GCSE

wjec
cbac

WJEC GCSE in

MATHEMATICS

ACCREDITED BY WELSH GOVERNMENT

SPECIFICATION

Teaching from 2015 - REVISED for teaching from 2017
For award from Summer 2019

Version 2 January 2019

SUMMARY OF AMENDMENTS

Version	Description	Page number
2	'Making entries' section has been amended to clarify resit rules.	44

WJEC GCSE IN MATHEMATICS

FOR TEACHING FROM 2015
FOR AWARD FROM NOVEMBER 2016

This specification meets the GCSE Qualification Principles which set out the requirements for all new or revised GCSE specifications developed to be taught in Wales from September 2015.

GCSE MATHEMATICS
SUMMARY OF ASSESSMENT

There are 3 tiers of entry for this qualification.

Higher Tier: Grades A* – C
Intermediate Tier: Grades B – E
Foundation Tier: Grades D – G

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

Unit 1: Non-calculator
Written examination
Higher: 1 hour 45 minutes (80 marks)
Intermediate:1 hour 45 minutes (80 marks)
Foundation: 1 hour 30 minutes (65 marks)
50% of qualification

The written paper for each tier will comprise a number of short and longer, both structured and unstructured questions which may be set on any part of the subject content of the specification.
Candidates entered for GCSE Mathematics will be expected to be familiar with the knowledge, skills and understanding implicit in GCSE Mathematics – Numeracy.
Questions may be set on topics that are explicitly listed in the content of GCSE Mathematics – Numeracy.
Some questions will use multiple-choice assessment.
A calculator will **not** be allowed in this paper.

Unit 2: Calculator-allowed
Written examination
Higher: 1 hour 45 minutes (80 marks)
Intermediate:1 hour 45 minutes (80 marks)
Foundation: 1 hour 30 minutes (65 marks)
50% of qualification

The written paper for each tier will comprise a number of short and longer, both structured and unstructured questions which may be set on any part of the subject content of the specification.
Candidates entered for GCSE Mathematics will be expected to be familiar with the knowledge, skills and understanding implicit in GCSE Mathematics – Numeracy.
Questions may be set on topics that are explicitly listed in the content of GCSE Mathematics – Numeracy.
Some questions will use multiple-choice assessment.
A calculator will be allowed in this paper.

This linear qualification will be available in the summer and November series each year. The qualification will be awarded for the first time in November 2016.

Qualification Number listed on The Register: 601/4907/3

Qualifications Wales Approval Number listed on QiW: C00/0720/4

GCSE MATHEMATICS

1   INTRODUCTION

1.1   Aims and objectives

GCSE Mathematics is one of two GCSEs in mathematics for use in Wales in response to recommendation 19 of the *Review of Qualifications for 14 to 19-year-olds in Wales* (Welsh Government, 2012). This specification meets the subject principles for GCSE Mathematics.

GCSE Mathematics will build on and progress from the levels of mathematics expected at the end of KS3 through the National Curriculum Programme of Study for Mathematics. Whilst GCSE in Mathematics – Numeracy will assess the mathematics that learners will need in their everyday lives, in the world of work, and in other general curriculum areas, GCSE Mathematics will extend to aspects of mathematics needed for progression to scientific, technical or further mathematical study.

This specification will encourage learners to be inspired, moved and challenged by following a broad, coherent, satisfying and worthwhile course of study. It will help learners to develop confidence in, and a positive attitude towards, mathematics and to recognise the importance and relevance of mathematics to their everyday lives and to society.

It will enable learners to appreciate the coherence, creativity, elegance and power of mathematics. It will prepare learners to make informed decisions about further learning opportunities and career choices. It will have an emphasis on those aspects of mathematics required for progression into mathematics or mathematically-related disciplines or employment routes. It will feature problems set both in real-world contexts and within mathematics itself and will encourage learners to employ and evaluate different mathematical techniques.

The GCSE specification in Mathematics should enable learners to:
- develop knowledge, skills and understanding of mathematical methods, techniques and concepts required for progression into mathematics or mathematically-related disciplines or employment routes
- make connections between different areas of mathematics
- select and apply mathematical methods in both mathematical and real-world contexts
- reason mathematically, construct arguments and simple proofs, and make logical deductions and inferences
- develop and refine strategies for solving a range of mathematical and real-world problems
- communicate mathematical information in a variety of forms
- interpret mathematical results and draw and justify conclusions that are relevant to the context
- communicate mathematical information in a variety of forms.

1.2   Prior learning and progression

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

GCSE Mathematics will build on and progress from the levels of mathematics expected at the end of KS3 through the National Curriculum Programme of Study for Mathematics. Together with GCSE Mathematics - Numeracy, this specification provides a suitable foundation for the study of mathematics at either AS or A level.
In addition, the specification provides a coherent, satisfying and worthwhile course of study for learners who do not progress to further study in this subject.

1.3   Equality and fair assessment

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

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

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

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

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

1.4   Welsh Baccalaureate

In following this specification, learners should be given opportunities, where appropriate, to develop the skills that are being assessed through the Core of the Welsh Baccalaureate:
• Literacy
• Numeracy
• Digital Literacy
• Critical Thinking and Problem Solving
• Planning and Organisation
• Creativity and Innovation
• Personal Effectiveness.

