practice upon the extent to which the candidate has met the assessment objectives overall. Shortcomings in some aspects of candidates' performance in the assessment may be balanced by better performance in others.

Grade F

In order to carry through tasks and solve mathematical problems, candidates identify and obtain necessary information; they check their results, considering whether these are sensible. Candidates show understanding of situations by describing them mathematically using symbols, words and diagrams. They draw simple conclusions of their own and give an explanation of their reasoning.

Candidates use their understanding of place value to multiply and divide whole numbers and decimals by 10, 100 and 1000. They order, add and subtract negative numbers in context. They use all four operations with decimals to two places. They reduce a fraction to its simplest form by cancelling common factors and solve simple problems involving ratio and direct proportion. They calculate fractional or percentage parts of quantities and measurements, using a calculator where necessary. Candidates understand and use an appropriate non-calculator method for solving problems involving multiplying and dividing any three-digit by any two-digit number. In solving problems with or without a calculator, candidates check the reasonableness of their results by reference to their knowledge of the context or to the size of the numbers, by applying inverse operations or by estimating using approximations. Candidates explore and describe number patterns and relationships including multiple, factor and square. They construct, express in symbolic form, and use simple formulae involving one or two operations.

When constructing models, and when drawing or using shapes, candidates measure and draw angles as accurately as practicable, and use language associated with angle. They know the angle sum of a triangle and that of angles at a point. They identify all the symmetries of 2-D shapes. They know the rough metric equivalents of imperial units still in daily use and convert one metric unit to another. They make sensible estimates of a range of measures in relation to everyday situations. Candidates calculate areas of rectangles. Candidates use coordinates in all four quadrants to locate and specify points.

Candidates understand and use the mean of discrete data. They compare two simple distributions, using the range and one of the mode, median or mean. They interpret graphs and diagrams, including pie charts, and draw conclusions. They understand and use the probability scale from 0 to 1. Candidates make and justify estimates of probability by selecting and using a method based on equally likely outcomes or on experimental evidence as appropriate. They understand that different outcomes may result from repeating an experiment.

Grade C

Starting from problems or contexts that have been presented to them, candidates refine or extend the mathematics used to generate fuller solutions. They give a reason for their choice of mathematical presentation, explaining features they have selected. Candidates justify their generalisations, arguments or solutions, showing some insight into the mathematical structure of the problem. They appreciate the difference between mathematical explanation and experimental evidence.

In making estimates candidates use appropriate techniques and multiply and divide mentally. They solve numerical problems involving multiplication and division with numbers of any size using a calculator efficiently and appropriately. They understand the effects of multiplying and dividing by numbers between 0 and 1. They use ratios in appropriate situations. They understand and use proportional changes. Candidates find and describe in symbols the next term or the nth term of a sequence, where the rule is linear. Candidates calculate one quantity as a percentage of another. They multiply two expressions of the form $(x + n)$; they simplify the corresponding quadratic expressions. They solve simple polynomial equations by trial and improvement and represent inequalities using a number line. They formulate and solve linear equations with whole number coefficients. They manipulate simple algebraic formulae, equations and expressions. Candidates draw and use graphs of quadratic functions.

Candidates solve problems using angle and symmetry properties of polygons and properties of intersecting and parallel lines. They understand and apply Pythagoras' theorem when solving problems in two dimensions. Candidates solve problems involving areas and circumferences of circles. They calculate lengths, areas and volumes in plane shapes and right prisms. Candidates enlarge shapes by a positive whole number or fractional scale factor. They appreciate the imprecision of measurement and recognise that a measurement given to the nearest whole number may be inaccurate by up to one half in either direction. They understand and use compound measures such as speed. Candidates use mathematical instruments to carry out accurate constructions of loci.

Candidates construct and interpret frequency diagrams with grouped data. They specify hypotheses and test them. They determine the modal class and estimate the mean, median and range of a set of grouped data, selecting the statistic most appropriate to their line of enquiry. They use measures of average and range with associated frequency polygons, as appropriate, to compare distributions and make inferences. Candidates understand relative frequency as an estimate of probability and use this to compare outcomes of experiments.

Grade A

Candidates give reasons for the choices they make when investigating within mathematics itself or when using mathematics to analyse tasks; these reasons explain why particular lines of enquiry or procedures are followed and others rejected. Candidates apply the mathematics they know in familiar and unfamiliar contexts. Candidates use mathematical language and symbols effectively in presenting a convincing and reasoned argument. Their reports include mathematical justifications, explaining their solutions to problems involving a number of features or variables.

Candidates manipulate simple surds. They determine the bounds of intervals. Candidates understand and use direct and inverse proportion. They manipulate algebraic formulae, equations and expressions, finding common factors and multiplying two linear expressions. In simplifying algebraic expressions, they use rules of indices for negative and fractional values. They solve problems using intersections and gradients of graphs.

Candidates sketch the graphs of sine, cosine and tangent functions for any angle and generate and interpret graphs based on these functions. Candidates use sine, cosine and tangent of angles of any size, and Pythagoras' theorem, when solving problems in two and three dimensions. They use the conditions for congruent triangles in formal geometric proofs. They calculate lengths of circular arcs and areas of sectors, and calculate the surface area of cylinders and volumes of cones and spheres. They understand and use the effect of enlargement on areas and volumes of shapes and solids.

Candidates interpret and construct histograms. They understand how different methods of sampling and different sample sizes may affect the reliability of conclusions drawn; they select and justify a sample and method to investigate a population. They recognise when and how to work with probabilities associated with independent and mutually exclusive events.

The wider curriculum

Key skills

This specification will provide opportunities, as appropriate, to develop the key skills of communication, information and communication technology, application of number, improving own learning and performance, working with others and problem solving.

A*–C examination performance in GCSE Mathematics provides exemption from the external test in application of number at Level 2.

D–G examination performance in GCSE Mathematics provides exemption from the external test in application of number at Level 1.

Spiritual, moral, ethical, social, cultural and environmental issues, health and safety considerations and the European dimension

This specification will enable centres to provide courses in mathematics that will allow students to discriminate between truth and falsehood. As candidates explore mathematical models of the real world there will be many naturally arising moral and cultural issues, environmental and safety considerations and aspects of European developments for discussion.

Education for citizenship

The specification for GCSE Mathematics gives candidates the opportunity to develop their skills of enquiry and communication in relation to citizenship. In particular they will be able to develop their ability to analyse information from different sources, including ICT-based sources, and explore the use and abuse of statistics. They will also have the opportunity to develop their knowledge and understanding of citizenship. In particular through their work in handling data (AO4), candidates may have the opportunity to explore the use of statistical information in the media and its role in providing information and affecting opinion. Through their work on number (AO2) candidates may explore the practical applications of their work in the fields of business and financial services. Other opportunities for developing ideas of citizenship will present themselves depending on the contexts in which they explore and develop their mathematical knowledge, skills and understanding.

Information and communication technology

Candidates following this specification will have many opportunities to use ICT. These include use of spreadsheets to make calculations, create formulas, charts and graphs and using the internet to gather statistics and data. Dedicated software such as a multimedia CD ROM or dedicated websites can be used to support mathematics work. There is also software available to enhance the delivery of some of the requirements of the GCSE specification. Use of calculators, including graphic and programmable calculators, also falls within the ICT category.