1.5   Welsh perspective

In following this specification, learners must consider a Welsh perspective if the opportunity arises naturally from the subject matter and if its inclusion would enrich learners' understanding of the world around them as citizens of Wales as well as the UK, Europe and the world.

2 SUBJECT CONTENT

It is important that, during the course, learners should be given opportunities to:
- develop problem solving skills
- generate strategies to solve problems that are unfamiliar
- answer questions that span more than one topic area of the curriculum
- make mental calculations and calculations without the aid of a calculator
- make estimates
- understand 3-D shape
- use computers and other technological aids
- collect data
- understand and use the statistical problem solving cycle.

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

The following table summarises the way in which the mathematical content will be divided across the two mathematics GCSEs (GCSE Mathematics – Numeracy and GCSE Mathematics).

GCSE	Mathematics – Numeracy	Mathematics	
Content	Number, Measure and Statistics plus <u>some aspects of</u> Algebra, Geometry and Probability	<u>All</u> the content of GCSE Mathematics - Numeracy	<u>Additional</u> Algebra, Geometry and Probability
Assessment focus	The application of the above content in context	–	The application of the <u>above</u> content in context
		Procedural skills in situations that are context-free or involve minimal context for <u>all</u> content	

The tables below set out the detail of the mathematical content that will be assessed as part of GCSE Mathematics - Numeracy as well as the additional mathematics that will be assessed as part of GCSE Mathematics.

Foundation tier content is in standard text.
Intermediate tier content which is in addition to foundation tier content is in <u>underlined</u> text.
Higher tier content which is in addition to intermediate tier content is in **bold** text.

Candidates entered for GCSE Mathematics will be expected to be familiar with the knowledge, skills and understanding implicit in GCSE Mathematics – Numeracy.

2.1 Foundation tier

**Candidates entered for GCSE Mathematics will be expected to be familiar with the knowledge, skills and understanding implicit in GCSE Mathematics – Numeracy.*

Foundation tier – Number

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding number and place value	
Reading and writing whole numbers of any magnitude expressed in figures or words. Rounding whole numbers to the nearest 10, 100, 1000, etc. Understanding place value and decimal places. Rounding decimals to the nearest whole number or a given number of decimal places.	
Using the equivalences between decimals, fractions, ratios and percentages. Converting numbers from one form into another. Ordering and comparing whole numbers, decimals, fractions and percentages. Understanding and using directed numbers, including ordering directed numbers.	
Understanding number relationships and methods of calculation	
Using the common properties of numbers, including odd, even, multiples, factors, primes. Expressing numbers as the product of their prime factors. Using the terms square, square root and cube. The use of index notation for positive integral indices. Interpreting numbers written in standard form in the context of a calculator display.	

Foundation tier – Number

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Using the facilities of a calculator to plan a calculation and evaluate expressions. Using addition, subtraction, multiplication, division, square and square root. Knowing how a calculator orders its operations. (Candidates will not be expected to list the key depressions that they have made.) Using calculators effectively and efficiently. Reading a calculator display correct to a specified number of decimal places.	
Understanding and using number operations and the relationships between them, including inverse operations and the hierarchy of operations. Addition, subtraction, multiplication and division of whole numbers, decimals, fractions and negative numbers. Finding a fraction or percentage of a quantity. Expressing one number as a fraction or percentage of another. Calculating fractional and percentage changes (increase and decrease). Calculating using ratios in a variety of situations; proportional division. The use of a non-calculator method to multiply and divide whole numbers up to and including the case of multiplication and division of a three-digit number by a two-digit number.	
Recognising that recurring decimals are exact fractions, and that some exact fractions are recurring decimals.	
Estimating and approximating solutions to numerical calculations. Using estimation in multiplication and division problems with whole numbers to obtain approximate answers, e.g. by first rounding the numbers involved to 1 significant figure. Candidates must show sufficient working in order to demonstrate how they have obtained their estimate.	

Foundation tier – Number

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Solving numerical problems	
Interpretation and use of mathematical information presented in written or visual form when solving problems, e.g. TV programme schedules, bus/rail timetables, distance charts, holiday booking information. Money: The basic principles of personal and household finance, including fuel and other bills, hire purchase, discount, VAT, taxation, best buys, wages and salaries, loan repayments, mortgages, budgeting, exchange rates and commissions. Simple interest. Profit and loss. Foreign currencies and exchange rates. Carrying out calculations relating to enterprise, saving and borrowing, investing, appreciation and depreciation.	
Giving solutions in the context of a problem, interpreting the display on a calculator. Interpreting the display on a calculator. Knowing whether to round up or down as appropriate.	
Understanding and using Venn diagrams to solve problems.	

Foundation tier – Algebra

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding and using functional relationships	
Recognition, description and continuation of patterns in number. Description, in words, of the rule for the next term of a sequence.	Generating linear sequences given the *n*th term rule.
Construction and interpretation of conversion graphs. Construction and interpretation of travel graphs. Construction and interpretation of graphs that describe real-life situations. Interpretation of graphical representation used in the media, recognising that some graphs may be misleading.	
Using coordinates in 4 quadrants. Drawing and interpreting the graphs of $x = a$, $y = b$, $y = ax + b$.	
Understanding and using equations and formulae	
Substitution of positive and negative whole numbers, fractions and decimals into simple formulae expressed in words or in symbols. Understanding the basic conventions of algebra. Formation and simplification of expressions involving sums, differences and products. Collection of like terms. Expansion of $a(bx + c)$, where a, b and c are integers. Formation, manipulation and solution of linear equations.	

Foundation tier – Geometry and Measure

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding and using properties of shape	
The geometrical terms: point, line, plane, parallel, right angle, clockwise and anticlockwise turns, perpendicular, horizontal, vertical, acute, obtuse and reflex angles, face, edge and vertex. Vocabulary of triangles, quadrilaterals and circles: isosceles, equilateral, scalene, exterior/interior angle, diagonal, square, rectangle, parallelogram, rhombus, kite, trapezium, polygon, pentagon, hexagon, radius, diameter, tangent, circumference, chord, arc, sector, segment. Simple solid figures: cube, cuboid, cylinder, cone and sphere. Interpretation and drawing of nets. Using and drawing 2-D representations of 3-D shapes, including the use of isometric paper.	
Accurate use of ruler, pair of compasses and protractor. (Lengths accurate to 2mm and angles accurate to 2°.) Bisecting a given line, bisecting a given angle. Constructing 2-D shapes from given information.	Use of ruler and pair of compasses to do constructions. Construction of triangles, quadrilaterals and circles.
	Simple description of symmetry in terms of reflection in a line/plane or rotation about a point. Order of rotational symmetry.
Angles at a point. Angles at a point on a straight line. Opposite angles at a vertex. Parallel lines. Corresponding, alternate and interior angles. Angle properties of triangles. Using the fact that the angle sum of a triangle is 180°.	Using the fact that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices. Using angle properties of equilateral, isosceles and right-angled triangles; understand congruence; explain why the angle sum of any quadrilateral is 360°. Regular and irregular polygons. Sum of the interior and sum of the exterior angles of a polygon.

Foundation tier – Geometry and Measure

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding and using properties of position, movement and transformation	
	Finding the coordinates of points identified by geometrical information, for example, finding the coordinates of the mid-point of the line segment *AB*, given points *A* and *B*; finding the coordinates of the fourth vertex of a parallelogram, given the coordinates of the other three vertices. Location determined by distance from a given point and angle made with a given line.
	Transformations, including: • Reflection • Rotation through 90°, 180°, 270°. Clockwise or anticlockwise rotations; centre of rotation • Enlargement with positive scale factors • Translation. Candidates will be expected to draw the image of a shape under transformation.
Solving problems in the context of tiling patterns and tessellation.	
Using and interpreting maps. Interpretation and construction of scale drawings. Scales may be written in the form 1 cm represents 5 m, or 1:500. Use of bearings. (Three figure bearings will be used e.g. 065°, 237°.)	

Foundation tier – Geometry and Measure

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding and using measures	
Standard metric units of length, mass and capacity. The standard units of time; the 12- and 24- hour clock. (The notation for the 12- and 24- hour clock will be 1:30 p.m. and 13:30.) Knowledge and use of the relationship between metric units of length, mass, capacity, area and volume. Making sensible estimates of measurements in everyday situations, recognising the appropriateness of units in different contexts. Conversion between the following metric and Imperial units: km - miles; cm, m - inches, feet; kg - lb; litres - pints, gallons. Candidates will be expected to know the following approximate equivalences: 8km ≈ 5 miles, 1kg ≈ 2·2 lb, 1 litre ≈ 1·75 pints	
Reading and interpreting scales, including decimal scales.	
Using compound measures including speed. Using compound measures such as m/s, km/h, mph and mpg.	
Estimating of the area of an irregular shape drawn on a square grid. Calculating: - perimeter and area of a square, rectangle, triangle, parallelogram, trapezium, circle, semicircle and composite shapes. - surface area, cross-sectional area and volume of cubes and cuboids.	

Foundation tier – Statistics

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding and using the statistical problem solving process: specifying the problem/planning; collecting, processing and representing data; interpreting and discussing results.	
Specifying the problem and planning	
Specifying and testing hypotheses, taking account of the limitations of the data available. Designing and criticising questions for a questionnaire, including notions of fairness and bias.	
Processing, representing and interpreting data	
Sorting, classification and tabulation of qualitative (categorical) data, discrete or continuous quantitative data. Grouping of discrete or continuous data into class intervals of equal widths. Understanding and using tallying methods.	
Constructing and interpreting pictograms, bar charts and pie charts for qualitative data. Constructing and interpreting vertical line diagrams for discrete data. Constructing line graphs for the values of a variable at different points in time; understanding that intermediate values in a line graph may or may not have meaning. Simple cases of constructing and interpreting grouped frequency diagrams. Temperature charts. Constructing and interpreting scatter diagrams for data on paired variables.	

Foundation tier – Statistics

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Mean, median and mode for a discrete (ungrouped) frequency distribution. Comparison of two distributions using one measure of central tendency (i.e. the mean or the median). Modal category for qualitative data. Modal class for grouped data. Calculating or estimating the range applied to discrete data. Drawing 'by eye' a line of 'best fit' on a scatter diagram, understanding and interpreting what this represents.	
Discussing results	
Recognising that graphs may be misleading. Looking at data to find patterns and exceptions. Drawing inferences and conclusions from summary measures and data representations, relating results back to the original problem. Drawing of conclusions from scatter diagrams; using terms such as positive correlation, negative correlation, little or no correlation. Appreciating that correlation does not imply causality.	.