Papers 2 and 4 will provide opportunities to assess candidates’ ability to use a calculator efficiently.

Support and training

Textbooks and other resources

A number of publishers will be producing textbooks and electronic resources to support this qualification. Publishers include Causeway Press, Harcourt, HarperCollins, Hodder Murray, Longman and Oxford University Press.

Training

A programme of professional development courses covering various aspects of the specification and assessment will be arranged by Edexcel each year on a regional basis. Full details may be obtained from:

Professional Development and Training
Edexcel
One90 High Holborn
London WC1V 7BH

Telephone: 0870 240 9800
Fax: 020 7190 5700

Website

www.edexcel.org.uk

Please visit the Edexcel website, where further information about training and support for all qualifications, including this GCSE, can be found.

The website is regularly updated and an increasing amount of support material and information will become available through it.

Edexcel publications

Support materials and further copies of this specification can be obtained from:

Edexcel Publications
Adamsway
Mansfield
Notts NG18 4LN

Telephone: 01623 467467
Fax: 01623 450481
Email: publications@linneydirect.com

The following support materials will be available from spring 2007 onwards:

- specimen papers
- coursework guide
- teachers' guide.

Regional offices and Customer Services

Further advice and guidance is available through a national network of regional offices. For general enquiries, and for details of your nearest office, please call the Customer Services on 0870 240 9800. Calls may be recorded for training purposes.

Appendices

Appendix 1: Assessment criteria for using and applying mathematics (tasks)

Mark	Making and monitoring decisions to solve problems	Communicating mathematically	Developing skills of mathematical reasoning
1	Candidates try different approaches and find ways of overcoming difficulties that arise when they are solving problems. They are beginning to organise their work and check results.	Candidates discuss their mathematical work and are beginning to explain their thinking. They use and interpret mathematical symbols and diagrams.	Candidates show that they understand a general statement by finding particular examples that match it.
2	Candidates are developing their own strategies for solving problems and are using these strategies both in working within mathematics and in applying mathematics to practical contexts.	Candidates present information and results in a clear and organised way, explaining the reasons for their presentation.	Candidates search for a pattern by trying out ideas of their own.
3	In order to carry through tasks and solve mathematical problems, candidates identify and obtain necessary information; they check their results, considering whether these are sensible.	Candidates show understanding of situations by describing them mathematically using symbols, words and diagrams.	Candidates make general statements of their own, based on evidence they have produced, and give an explanation of their reasoning.
4	Candidates carry through substantial tasks and solve quite complex problems by breaking them down into smaller, more manageable tasks.	Candidates interpret, discuss and synthesise information presented in a variety of mathematical forms. Their writing explains and informs their use of diagrams.	Candidates are beginning to give a mathematical justification for their generalisations; they test them by checking particular cases.
5	Starting from problems or contexts that have been presented to them, candidates introduce questions of their own, which generate fuller solutions.	Candidates examine critically and justify their choice of mathematical presentation, considering alternative approaches and explaining improvements they have made.	Candidates justify their generalisations or solutions, showing some insight into the mathematical structure of the situation being investigated. They appreciate the difference between mathematical explanation and experimental evidence.

Mark	Making and monitoring decisions to solve problems	Communicating mathematically	Developing skills of mathematical reasoning
6	Candidates develop and follow alternative approaches. They reflect on their own lines of enquiry when exploring mathematical tasks; in doing so they introduce and use a range of mathematical techniques.	Candidates convey mathematical meaning through consistent use of symbols.	Candidates examine generalisations or solutions reached in an activity, commenting constructively on the reasoning and logic employed, and make further progress in the activity as a result.
7	Candidates analyse alternative approaches to problems involving a number of features or variables. They give detailed reasons for following or rejecting particular lines of enquiry.	Candidates use mathematical language and symbols accurately in presenting a convincing reasoned argument.	Candidate reports include mathematical justifications, explaining their solutions to problems involving a number of features or variables.
8	Candidates consider and evaluate a number of approaches to a substantial task. They explore extensively a context or area of mathematics which they are unfamiliar. They apply independently a range of appropriate mathematical techniques.	Candidates use mathematical language and symbols efficiently in presenting a concise reasoned argument.	Candidates provide a mathematically rigorous justification or proof of their solution to a complex problem, considering the conditions under which it remains valid.

Elaboration of Ma1 Assessment Criteria

	Making and monitoring decisions to solve problems	Minimum requirements	Notes
1/1	Candidates try different approaches and find ways of overcoming difficulties that arise when they are solving problems. They are beginning to organise their work and check results.	The candidate can, with help, understand a simple task and produce some information or results..	Simple task eg matchstick row of squares — one or two random examples
1/2	Candidates are developing their own strategies for solving problems and are using these strategies both in working within mathematics and in applying mathematics to practical contexts.	The candidate interprets a simple task showing some evidence of their own planning, and obtains a number of results, but no conclusion.	Planning may simply imply more calculations or results. Those may contain errors.
1/3	In order to carry through tasks and solve mathematical problems, candidates identify and obtain necessary information: they check their results, considering whether these are sensible.	The candidate obtains what is required to solve a simple task, finding and checking necessary information.	Checking: There should be no results that are obviously wrong eg 1, 2, 3, 5, 8, 25, 21 for Fibonacci. Checking is implied by correct results.
1/4	Candidates carry through substantial tasks and solve quite complex problems by breaking them down into smaller, more manageable tasks.	The candidate carries through a substantial task without additional direction, by breaking it down into smaller more manageable sub-tasks at least one of which is solved.	Substantial task: A task that needs to be subdivided into smaller tasks by the candidate in order to reach a solution.
1/5	Starting from problems or contexts that have been presented to them, candidates introduce questions of their own, which generate fuller solutions.	The candidate independently extends the task by changing one feature in order to give a fuller solution.	A feature is some aspect of the task such as a variable, constraint or condition
1/6	Candidates develop and follow alternative approaches. They reflect on their own lines of enquiry when exploring mathematical tasks; in doing so they introduce and use a range of mathematical techniques	The candidate reflects on their line of enquiry and uses an additional relevant technique to extend the task further.	Reflects: Looks at and learns from their previous experience and moves the task on.
1/7	Candidates analyse alternative approaches to problems involving a number of features of variables. They give detailed reasons for following or rejecting particular lines of enquiry.	The candidate works on complex task(s) involving at least three features and gives reasons for following or rejecting lines of enquiry.	Complex task: A substantial task involving at least three features requiring a range of techniques to reach a solution. The work must be at an appropriate level.
1/8	Candidates consider and evaluate a number of approaches to a substantial task. They explore extensively a context or area of mathematics with which they are unfamiliar. They apply independently a range of appropriate mathematical techniques.	The candidate applies independently appropriate mathematical techniques extensively to solve a complex problem.	The mathematics should be from the National Curriculum ‘further material’ or beyond.

In strand 1: a maximum of 3 marks should be awarded in relation to ‘simple’ tasks; a maximum of 6 marks should be awarded to ‘substantial tasks; a maximum of 8 marks should be awarded in relation to ‘complex’ tasks.

To qualify for a mark of 4, 6, 8 on any strand the content of the task must meet, or go beyond, the relevant aspects of the grade descriptors for grades E, C and A respectively.