Foundation tier – Statistics

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Estimating and calculating the probabilities of events	
Understanding and using the vocabulary of probability, including notions of uncertainty and risk. The terms 'fair', 'evens', 'certain', 'likely', 'unlikely ' and 'impossible'.	Understanding and using the probability scale from 0 to 1. Use of: the probability of an event not occurring is one minus the probability that it occurs. (Probabilities must be expressed as fractions, decimals or percentages.)
	Estimating the probability of an event as the proportion of times it has occurred. Relative frequency. An understanding of the long-term stability of relative frequency is expected. Calculating theoretical probabilities based on equally likely outcomes. Estimating probabilities based on experimental evidence. Comparing an estimated probability from experimental results with a theoretical probability.
	Identifying all the outcomes of a combination of two experiments, *e.g. throwing two dice;* use tabulation, Venn diagrams, or other diagrammatic representations of compound events.
.	Knowledge that the total probability of all the possible outcomes of an experiment is 1.

2.2 Intermediate tier

Foundation tier content is in standard text.
Intermediate tier content which is in addition to foundation tier content is in <u>underlined</u> text.

**Candidates entered for GCSE Mathematics will be expected to be familiar with the knowledge, skills and understanding implicit in GCSE Mathematics – Numeracy.*

Intermediate tier – Number

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding number and place value	
Reading and writing whole numbers of any magnitude expressed in figures or words. Rounding whole numbers to the nearest 10, 100, 1000, etc. Understanding place value and decimal places. Rounding decimals to the nearest whole number or a given number of decimal places. <u>Rounding numbers to a given number of significant figures.</u>	
Using the equivalences between decimals, fractions, ratios and percentages. Converting numbers from one form into another. Ordering and comparing whole numbers, decimals, fractions and percentages. Understanding and using directed numbers, including ordering directed numbers.	
Understanding number relationships and methods of calculation	
Using the common properties of numbers, including odd, even, multiples, factors, primes. Expressing numbers as the product of their prime factors. <u>Least common multiple and highest common factor.</u> <u>Finding the LCM and HCF of numbers written as the product of their prime factors.</u> Using the terms square, square root, cube, <u>cube root and reciprocal.</u> The use of index notation for <u>zero,</u> positive <u>and negative</u> integral indices. <u>The use of index notation for positive unit fractional indices.</u> Interpreting numbers written in standard form in the context of a calculator display. <u>Writing whole numbers in index form.</u> <u>Using the rules of indices.</u> <u>Expressing and using numbers in standard form with positive and negative powers of 10.</u>	

Intermediate tier – Number

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Using the facilities of a calculator, including the <u>constant function, memory and brackets,</u> to plan a calculation and evaluate expressions. Using addition, subtraction, multiplication, division, square, square root, <u>power, root, constant, memory, brackets and appropriate statistical functions.</u> Knowing how a calculator orders its operations. (Candidates will not be expected to list the key depressions that they have made.) Using calculators effectively and efficiently. Reading a calculator display correct to a specified number of decimal places or <u>significant figures.</u> <u>Using appropriate trigonometric functions on a calculator.</u>	
Understanding and using number operations and the relationships between them, including inverse operations and the hierarchy of operations. Addition, subtraction, multiplication and division of whole numbers, decimals, fractions and negative numbers. Finding a fraction or percentage of a quantity. Expressing one number as a fraction or percentage of another. Calculating fractional and percentage changes (increase and decrease), <u>including the use of multipliers</u>. <u>Repeated proportional changes; appreciation and depreciation.</u> Calculating using ratios in a variety of situations; proportional division. <u>Direct and inverse proportion.</u> The use of a non-calculator method to multiply and divide whole numbers up to and including the case of multiplication and division of a three-digit number by a two-digit number.	
Recognising that recurring decimals are exact fractions, and that some exact fractions are recurring decimals.	
Estimating and approximating solutions to numerical calculations. Using estimation in multiplication and division problems with whole numbers to obtain approximate answers, e.g. by first rounding the numbers involved to 1 significant figure. Candidates must show sufficient working in order to demonstrate how they have obtained their estimate.	

Intermediate tier – Number

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Solving numerical problems	
Interpretation and use of mathematical information presented in written or visual form when solving problems, e.g. TV programme schedules, bus/rail timetables, distance charts, holiday booking information. Money: The basic principles of personal and household finance, including fuel and other bills, hire purchase, discount, VAT, taxation, best buys, wages and salaries, loan repayments, mortgages, budgeting, exchange rates and commissions. Simple and compound interest, including the use of efficient calculation methods. Profit and loss. Finding the original quantity given the result of a proportional change. Foreign currencies and exchange rates. Carrying out calculations relating to enterprise, saving and borrowing, investing, appreciation and depreciation.	
Giving solutions in the context of a problem, selecting an appropriate degree of accuracy, interpreting the display on a calculator, and recognising limitations on the accuracy of data and measurements. Rounding an answer to a reasonable degree of accuracy in the light of the context. Interpreting the display on a calculator. Knowing whether to round up or down as appropriate. Recognising that measurement is approximate and that a measurement expressed to a given unit is in possible error of half a unit. The upper and lower bounds of numbers expressed to a given degree of accuracy. Calculating the upper and lower bounds in the addition and subtraction of numbers expressed to a given degree of accuracy.	
Understanding and using Venn diagrams to solve problems.	

Intermediate tier – Algebra

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding and using functional relationships	
Recognition, description and continuation of patterns in number. Description, in words and symbols, of the rule for the next term of a sequence.	Finding the nth term of a sequence where the rule is linear or quadratic. Generating linear and non-linear sequences given the nth term rule.
Construction and interpretation of conversion graphs. Construction and interpretation of travel graphs. Construction and interpretation of graphs that describe real-life situations. Interpretation of graphical representation used in the media, recognising that some graphs may be misleading. Recognising and interpreting graphs that illustrate direct and inverse proportion.	
Using coordinates in 4 quadrants. Drawing, interpreting, recognising and sketching the graphs of $x = a, y = b,$ $y = ax + b.$ The gradients of parallel lines.	Identifying the equation of lines parallel or perpendicular to a given line, to satisfy given conditions. Knowledge and use of the form $y = mx + c$ to represent a straight line where m is the gradient of the line, and c is the value of the y-intercept. Drawing, interpretation, recognition and sketching the graphs of $y = ax^2 + b.$ Drawing and interpretation of graphs of $y = ax^2 + bx + c.$ Drawing and interpreting graphs when *y* is given implicitly in terms of *x.*

Intermediate tier – Algebra

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding and using equations and formulae	
Substitution of positive and negative whole numbers, fractions and decimals into simple formulae expressed in words or in symbols. Understanding the basic conventions of algebra. Formation and simplification of expressions involving sums, differences, products <u>and powers.</u> Collection of like terms. Expansion of $a(bx + c)$, where a, b and c are integers. Formation, manipulation and solution of linear equations. <u>Changing the subject of a formula when the subject appears in one term.</u>	<u>Extraction of common factors.</u> <u>Formation and manipulation of simple linear inequalities.</u> <u>Multiplication of two linear expressions; expansion of $(ax + by)(cx + dy)$ and $(ax + by)^2$, where a, b, c, d are integers.</u> <u>Factorisation of quadratic expressions of the form $x^2 + ax + b$.</u>
<u>The solution of linear equations with whole number coefficients in solving problems set in real-life contexts.</u>	<u>Solution of linear equations and linear inequalities with whole number and fractional coefficients.</u> <u>The formation and solution of two simultaneous linear equations with whole number coefficients by graphical and algebraic methods in solving problems set in real-life contexts.</u> <u>Solution by factorisation and graphical methods of quadratic equations of the form $x^2 + ax + b = 0$.</u> <u>Solution of a range of cubic equations by trial and improvement methods, justifying the accuracy of the solution.</u>
	<u>Distinguishing in meaning between equations, formulae and expressions.</u>

Intermediate tier – Geometry and Measure

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding and using properties of shape	
The geometrical terms: point, line, plane, parallel, right angle, clockwise and anticlockwise turns, perpendicular, horizontal, vertical, acute, obtuse and reflex angles, face, edge and vertex. Vocabulary of triangles, quadrilaterals and circles: isosceles, equilateral, scalene, exterior/interior angle, diagonal, square, rectangle, parallelogram, rhombus, kite, trapezium, polygon, pentagon, hexagon, radius, diameter, tangent, circumference, chord, arc, sector, segment. Simple solid figures: cube, cuboid, cylinder, <u>prism, pyramid</u>, cone, sphere, <u>tetrahedron.</u> Interpretation and drawing of nets. Using and drawing 2-D representations of 3-D shapes, including the use of isometric paper.	
Accurate use of ruler, pair of compasses and protractor. (Lengths accurate to 2mm and angles accurate to 2°.) Bisecting a given line, bisecting a given angle. <u>Constructing the perpendicular from a point to a line.</u> <u>Essential properties of special types of quadrilateral, including square, rectangle, parallelogram, trapezium, kite and rhombus; classify quadrilaterals by their geometric properties.</u> Constructing 2-D shapes from given information <u>and drawing plans and elevations of any 3-D solid.</u>	Use of ruler and pair of compasses to do constructions. Construction of triangles, quadrilaterals and circles. <u>Constructing angles of 60°, 30°, 90° and 45°.</u> <u>The identification of congruent shapes.</u>
	Simple description of symmetry in terms of reflection in a line/plane or rotation about a point. Order of rotational symmetry.

Intermediate tier – Geometry and Measure

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Angles at a point. Angles at a point on a straight line. Opposite angles at a vertex. Parallel lines. Corresponding, alternate and interior angles. Angle properties of triangles. Using the fact that the angle sum of a triangle is 180°.	Using the fact that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices. Using angle properties of equilateral, isosceles and right-angled triangles; understand congruence; explain why the angle sum of any quadrilateral is 360°. Regular and irregular polygons. Sum of the interior and sum of the exterior angles of a polygon.
Using Pythagoras' theorem in 2-D, including reverse problems.	
Using trigonometric relationships in right-angled triangles to solve problems, including those involving bearings and angles of elevation and depression. Calculating a side or an angle of a right-angled triangle in 2-D.	
	Using angle and tangent properties of circles. Understanding that the tangent at any point on a circle is perpendicular to the radius at that point. Using 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, that 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°. Understanding and using the fact that tangents from an external point are equal in length.