	Communicating mathematically	Minimum requirements	Notes
2/1	Candidates discuss their mathematical work and are beginning to explain their thinking. They use and interpret mathematical symbols and diagrams.	The candidate shows some evidence of their thinking.	This may be oral, (supported by teacher annotation), or written and could take the form of random calculations or drawings etc.
2/2	Candidates present information and results in a clear and organised way, explaining the reasons for their presentation.	The candidates present some information or results in a clear or organised way.	This could include listing and/or diagrams
2/3	Candidates show understanding of situations by describing them mathematically using symbols, words and diagrams.	The candidate shows some understanding of the task by describing a feature of the task mathematically by using words and symbols or symbols and diagrams.	Words can be headings, statements or connectives. It could be shown by a list with 'lettered' headings.
2/4	Candidates interpret, discuss and synthesise information presented in a variety of mathematical forms. Candidates' writing explains and informs their use of diagrams.	The candidate brings together more than one form of mathematical presentation with a linking commentary.	This is not a series of displays or diagrams included for no purpose. The commentary must allow the reader to understand what the candidate has done.
2/5	Candidates examine critically and justify their choice of mathematical presentation, considering alternative approaches and explaining improvements they have made.	The candidate gives some explanation for their choice of presentation may be symbolic or diagrammatic.	The introduction of a simple algebraic formula does not justify 6 marks in this strand but, as best fit, could achieve 5 marks. Key words such as 'because', 'therefore', 'hence', 'since', … could be used when justifying improvements.
2/6	Candidates convey mathematical meaning through consistent use of symbols.	The candidate conveys mathematical meaning through the sustained use of symbolism * at the appropriate level.	Variables need to be defined and symbols must be correctly used in a number of cases. Some minor errors or omissions may occur without penalty.
2/7	Candidates use mathematical language and symbols accurately in presenting a convincing reasoned argument.	The candidate presents a convincing reasoned argument through the use of mathematical language and symbolism which is generally accurate.	There should be increased emphasis on accuracy. Incorrect algebra cannot lead to a convincing argument.
2/8	Candidates use mathematical language and symbols efficiently in presenting a concise reasoned argument.	The candidate produces an elegant argument.	

To qualify for a mark of 4, 6, 8 on any strand the content of the task must meet, or go beyond, the relevant aspects of the grade descriptors for grades F, C and A respectively.

* Symbolism might include for example: 1 Algebra

2 Trigonometry

3 Statistics

4 Probability

	Developing the skills of mathematical reasoning	Minimum requirements	Notes
3/1	Candidates show that they understand a general statement by finding particular examples that match it.	The candidate produces a simple example that shows an understanding of the task.	
3/2	Candidates search for a pattern by trying out ideas of their own.	The candidate gathers sufficient data from which a simple observation may be made.	In most situations this would involve at least three results.
3/3	Candidates make general statements of their own, based on evidence they have produced, and give an explanation of their reasoning.	The candidate makes a general statement based on their results.	Their result need not be correct for the task but should be consistent with their data. A general statement might be as simple as ‘goes up in 2’s’ or ‘all odd numbers’.
3/4	Candidates are beginning to give a mathematical justification for their generalisation; they test them by checking particular cases.	The candidate tests their generalisation by checking a further case.	A test is a prediction with a confirmation from the mathematical situation of the problem using new data.
3/5	Candidates justify their generalisation or solutions, showing some insight into the mathematical structure of the situation being investigated. They appreciate the difference between mathematical explanation and experimental evidence.	The candidate produces a sensible argument stating why the results occur by relating these results to the mathematical situation eg physical, geometrical or graphic.	For example explaining why coefficients and constants in a generalisation occur, not simply from difference tables.
3/6	Candidates justify their generalisation or solutions reached in an activity, commenting constructively on the reasoning and logic employed, and make further progress in the activity as a result.	The candidate uses reasoning and logic to make further progress in the activity.	
3/7	Candidate reports include mathematical justifications, explaining their solutions to problems involving a number of features or variables.	The candidate gives a general result or conclusion with justification for parts of the overall solution, coordinating at least three features.	This mark cannot be awarded without the award of 7 or 8 marks in strand 1.
3/8	Candidates provide a mathematically rigorous justification or proof of their solution to a complex problem, considering the conditions under which it remains valid.		

To qualify for a mark of 4, 6, 8 on any strand the content of the task must meet, or go beyond, the relevant aspects of the grade descriptors for grades F, C and A respectively.

Appendix 2: Assessment criteria for data-handling projects

Notes:

- One major project is expected, not several smaller ones.
- The criteria are to be used as best-fit indicative descriptions and the statements within them are not to be taken as hurdles. This means candidates' work should be assessed in relation to the criteria taken as holistic descriptions of performance. The first consideration is which of the descriptions in each strand best describes the work in a candidate's project. Once that is established, the final step is to decide between the lower and higher mark available for that description. This decision may well involve looking again at the criteria above and below the selected best fitting criterion. It is not appropriate to take each statement in each description and regard it as a separate assessment criterion. Nor is it necessary to consider whether the majority of the statements within a criterion have been met.
- A mark of 0 should be awarded if a candidate's work fails to satisfy the requirements for 1 mark.
- Descriptions for higher marks subsume those for lower marks.
- Where there are references to 'at least the level detailed in the handling data paragraph of the grade description for grade X', work which uses no technique beyond the specified grade is indicative of the lower of the two marks. To obtain the higher of the two marks requires processing and analysis using techniques that best fit a more demanding standard.
- In these criteria, there is an intended approximate link between 7 marks and grade A, 5 marks and grade C, and 3 marks and grade F.

Specify the problem and plan

Mark	Mark description
1–2	Candidates choose a simple well-defined problem. Their aims have some clarity. The appropriate data to collect are reasonably obvious. An overall plan is discernible and some attention is given to whether the plan will meet the aims. The structure of the report as a whole is loosely related to the aims.
3–4	Candidates choose a problem involving routine use of simple statistical techniques and set out reasonably clear aims. Consideration is given to the collection of data. Candidates describe an overall plan largely designed to meet the aims and structure the project report so that results relating to some of the aims are brought out. Where appropriate, they use a sample of adequate size.
5–6	Candidates consider a more complex problem. They choose appropriate data to collect and state their aims in statistical terms with the selection of an appropriate plan. Their plan is designed to meet the aims and is well described. Candidates consider the practical problems of carrying out the survey or experiment. Where appropriate, they give reasons for choosing a particular sampling method. The project report is well structured so that the project can be seen as a whole.
7–8	Candidates work on a problem requiring creative thinking and careful specification. They state their aims clearly in statistical terms and select and develop an appropriate plan to meet these aims giving reasons for their choice. They foresee and plan for practical problems in carrying out the survey or experiment. Where appropriate, they consider the nature and size of sample to be used and take steps to avoid bias. Where appropriate, they use techniques such as control groups, or pre-tests or questionnaires or data sheets, and refine these to enhance the project. The project report is well structured and the conclusions are related to the initial aims.

Collect, process and represent data

Mark	Mark description
1–2	Candidates collect data with limited relevance to the problem and plan. The data is collected or recorded with little thought given to processing. Candidates use calculations of the simplest kind. The results are frequently correct. Candidates present information and results in a clear and organised way. The data presentation is sometimes related to their overall plan.
3–4	Candidates collect data with some relevance to the problem and plan. The data is collected or recorded with some consideration given to efficient processing. Candidates use straightforward and largely relevant calculations involving techniques of at least the level detailed in the handling data paragraph of the grade description for grade F. The results are generally correct. Candidates show understanding of situations by describing them using statistical concepts, words and diagrams. They synthesise information presented in a variety of forms. Their writing explains and informs their use of diagrams, which are usually related to their overall plan. They present their diagrams correctly, with suitable scales and titles.
5–6	Candidates collect largely relevant and mainly reliable data. The data is collected in a form designed to ensure that they can be used. Candidates use a range of more demanding, largely relevant calculations that include techniques meeting the level detailed in the handling data paragraph of the grade description for grade C. The results are generally correct and no obviously relevant calculation is omitted. There is little redundancy in calculation or presentation. Candidates convey statistical meaning through precise and consistent use of statistical concepts that is sustained throughout the work. They use appropriate diagrams for representing data and give a reason for their choice of presentation, explaining features they have selected.
7–8	Candidates collect reliable data relevant to the problem under consideration. They deal with practical problems such as non-response, missing data or ensuring secondary data are appropriate. Candidates use a range of relevant calculations that include techniques meeting the level detailed in the handling data paragraph of the grade description for grade A. These calculations are correct and no obviously relevant calculation is omitted. Numerical results are rounded appropriately. There is no redundancy in calculation or presentation. Candidates use language and statistical concepts effectively in presenting a convincing reasoned argument. They use an appropriate range of diagrams to summarise the data and show how variables are related.

Interpret and discuss results

Mark	Mark description
1–2	Candidates comment on patterns in the data. They summarise the results they have obtained but make little attempt to relate the results to the initial problem.
3–4	Candidates comment on patterns in the data and any exceptions. They summarise and give a reasonably correct interpretation of their graphs and calculations. They attempt to relate the summarised data to the initial problem, though some conclusions may be incorrect or irrelevant. They make some attempt to evaluate their strategy.
5–6	Candidates comment on patterns in the data and suggest reasons for exceptions. They summarise and correctly interpret their graphs and calculations, relate the summarised data to the initial problem and draw appropriate inferences. Candidates use summary statistics to make relevant comparisons and show an informal appreciation that results may not be statistically significant. Where relevant, they allow for the nature of the sampling method in making inferences about the population. They evaluate the effectiveness of the overall strategy and make a simple assessment of limitations.
7–8	Candidates comment on patterns and give plausible reasons for exceptions. They correctly summarise and interpret graphs and calculations. They make correct and detailed inferences from the data concerning the original problem using the vocabulary of probability. Candidates appreciate the significance of results they obtain. Where relevant, they allow for the nature and size of the sample and any possible bias in making inferences about the population. They evaluate the effectiveness of the overall strategy and recognise limitations of the work done, making suggestions for improvement. They comment constructively on the practical consequences of the work.

Elaboration of AO4 Assessment criteria

SPECIFY and PLAN

Notes: **1. In these criteria there is an intended approximate link between 7 marks and grade A, 5 marks and grade C and 3 marks and grade F.**
2. Candidates must provide evidence of their plan being implemented.
3. If secondary data is provided it must be in sufficient quantity to allow sampling to take place.

Mark	Description	Minimum requirements	Teachers' notes
1	Candidates choose a simple well-defined problem. Their aims have some clarity. The appropriate data to collect are reasonably obvious. An overall plan is	• The candidate shows they understand a simple problem. • There is an implicit plan.	May be shown by collecting or using some data.
2	discernible and some attention is given to whether the plan will meet the aims. The structure of the report as a whole is loosely related to the aims.		
3	Candidates choose a problem involving routine use of simple statistical techniques and set out reasonably clear aims. Consideration is given to the collection of data. Candidates describe an overall plan largely designed to meet the aims and structure the project report so that results relating to some of the aims are brought out. Where appropriate, they use a sample of adequate size.	• Candidates set out reasonably clear aims (or the purpose). • Their planning is largely designed to meet the aims/purpose. • They use data appropriate to the problem.	These aims can occur at any point within the work. Appropriate data would allow a valid inference to be drawn meeting the stated aims/purpose.
4			
5	Candidates consider a more complex problem. They choose appropriate data to collect and state their aims in statistical terms with the selection of an appropriate plan. Their plan is designed to meet the aims and is well-described. Candidates consider the practical problems of carrying out the survey or experiment. Where appropriate, they give reasons for choosing a	• Candidates consider a **substantial** problem stating their initial aims clearly at the beginning of the report. • Their plan is explicitly stated to meet those aims. • They choose an appropriate sample.	A 'more complex' problem is defined as substantial ie one in which comparisons are made relating a number of features. Initial aims may be revised or reviewed as the work develops. A sample size of 30 is often reasonable for problems at this level.
6	particular sampling method. The project report is well structured so that the project can be seen as a whole.		
7	Candidates work on a problem requiring creative thinking and careful specification. They state their aims clearly in statistical terms and select and develop an appropriate plan to meet these aims giving reasons for their choice. They foresee and plan for practical problems in carrying out the survey or experiment.	• Candidates work on a **demanding** problem. • They state their aims clearly in statistical terms and give valid reasons for their choice of planning. • They explain and act upon limitations of their chosen sample (eg bias), where appropriate.	A demanding problem is defined as one which requires careful specification, sophisticated thinking and efficient planning.
8	Where appropriate, they consider the nature and size of sample to be used and take steps to avoid bias. Where appropriate, they use techniques such as control groups, or pre-tests or questionnaires or data sheets, and refine these to enhance the project. The project report is well structured and the conclusions are related to the initial aims.		

COLLECT, PROCESS and REPRESENT

Notes:
1. In these criteria there is an intended approximate link between 7 marks and grade A, 5 marks and grade C and 3 marks and grade F.
2. The mark awarded to a particular technique should reflect the quality of use and understanding as well as its position within the Level Indicators.
3. The inclusion of statistical techniques outside the National Curriculum does not necessarily justify the award of higher marks.
4. 'Diagrams' include tables, charts and graphs. At 5-6 marks the diagrams used should be appropriate. At 7–8 marks the range of diagrams should be appropriate to the problem chosen and the statistical strategy chosen.
5. 'Redundancy' implies unnecessary and/or inappropriate diagrams or calculations. This includes techniques that are not used for any conclusion.