Intermediate tier – Geometry and Measure

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding and using properties of position, movement and transformation	
	Finding the coordinates of points identified by geometrical information, for example, finding the coordinates of the mid-point of the line segment *AB*, given points *A* and *B*; finding the coordinates of the fourth vertex of a parallelogram, given the coordinates of the other three vertices. Location determined by distance from a given point and angle made with a given line.
Using the knowledge that, for two similar 2-D or 3-D shapes, one is an enlargement of the other. Using the knowledge that, in similar shapes, corresponding dimensions are in the same ratio.	Transformations, including: • Reflection • Rotation through 90°, 180°, 270°. Clockwise or anticlockwise rotations; centre of rotation • Enlargement with positive, fractional scale factors • Translation; description of translations using column vectors. Candidates will be expected to draw the image of a shape under transformation. Questions may involve two successive transformations.
Solving problems in the context of tiling patterns and tessellation.	
Using and interpreting maps. Interpretation and construction of scale drawings. Scales may be written in the form 1 cm represents 5 m, or 1:500. Use of bearings. (Three figure bearings will be used e.g. 065°, 237°.)	
Constructing the locus of a point which moves such that it satisfies certain conditions, for example, (i) a given distance from a fixed point or line, (ii) equidistant from two fixed points or lines. Solving problems involving intersecting loci in two dimensions. Questions on loci may involve inequalities.	

Intermediate tier – Geometry and Measure

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding and using measures	
Standard metric units of length, mass and capacity. The standard units of time; the 12- and 24- hour clock. (The notation for the 12- and 24- hour clock will be 1:30 p.m. and 13:30.) Knowledge and use of the relationship between metric units of length, mass, capacity, area and volume. Making sensible estimates of measurements in everyday situations, recognising the appropriateness of units in different contexts. Conversion between the following metric and Imperial units: km - miles; cm, m - inches, feet; kg - lb; litres - pints, gallons. Candidates will be expected to know the following approximate equivalences: 8km $\approx$ 5 miles, 1kg $\approx$ 2·2 lb, 1 litre $\approx$ 1·75 pints	
Reading and interpreting scales, including decimal scales.	
Distinguishing between formulae for length, area and volume by considering dimensions. Using compound measures including speed, density and population density. Using compound measures such as m/s, km/h, mph, mpg, kg/m^3, g/cm^3, population per km^2.	
Estimating of the area of an irregular shape drawn on a square grid. Calculating: - perimeter and area of a square, rectangle, triangle, parallelogram, trapezium, circle, semicircle and composite shapes. - surface area, cross-sectional area and volume of cubes, cuboids, prisms, cylinders and composite solids.	

Intermediate tier – Statistics

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding and using the statistical problem solving process: specifying the problem/planning; collecting, processing and representing data; interpreting and discussing results.	
Specifying the problem and planning	
Specifying and testing hypotheses, taking account of the limitations of the data available. Testing an hypothesis such as 'Girls tend to do better than boys in biology tests'. Specifying the data needed and considering potential sampling methods. Sampling systematically. Designing and criticising questions for a questionnaire, including notions of fairness and bias. Considering the effect of sample size and other factors that affect the reliability of conclusions drawn.	
Processing, representing and interpreting data	
Sorting, classification and tabulation of qualitative (categorical) data, discrete or continuous quantitative data. Grouping of discrete or continuous data into class intervals of equal or unequal widths. Understanding and using tallying methods.	
Constructing and interpreting pictograms, bar charts and pie charts for qualitative data. Constructing and interpreting vertical line diagrams for discrete data. Constructing line graphs for the values of a variable at different points in time; understanding that intermediate values in a line graph may or may not have meaning. Constructing and interpreting grouped frequency diagrams and frequency polygons. Temperature charts. Constructing and interpreting scatter diagrams for data on paired variables. Constructing and interpreting cumulative frequency tables and diagrams using the upper boundaries of the class intervals.	

Intermediate tier – Statistics

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Selecting and using an appropriate measure of central tendency. Mean, median and mode for a discrete (ungrouped) frequency distribution. Estimates for the median and mean of grouped frequency distributions. Comparison of two distributions using one measure of central tendency (i.e. the mean or the median) and/or one measure of spread. Modal category for qualitative data. Modal class for grouped data. Estimating the median from a cumulative frequency diagram. Selecting and calculating or estimating appropriate measures of spread, including the range and interquartile range applied to discrete, grouped and continuous data. Producing and using box-and-whisker plots to compare distributions. Drawing 'by eye' a line of 'best fit' on a scatter diagram, understanding and interpreting what this represents. [In questions where the mean point has been given, calculated or plotted, candidates will be expected to draw the line of 'best fit' through that point.]	
Discussing results	
Recognising that graphs may be misleading. Looking at data to find patterns and exceptions. Drawing inferences and conclusions from summary measures and data representations, relating results back to the original problem. Drawing of conclusions from scatter diagrams; using terms such as positive correlation, negative correlation, little or no correlation. Appreciating that correlation does not imply causality.	.

Intermediate tier – Statistics

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Estimating and calculating the probabilities of events	
Understanding and using the vocabulary of probability, including notions of uncertainty and risk. The terms 'fair', 'evens', 'certain', 'likely', 'unlikely ' and 'impossible'.	Understanding and using the probability scale from 0 to 1. Use of: the probability of an event not occurring is one minus the probability that it occurs. (Probabilities must be expressed as fractions, decimals or percentages.)
	Estimating the probability of an event as the proportion of times it has occurred. Relative frequency. An understanding of the long-term stability of relative frequency is expected. <u>Graphical representation of relative frequency against the number of trials.</u> Calculating theoretical probabilities based on equally likely outcomes. Estimating probabilities based on experimental evidence. Comparing an estimated probability from experimental results with a theoretical probability.
	Identifying all the outcomes of a combination of two experiments, *e.g. throwing two dice;* use tabulation, <u>tree diagrams</u>, Venn diagrams, or other diagrammatic representations of compound events
.	Knowledge that the total probability of all the possible outcomes of an experiment is 1. <u>Recognising the conditions when the addition of probabilities for mutually exclusive events and the multiplication of probabilities for two independent events apply, and making the appropriate calculations.</u> <u>If *A* and *B* are mutually exclusive, then the probability of *A* or *B* occurring is P(A) + P(B).</u> <u>If *A* and *B* are independent events, the probability of *A* and *B* occurring is $P(A) \times P(B)$.</u>

2.3 Higher tier

Foundation tier content is in standard text.
Intermediate tier content which is in addition to foundation tier content is in <u>underlined</u> text.
Higher tier content which is in addition to intermediate tier content is in **bold** text.

*Candidates entered for GCSE Mathematics will be expected to be familiar with the knowledge, skills and understanding implicit in GCSE Mathematics – Numeracy.

Higher tier – Number

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding number and place value	
Reading and writing whole numbers of any magnitude expressed in figures or words. Rounding whole numbers to the nearest 10, 100, 1000, etc. Understanding place value and decimal places. Rounding decimals to the nearest whole number or a given number of decimal places. <u>Rounding numbers to a given number of significant figures.</u>	
Using the equivalences between decimals, fractions, ratios and percentages. Converting numbers from one form into another. Ordering and comparing whole numbers, decimals, fractions and percentages. Understanding and using directed numbers, including ordering directed numbers.	
Understanding number relationships and methods of calculation	
Using the common properties of numbers, including odd, even, multiples, factors, primes. Expressing numbers as the product of their prime factors. <u>Least common multiple and highest common factor.</u> <u>Finding the LCM and HCF of numbers written as the product of their prime factors.</u> Using the terms square, square root, cube, <u>cube root and reciprocal.</u> The use of index notation for <u>zero</u>, positive <u>and negative</u> integral indices. <u>The use of index notation for positive unit fractional and</u> **other fractional** <u>indices.</u> Interpreting numbers written in standard form in the context of a calculator display. <u>Writing whole numbers in index form.</u> <u>Using the rules of indices.</u> <u>Expressing and using numbers in standard form with positive and negative powers of 10.</u>	

Higher tier – Number

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Using the facilities of a calculator, including the constant function, memory and brackets, to plan a calculation and evaluate expressions. Using addition, subtraction, multiplication, division, square, square root, power, root, constant, memory, brackets and appropriate statistical functions. Knowing how a calculator orders its operations. (Candidates will not be expected to list the key depressions that they have made.) Using calculators effectively and efficiently. Reading a calculator display correct to a specified number of decimal places or significant figures. Using appropriate trigonometric functions on a calculator.	
Understanding and using number operations and the relationships between them, including inverse operations and the hierarchy of operations. Addition, subtraction, multiplication and division of whole numbers, decimals, fractions and negative numbers. Finding a fraction or percentage of a quantity. Expressing one number as a fraction or percentage of another. Calculating fractional and percentage changes (increase and decrease), including the use of multipliers. Repeated proportional changes; appreciation and depreciation. Calculating using ratios in a variety of situations; proportional division. Direct and inverse proportion. The use of a non-calculator method to multiply and divide whole numbers up to and including the case of multiplication and division of a three-digit number by a two-digit number.	
Estimating and approximating solutions to numerical calculations. Using estimation in multiplication and division problems with whole numbers to obtain approximate answers, e.g. by first rounding the numbers involved to 1 significant figure. Candidates must show sufficient working in order to demonstrate how they have obtained their estimate.	

Higher tier – Number

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Recognising that recurring decimals are exact fractions, and that some exact fractions are recurring decimals. **Converting recurring decimals to fractional form.** **Distinguishing between rational and irrational numbers.** **Manipulating surds; using surds and π in exact calculations.** **Simplifying numerical expressions involving surds,** **excluding the rationalisation of the denominator of a fraction such as** $\dfrac{1}{(2-\sqrt{3})}$.	
Solving numerical problems	
Interpretation and use of mathematical information presented in written or visual form when solving problems, e.g. TV programme schedules, bus/rail timetables, distance charts, holiday booking information. Money: The basic principles of personal and household finance, including fuel and other bills, hire purchase, discount, VAT, taxation, best buys, wages and salaries, loan repayments, mortgages, budgeting, exchange rates and commissions. Simple and compound interest, including the use of efficient calculation methods. Profit and loss. Finding the original quantity given the result of a proportional change. Foreign currencies and exchange rates. Carrying out calculations relating to enterprise, saving and borrowing, investing, appreciation and depreciation and **understanding annual rates, e.g. AER, APR.**	
Giving solutions in the context of a problem, selecting an appropriate degree of accuracy, interpreting the display on a calculator, and recognising limitations on the accuracy of data and measurements. Rounding an answer to a reasonable degree of accuracy in the light of the context. Interpreting the display on a calculator. Knowing whether to round up or down as appropriate.	