Mark	Description	Minimum requirements	Level indicators
1	Candidates collect data with limited relevance to the problem and plan. The data are collected or recorded with little thought given to processing. Candidates use calculations of the simplest kind. The results are frequently correct. Candidates present information and results in a clear and organised way. The data presentation is sometimes related to their overall plan.	• Candidates collect or use data and record it.	For example extract and interpret information in simple tables and lists; construct bar charts and pictograms and interpret. For example collect discrete data and record using frequency tables; understand and use mode and range of data; group data in equal class intervals; represent collected data in frequency diagrams and interpret; construct and interpret simple line graphs.
2			
3	Candidates collect data with some relevance to the problem and plan. The data are collected or recorded with some consideration given to efficient processing. Candidates use straightforward and largely relevant calculations involving techniques meeting the level detailed in the handling data paragraph of the grade description for grade F. The results are generally correct. Candidates show understanding of situations by describing them using statistical concepts, words and diagrams. They synthesise information presented in a variety of forms. Their writing explains and informs their use of diagrams, which are usually related to their overall plan. They present their diagrams correctly, with suitable scales and titles.	• Candidates collect or use data with some relevance to the problem. • They utilise statistical techniques/diagrams (see note 1 above) to process and represent the data. • Their results are generally correct.	For example understand and use mean of discrete data; compare simple distributions using range and one of mean, mode, median; interpret diagrams, including pie charts, and draw conclusions. For example collect and record continuous data, choosing appropriate equal class intervals to create frequency tables; construct and interpret frequency tables; construct pie charts; draw conclusions from scatter diagrams and have a basic understanding of correlation.
4			
5	Candidates collect largely relevant and mainly reliable data. The data are collected in a form designed to ensure that they can be used. Candidates use a range of more demanding, largely relevant calculations that include techniques meeting the level detailed in the handling data paragraph of the grade description for grade C. The results are generally correct and no obviously relevant calculation is omitted. There is little redundancy in calculation or presentation. Candidates convey statistical meaning through precise and consistent use of statistical concepts that is sustained throughout the work. They use appropriate diagrams for representing data and give a reason for their choice of presentation, explaining features they have selected.	• Candidates collect/sample largely relevant data. • They utilise appropriate calculations/techniques/ diagrams (see note 1 above) within the problem. • Their results are generally correct.	For example specify and test hypotheses using appropriate methods to take account of variability or bias; determine modal class and estimate mean, median and range of grouped data, selecting the most appropriate statistic; use measures of average and range, with frequency polygons, to compare distributions and make inferences; draw a line of best fit on a scatter diagram, by inspection. For example interpret and construct cumulative frequency diagrams; estimate median and interquartile range and use to compare distributions and make inferences.
6			
7	Candidates collect reliable data relevant to the problem under consideration. They deal with practical problems such as non-response, missing data or ensuring secondary data are appropriate. Candidates use a range of relevant calculations that include techniques meeting the level detailed in the handling data paragraph of the grade description for grade A. These calculations are correct and no obviously relevant calculation is omitted. Numerical results are rounded appropriately. There is no redundancy in calculation or presentation. Candidates use language and statistical concepts effectively in presenting a convincing reasoned argument. They use an appropriate range of diagrams to summarise the data and show how variables are related.	• Candidates collect/sample largely relevant data. • They utilise appropriate and necessary calculations/techniques/ diagrams (see note 1 above) consistently within the problem. • Their results are correct. (***Some minor errors may be condoned provided they do not detract from the quality of the argument.***)	For example interpret and construct histograms; understand how different methods of sampling and different sample sizes affect reliability of conclusions drawn; select and justify a sample and method to investigate a population.
8			

INTERPRET and DISCUSS

Notes:

1. In these criteria there is an intended approximate link between 7 marks and grade A, 5 marks and grade C and 3 marks and grade F.
2. The number of marks awarded at this strand is unlikely to exceed the mark at Strand 1 by more than 1.
3. The use of ICT is to be encouraged to allow candidates more time to analyse and interpret the data. (There is no requirement for the diagrams to be drawn by hand).

Mark	Description	Minimum requirements	Teachers' notes
1	Candidates comment on patterns in the data. They summarise the results they have obtained but make little attempt to relate the results to the initial problem.	• Candidates comment on their data.	
2			
3	Candidates comment on patterns in the data and any exceptions. They summarise and give a reasonably correct interpretation of their graphs and calculations. They attempt to relate the summarised data to the initial problem, though some conclusions may be incorrect or irrelevant. They make some attempt to evaluate their strategy.	• Candidates summarise some of their data. • They make a statement based on their diagrams or calculations, which is relevant to the problem.	
4			
5	Candidates comment on patterns in the data and suggest reasons for exceptions. They summarise and correctly interpret their graphs and calculations, relate the summarised data to the initial problem and draw appropriate inferences. Candidates use summary statistics to make relevant comparisons and show an informal appreciation that results may not be statistically significant. Where relevant, they allow for the nature of the sampling method in making inferences about the population. They evaluate the effectiveness of the overall strategy and make a simple assessment of limitations.	• Candidates summarise **and** correctly interpret their diagrams or calculations. • They relate these interpretations back to the original problem. • They evaluate their strategy.	Some relevant comparisons are likely to be included. An evaluation of strategy should include reflective comments on the strengths and/or weaknesses of their methodology in identifying, collecting or processing data.
6			
7	Candidates comment on patterns and give plausible reasons for exceptions. They correctly summarise and interpret graphs and calculations. They make correct and detailed inferences from the data concerning the original problem using the vocabulary of probability. Candidates appreciate the significance of results they obtain. Where relevant, they allow for the nature and size of the sample and any possible bias in making inferences about the population. They evaluate the effectiveness of the overall strategy and recognise limitations of the work done, making suggestions for improvement. They comment constructively on the practical consequences of the work.	• Candidates summarise and correctly interpret their results. • They show an appreciation of the significance of these results. • They recognise possible limitations in their strategy and suggest improvements.	The use of the phrase 'using the vocabulary of probability' (with statistical relevance) is intended to recognise that the best work will give some indication how likely or unlikely the events inferred from the data are.
8			

Appendix 3: Option A — Teacher Assessed Coursework

GCSE Mathematics Specifications A and B (2540/2544)

Coursework Record Form

Candidate name: ____________________ Candidate number: ____________

Centre name: ____________________ Centre number: ____________

Task: ____________________ Project: ____________________

Date: __________ Date: __________

Tier of Entry __________

Overall Total Mark (out of 48)

______

Task 1		Task 2 (optional)		Project	
Strand	Mark	Strand	Mark	Area	Mark
1		1		1	
2		2		2	
3		3		3	

Help given over and above normal classroom practice

Date	Nature of help

Candidate's oral contribution

Candidate's practical work

DECLARATION TO BE SIGNED BY THE CANDIDATE

I declare that the work submitted for assessment has been carried out without assistance other than that which is acceptable under the scheme of assessment.

Signed: .... **Date:** ....

DECLARATION TO BE SIGNED BY THE TEACHER-EXAMINER RESPONSIBLE FOR COMPLETING THE TASK FORM

I declare that the task and project of the candidate in respect of the marks on this form have been kept under regular supervision and that, to the best of my knowledge, no assistance has been given apart from any which is acceptable under the scheme of assessment and has been identified and recorded.

Signed: .... **Date:** ....

Appendix 4: Key skills

The GCSE in Mathematics offers a range of opportunities for students to:

- develop their key skills
- generate assessed evidence for their portfolio.

In particular, the following key skills can be developed and assessed through this specification at Level 2:

- application of number
- communication
- information and communication technology
- improving own learning and performance
- working with others
- problem solving.

Further guidance on the development of Level 1 key skills through the GCSE in Mathematics will be made available in future publications.

Copies of the key skills specifications can be ordered from Edexcel Publications.

Individual key skills units are divided into three parts:

• **Part A** — what you need to know	this identifies the underpinning knowledge and skills required of the student
• **Part B** — what you must do	this identifies the evidence that students must produce for their portfolio
• **Part C** — guidance	this gives examples of possible activities and types of evidence that may be generated.

This GCSE specification signposts development and internal assessment opportunities which are based on Part B of the Level 2 key skills units.

The evidence generated through this GCSE will be internally assessed and contribute to students' key skills portfolios. In addition, in order to achieve the key skills Qualification, students will need to take the additional external tests associated with communication, information and communication technology and application of number. Centres should check the current position on proxy qualifications as some students may be exempt from part or all of the assessment of a specific key skill.

The GCSE in Mathematics will provide many opportunities for the development of the key skills identified. This appendix provides a mapping of those opportunities and also identifies the key skills evidence requirements. Students will need to have opportunities to develop their skills over time before they are ready for assessment. In order to satisfy the key skills requirements, students will need to apply their mathematical skills **in context**. Teachers need to adopt a method of delivering the specifications which ensures that students are given the opportunities to use and apply their knowledge in a sustained way, creating a portfolio of evidence as they progress through the GCSE syllabus. Evidence for their key skills portfolio could be compiled as they complete their coursework tasks for GCSE.

This appendix contains illustrative activities for each key skill that will aid development and facilitate the generation of appropriate portfolio evidence. To assist in the recording of key skills evidence Edexcel has produced recording documentation which can be ordered from Edexcel Publications.

Mapping of key skills: summary table

Key skills (Level 2)	Foundation tier	Higher tier
Application of number		
N2.1	✓ (grade C standard or above)	✓
N2.2	✓ (grade C standard or above)	✓
N2.3	✓	✓
Communication		
C2.1a	✓	✓
C2.1b	✓	✓
C2.2		
C2.3	✓	✓
Information and communication technology		
IT2.1	✓	✓
IT2.2	✓	✓
IT2.3	✓	✓
Working with others		
WO2.1	✓	✓
WO2.2	✓	✓
WO2.3	✓	✓
Improving own learning and performance		
LP2.1	✓	✓
LP2.2	✓	✓
LP2.3	✓	✓
Problem solving		
PS2.1	✓	✓
PS2.2	✓	✓
PS2.3	✓	✓

Application of number Level 2

The GCSE in Mathematics provides opportunities for students both to develop the key skill of application of number and also to generate evidence for their portfolio. As well as undertaking tasks related to the three areas of evidence required students also undertake a substantial activity that includes straightforward tasks. This will involve them obtaining and interpreting information, using this information when carrying out calculations, and interpreting and presenting the results of the calculations.

Key skill portfolio evidence requirements		Opportunities for development or internal assessment
N2.1	Interpret information from **two** different sources, including material containing a graph.	Students are required to: • choose how to obtain the information needed to meet the purpose of their activity • obtain the relevant information • select the appropriate methods to get the results they need. For example, the criteria for N2.1 are satisfied when: • producing a plan of action and breaking down a task into manageable components when given a practical problem to solve, eg designing a drinks can which maximises volume against minimising surface area, choosing to adopt a symbolic approach to a modelling task such as ‘Mobile Phones’, or ‘Open Box Problem’, deciding to group a large amount of data to enable a concise estimate of suitable average and spread to be calculated • designing a data collection sheet/questionnaire to gather relevant data for their statistics task, eg redesigning of a questionnaire after a pilot survey, using open and/or closed questioning techniques in the appropriate place • deciding upon a suitable sample and sampling method when collecting data from a large sample frame, eg ensure that in a sample of 50 students in school, proportions of male and female and/or numbers in each year group are maintained • gathering relevant information from a secondary data source, in chart or graphical form or written as an article, eg accident statistics, health statistics, newspaper articles. NB Students must be given tasks to solve where they have to choose the methods of calculation. In completing the GCSE in Mathematics at Level 2 students may not be given the opportunity to ‘read scales on a range of equipment to given levels of accuracy’.

Key skill portfolio evidence requirements		Opportunities for development or internal assessment
N2.2	Carry out calculations to do with: a amounts and sizes b scales and proportions c handling statistics d using formulae.	Students must: • carry out calculations, clearly showing their methods and levels of accuracy • check their methods to identify and correct any errors, and make sure their results make sense. For example, the criteria for N2.2 are satisfied when: • students carry out multi-stage calculations throughout the GCSE course, particularly when solving problems set in a real life context, eg using Pythagoras' theorem or trigonometry in surveying problems, using percentages when calculating interest or percentage profit and loss over several years, using indices when solving problems relating to population growth or radioactive decay • students understand and use fractions, decimals, ratio, proportion and percentages in context, eg creating and maintaining a shares portfolio over the GCSE course, producing a scale drawing of a room or building which is then used to redesign its layout for a purpose, completing any of the coursework tasks 'Patterns with Fractions', 'Metro mono', 'The Dice Game', 'Bugs' • converting measurements between systems, eg comparing prices of a selection of items from an overseas country to their own, comparing historical records of prices, athletic records, etc, to the present day • using the appropriate formulae to calculate, for example, lengths, areas and volumes, distance, speed or time. Completing tasks such as 'Mobile Pones', 'Open Box Problem', 'The Fencing Problem', 'The Carpet', beyond mark 4 of the GCSE coursework criteria • performing statistical calculations to enable comparisons of central tendency and spread for two data sets containing a minimum of 20 items of data in each, eg completing tasks such as 'Gary's Car Sales' • building in checking procedures into their extended tasks, making sure results are sensible, eg calculating percentage errors, using maximum and minimum values in compound calculations and recognising the effect this has on optimum solutions. NB The content of the GCSE specification from grade C upward would normally cover N2.2. However, it is important that students perform these calculations in the context of real life problems and tasks. Coursework tasks which are practical in nature or involve modelling/simulations are an ideal medium for satisfying the criteria.

Key skill portfolio evidence requirements		Opportunities for development or internal assessment
N2.3	Interpret results of your calculations and present your finding in two different ways using charts, graphs or diagrams.	Based on their findings, students must: • select effective methods of presentation • use appropriate charts, diagrams, and tables to present their findings clearly and describe their methods • explain how the results of their calculations meet the purpose of the activity undertaken. For example, the criteria for N2.3 are satisfied when: • methods of calculation are discussed and justified, eg when achieving mark 5 in strand 2 and beyond of the coursework criteria, a student discusses the change of approach and explains the benefits of their restructuring, ‘ If I use n to stand for any number then the result will work for all values…’, ‘ If I put these values on a graph I can see where they cross…’, ‘ If I put this equation and this one together…’, ‘If I substitute this expression in this equation…’ • students construct and use graphs, charts or diagrams to make further progress in a task, eg ‘Open Box Problem’, ‘Fencing Problem’, ‘Mobile Phones’, ‘The Dice Game’, ‘Gary’s Car Sales’ • arriving at conclusions that are explained and justified, eg ‘A square is the greatest area for a quadrilateral because…’ ‘Boys are generally taller in year 10 because…’ ‘An ISA will give you a better return for your money because…’ NB A student who takes a task or problem which uses grade C concepts to set up, process and solve a particular problem and then refines their approach to arrive at a better solution is meeting the required standard. This redefining the model in an attempt to improve the solution is linked with mark 5 in strand 3 of the coursework assessment criteria and also satisfies N2.3.

Evidence

Student evidence for application of number could include:

- description of the substantial activity
- a plan for obtaining and using the information required
- copies of source materials
- records of calculations showing methods used and levels of accuracy
- descriptions of findings, including justification of their presentation methods and explanations of how their results relate to their activity.

Communication Level 2

For the communication key skill, students are required to hold discussions and give presentations, read and summarise information, and write documents. Students will be able to develop all of these skills through an appropriate teaching and learning programme based on this GCSE specification.

Key skill portfolio evidence requirements		Opportunities for development or internal assessment
C2.1a	Take part in a group discussion.	Many of the topics in this specification are suitable as the basis of a group discussion. The discussion should be about a straightforward subject. This may be, for example, a subject often met in their studies and the vocabulary will be familiar. During the discussion students should make clear and relevant contributions, listen and respond to others, helping to move the discussion forward. Many topics within the specification lend themselves to group discussion, eg the validity of an answer given to five decimal places, the 'best' shape for a box of six tennis balls, the likely outcome of a probability experiment.
C21.b	Give a talk of at least four minutes.	Following a period of research students could be given the opportunity to give a short talk to the rest of their group. During the talk students should speak clearly in a way that suits the subject and situation. They should keep to the subject. The structure of the talk should help listeners follow points made. The talk should include an image to illustrate the main points clearly. Images could include charts and diagrams or other statistical diagrams, etc. Students could make presentations to a small group or class relating to topics in the specifications. Teachers should involve students in explaining results they have achieved in small and extended tasks. A student could illustrate using diagrams, for example, why the exterior angle of a nonagon is 140°, or use an overhead projector slide to illustrate the solution to a problem involving circle theorems.

Key skill portfolio evidence requirements		Opportunities for development or internal assessment
C2.2	Read and summarise information from **two** documents about the same subject. Each document must be at least 500 words long.	Students will have a number of opportunities to read and synthesise information from two extended documents, for example, as part of their preparation for the discussion and talk, or as preparation for a piece of written work for their GCSE. Extended documents may include textbooks and reports and articles of more than three pages. At least one of these documents should contain an image from which students can draw appropriate and relevant information. Students will need to select and read relevant material. From this information they will need to identify accurately the lines of reasoning and main points from the text and images. Students will then need to summarise this information in a form that suits the purpose, eg for a talk, discussion or an essay. Careful selection of their statistical investigation for GCSE would allow students to collect two sets of primary and/or secondary data which would enable a comparison to be drawn between the two, eg comparing the length of words and sentences of a foreign language to students' own language, comparing the length of words and sentences in newspapers from the 19th and 20th centuries, comparing data on a subject from abroad to the UK.
C2.3	Write **two** different types of documents, each one giving different information. **One** document must be at least 500 words long.	Students are required to produce two different types of document. At least one of these should be an extended document, for example a report or an essay of more than three pages. The document should present relevant information in an appropriate form. At least one of the documents should include an appropriate image that contains and effectively conveys relevant information. The information in the document should be clearly structured, eg through the use of headings, paragraphs. Students should ensure that the text is legible and that spelling, punctuation and grammar are accurate. In completing their two pieces of externally assessed work for GCSE, students should provide a commentary outlining their reasoning and choices made throughout the tasks. The use of diagrams, charts and/or images is expected in the extended piece of work.

Evidence

Student evidence for communication could include:

- teacher observation records
- preparatory notes
- audio/video tapes
- notes based on documents read
- essays.

It is not expected that the evidence produced during the GCSE in Mathematics for this key skill would be sufficient to satisfy the requirements. However, both of the externally assessed pieces of work should be written in a form that would make some contribution to the assessment of this key skill.

Information and communication technology Level 2

When producing work for their GCSE in Mathematics, students will have numerous opportunities to use information and communication technology. The internet, CD ROM, etc could be used to collect information. Documents can be produced using relevant software and images may be incorporated in those documents. Early drafts of documents could be emailed to tutors for initial comments and feedback.

If students undertaking coursework as part of their GCSE in Mathematics use information and communication technology, they will have opportunities to generate evidence for all three sections identified in Part B of the key skills specification.

In addition, students will be able to use information and communication technology to generate evidence for the communication key skill. For example the extended document with images, required for C2.3, could be generated using appropriate software.

Mathematics students should utilise ICT as a modelling tool, particularly when using graphical calculators and spreadsheets. Accounts of their use in this way should be encouraged as part of students' portfolios.

As part of their mathematics programme students may not be able to generate sufficient evidence required for this key skills unit. For example, working with numbers through the use of a spreadsheet application, or some aspects of database use. In this situation, students may use stand-alone IT sessions for development and evidence generation and/or other parts of their GCSE course.

Key skill portfolio evidence requirements		**Opportunities for development or internal assessment**
ICT2.1	Search for and select information to suit your needs. Use different information sources for each task and multiple search criteria in at least one case. You should include at least one ICT based source and one non-ICT based information source. You should present evidence of purposeful use of email.	Students will need to identify suitable sources of information and effectively search for information using multiple criteria. Information selected should be interpreted and students should decide what is relevant for their purpose. For example, opportunities for partially satisfying this criteria include: Collecting data from a variety of internet sources including: • Office for Health Statistics • DfES website for educational performance tables • www.ons.gov.uk • www.detr.gov.uk • www.stats.demon.nl • www.hea.org.uk/research/index.html Interrogating a database.

Key skill portfolio evidence requirements		Opportunities for development or internal assessment
ICT2.2	Explore and develop information and to suit the task and derive new information.	Students are required to bring together information in formats, such as tables, that help development. The information should be explored by, for example, changing information in a spreadsheet model. Information should also be developed and new information derived as appropriate, for example through the use of headings, tables, charts and graphs. New information should be derived from, for example, comparing information from different sources, using formulae to calculate totals or averages. For example, use of a spreadsheet to tabulate and then graph a curve to achieve a maximum or optimum value, eg 'Open Box Problem', 'Maxi Product', 'The Fencing Problem' are all enhanced greatly through the use of a spreadsheet. Modelling exercises such as probability exercises, eg 'The Dice Game', 'Bugs', 'Metro-mono' can all use spreadsheets to arrive at the results much more quickly than by using conventional methods.
ICT2.3	Present combined information such as text with image, text with number and image with number. This work must include at least **one** example of text, **one** example of images and **one** example of numbers.	In presenting combined information students will need to select and use appropriate layouts in a consistent way through, for example, the use of margins, headings, borders, font size, etc. Layouts, etc, should be refined to suit both the purpose and the needs of the audience (early drafts should be kept as portfolio evidence). The final piece of work should be suitable for its purpose and audience, eg GCSE coursework, OHTs/handouts for a presentation. The document should have accurate spelling (use of spell-checker) and have been proof read.

Evidence

Student evidence for information and communication technology could include:

- teacher observation records
- notes of sources used
- print-outs with annotations
- draft documents.

Working with others Level 2

To achieve this key skill, students are required to carry out at least two activities. One example must show that they can work in one-to-one situations and one example must show that they can work in group situations. Students will plan their work with others and confirm working arrangements; work cooperatively towards achieving identified objectives, and exchange information on progress. Students should provide at least two examples of meeting the standards for each of WO2.1, WO2.2 and WO2.3.

The delivery of the majority of the concepts in the GCSE in Mathematics can be modified to include group work. However, this approach should not be adopted solely to satisfy the criteria for this key skill. However, the content of AO4, handling data, can be modified readily to accommodate 'working with others'. Data collection can incorporate a collaborative approach, with the production of an externally assessed statistics task allowing further opportunities to satisfy WO2.1, 2.2 and 2.3.

Key skill portfolio evidence requirements		Opportunities for development or internal assessment
WO2.1	Plan work with others	Students should identify the objectives of working together and the tasks, resources and timescales required to meet these objectives. Information should be exchanged to clarify responsibilities. For example, suggesting ways help can be given, asking what others can do, checking their own and others' responsibilities. The group needs to confirm responsibilities and working arrangements. For example, throughout the data collection phase of all statistical tasks, students should be encouraged to: • discuss and agree on a hypothesis to be tested • share out the data collection within the group, taking the opportunity to discuss relevant sampling techniques • effectively manage the time of each group, agreeing targets and deadlines. Partial satisfaction of these criteria relies on the teacher creating opportunities for data collection rather than allocating data that has already been prepared.

Key skill portfolio evidence requirements		Opportunities for development or internal assessment
WO2.2	Work cooperatively with others towards achieving identified objectives.	Students will need to organise tasks so that responsibilities can be met. For example, obtaining resources, completing tasks on time. Tasks should be completed accurately and safely. Cooperative ways of working should be supported through, for example, anticipating the needs of others, avoiding actions that offend. Advice from others, including group members, teachers, etc, should be sought when needed.
WO2.3	Review your contributions and agree ways to improve your work with others.	Once completed the full group needs to review outcomes against the agreed objectives. In doing this they should identify what has gone well and what has gone less well. Students should listen and respond to progress reports from others and agree ways of improving work with others to help achieve objectives. For example, throughout the data collection activities, students should be encouraged to: • review outcomes against the agreed hypotheses • identify factors that have influenced the outcome • agree on the ways that the activity could have been carried out more effectively or modified to allow further progress.

Evidence

Student evidence for working with others could include:

- teacher observation records
- preparatory notes
- records of process and progress made.

Improving own learning and performance Level 2

Within GCSE in Mathematics programmes, students will have opportunities to develop and generate evidence that meets part of the evidence requirement of this key skill.

To achieve this key skill, students will need to provide at least **two** examples of meeting the required standard. Students are also required to improve their performance through studying a straightforward subject and by learning through a straightforward practical activity. This GCSE in Mathematics will provide opportunities for students to study a straightforward subject. Evidence for learning through a practical activity may come from certain topics within the specifications or from enrichment activities.

Activities that generate evidence for this key skill should take place over a period of a few weeks. Over the period of the activity there will be times when the students should work without close supervision. However, students should seek and receive feedback, from teachers and others, on their target setting and performance.

Any project work (including coursework) is a suitable learning activity and may be used to generate evidence for this key skill.

Key skill portfolio evidence requirements		**Opportunities for development or internal assessment**
LP2.1	Help set targets with an appropriate person and plan how these will be met.	Students plan how they are to meet short-term targets with an appropriate person, eg agreeing a project with their teacher. This will include setting realistic targets and action points. Review dates with, for example, their teacher should be built into the plan. For example, when starting a sustained piece of work such as a piece of coursework or a longitudinal study over several weeks or months, the student, in conjunction with their teacher: • completes a plan of action with the student identifying target dates, sources of information and methods of presentation • plans a rigorous timetable for home study, reviews and tutorials for each half term • develops a plan of action for their two pieces of externally assessed work.

Key skill portfolio evidence requirements		Opportunities for development or internal assessment
LP2.2	Take some responsibility for some decisions about your learning, using your plan to help meet targets and improve your learning. Improve your performance by: • studying a straightforward subject • learning through a straightforward practical activity.	The plan should be implemented with performance reviews and should include working for short periods without close supervision. Students use their plan effectively when producing, for example: • their externally assessed piece of coursework • their externally assessed piece of statistical analysis • a write up of an experiment or modelling exercise using – a spreadsheet – a database – practical equipment. This will involve: • prioritising action • managing their time effectively • revising their plan of action as necessary. Students should: • seek and use feedback and support and draw on different approaches to learning as outlined in their detailed plan of action.
LP2.3	Review progress with an appropriate person and provide evidence of your achievements.	Students should review their own progress with the help, for example, of their tutor. They should identify, with evidence, what and how they have learned and provide information on what has gone well and what has gone less well indicating which targets have been met and providing evidence of achievements from relevant sources. They should identify with, for example, their teacher, action for improving their performance.

Evidence

Student evidence for improving own learning and performance could include:

- teacher records
- annotated action plans
- records of discussions
- learning log
- work produced.

Problem solving Level 2

To achieve this key skill, students will need to provide at least **two** examples of meeting the required standard. **Each** example should cover a different problem and identify at least two different ways of solving it. Students should show that they can identify problems, plan and try out options to solve the problem and check whether the problem has been solved. For this GCSE, students may not be able to try out options and check results as there may be difficulties in implementing practical solutions in a school or college context.

Key skill portfolio evidence requirements		Opportunities for development or internal assessment
PS2.1	Identify a problem, with help from an appropriate person, and identify different ways of tackling it.	Students will need to identify the problem, describe its main features and show how it has been solved. They need to identify different ways of tackling the problem and ways of identifying success. They should use the help of others, for example, as appropriate. For example, students should discuss and agree an approach to solving problems presented in class and transfer this acquired approach to their extended pieces of coursework. When solving investigations in class, students may agree to break the task down into smaller, more manageable pieces, adopt a systematic or symbolic approach and predict and test a conjecture with a further case. Students would then transfer this approach to their externally assessed investigation. Alternatively, when solving a statistical investigation in class, students may discuss and agree the hypothesis to be tested, agree a suitable data collection method and appropriate methods of analysis and presentation. Students should then transfer this approach to their extended piece of statistical analysis required for their externally assessed GCSE commitment.
PS2.2	Plan and try out at least **one** way of solving the problem.	Students should confirm with their teacher, for example, their chosen option and how they will implement it. Upon implementation relevant tasks should be organised and changes made as necessary. Support should be obtained when needed. Students may identify several routes to a solution but choose, with justification, the most appropriate. At this level, for instance, a student should seek to use symbolism to solve, for example, ‘The Open Box’ problem rather than repeating calculations for specific cases. This process of the student redefining their method of solution in order to find a fuller solution is linked with mark 5 in strand 1 of the GCSE coursework criteria.

Key skill portfolio evidence requirements		Opportunities for development or internal assessment
PS2.3	Check if the problem has been solved and identify ways to improve problem solving.	Students should check if the problem has been solved using agreed methods, for example by test, observation, inspection. The results of this should be described with an explanation of the decisions taken. Students should identify the strengths and weaknesses of their approach and how they would do things differently if they met a similar problem. Students may, as part of a solution to an investigation, make a conjecture which is then tested. This should lead to the reformation of the problem, often progressing into a more general approach. In a modelling task, students often refine the model to accommodate more of the initial constraints, thus improving the effectiveness of the model. For example, in 'Hidden Faces' the student arranges the cubes in a horizontal single line and arrives at the expression 3n-2. The coefficients of this expression can then be linked to the structure of the cubes, ie 'the times 3 comes from the addition of three more hidden faces for each additional cube on the line', and 'the minus 2 from the two end faces being visible' etc would lead to the student exploring further cases without the need to calculate and tabulate numerical values. In 'Mobile Phones', the tariffs for two phones could be rewritten algebraically and equated, either through a graphical approach or using simultaneous equations.

Evidence

Student evidence for problem solving could include:

- description of the problem
- teacher records and agreement of standards and approaches
- annotated action plans
- records of discussions
- descriptions of options
- records of reviews.

GCSE Maths

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