Higher tier – Number

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
<u>Recognising that measurement is approximate and that a measurement expressed to a given unit is in possible error of half a unit.</u> <u>The upper and lower bounds of numbers expressed to a given degree of accuracy.</u> <u>Calculating the upper and lower bounds in the addition and subtraction of numbers expressed to a given degree of accuracy.</u> **Calculating the upper and lower bounds in calculations involving multiplication and division of numbers expressed to given degrees of accuracy.**	
Understanding and using Venn diagrams to solve problems.	

Higher Tier - Algebra

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding and using functional relationships	
Recognition, description and continuation of patterns in number. Description, in words <u>and symbols</u>, of the rule for the next term of a sequence.	<u>Finding the *n*th term of a sequence where the rule is linear or quadratic.</u> Generating linear <u>and non-linear</u> sequences given the *n*th term rule.
Construction and interpretation of conversion graphs. Construction and interpretation of travel graphs. Construction and interpretation of graphs that describe real-life situations. Interpretation of graphical representation used in the media, recognising that some graphs may be misleading. <u>Recognising and interpreting graphs that illustrate direct and inverse proportion.</u>	
Using coordinates in 4 quadrants. Drawing, interpreting, <u>recognising and sketching</u> the graphs of $x = a$, $y = b$, $y = ax + b$. <u>The gradients of parallel lines.</u>	<u>Identifying the equation of lines parallel or perpendicular to a given line, to satisfy given conditions.</u> <u>Knowledge and use of the form $y = mx + c$ to represent a straight line where *m* is the gradient of the line, and *c* is the value of the *y*-intercept.</u> <u>Drawing, interpretation, recognition and sketching the graphs of $y = ax^2 + b$, $\boldsymbol{y = \dfrac{a}{x}}$, $\boldsymbol{y = ax^3}$.</u> <u>Drawing and interpretation of graphs of $y = ax^2 + bx + c$, $\boldsymbol{y = ax^3 + b}$.</u> **Drawing and interpretation of graphs of $\boldsymbol{y = ax + b + \dfrac{a}{x}}$ with x not equal to 0,** $\boldsymbol{y = ax^3 + bx^2 + cx + d,}$ $\boldsymbol{y = k^x}$ **for integer values of x and simple positive values of k.** <u>Drawing and interpreting graphs when *y* is given implicitly in terms of *x*.</u>

Higher Tier - Algebra

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
	Understanding and using function notation. **Interpreting and applying the transformation of functions in the context of their graphical representation, including** $y = \mathrm{f}(x + a), \quad y = \mathrm{f}(kx), y = k\mathrm{f}(x)$ **and** $y = \mathrm{f}(x) + a$**, applied to** $y = \mathrm{f}(x)$**.**
Constructing and using tangents to curves to estimate rates of change for non-linear functions, and using appropriate compound measures to express results, including finding velocity in distance-time graphs and acceleration in velocity-time graphs. **Interpreting the meaning of the area under a graph, including the area under velocity-time graphs and graphs in other practical and financial contexts.** **Using the trapezium rule to estimate the area under a curve.**	
Understanding and using equations and formulae	
Substitution of positive and negative whole numbers, fractions and decimals into simple formulae expressed in words or in symbols. Understanding the basic conventions of algebra. Formation and simplification of expressions involving sums, differences, products <u>and powers.</u> Collection of like terms. Expansion of $a(bx + c)$, where a, b and c are integers. Formation, manipulation and solution of linear equations. <u>Changing the subject of a formula when the subject appears in one term.</u>	<u>Extraction of common factors.</u> <u>Formation and manipulation of simple linear inequalities.</u> **Changing the subject of a formula when the subject appears in more than one term.** <u>Multiplication of two linear expressions; expansion of $(ax + by)(cx + dy)$ and $(ax + by)^2$, where a, b, c, d are integers.</u> <u>Factorisation of quadratic expressions of the form $x^2 + ax + b$</u> **and** $ax^2 + bx + c$**, including the difference of two squares.** **Formation and manipulation of quadratic equations.** **Constructing and using equations that describe direct and inverse proportion.** **Simplifying algebraic fractions.**

Higher Tier - Algebra

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
The solution of linear equations with whole number coefficients in solving problems set in real-life contexts.	Solution of linear equations and linear inequalities with whole number and fractional coefficients. **The use of straight line graphs to locate regions given by linear inequalities.** The formation and solution of two simultaneous linear equations with whole number coefficients by graphical and algebraic methods in solving problems set in real-life contexts. Solution by factorisation and graphical methods of quadratic equations of the form $x^2 + ax + b = 0$. **Solution by factorisation, graphical methods and formula, of quadratic equations of the form $ax^2 + bx + c = 0$, selecting the most appropriate method for the problem concerned.** **Solution of equations involving linear denominators leading to quadratic or linear equations.** Solution of a range of cubic equations by trial and improvement methods, justifying the accuracy of the solution.
	Distinguishing in meaning between equations, formulae, **identities** and expressions.

Higher tier – Geometry and Measure

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding and using properties of shape	
The geometrical terms: point, line, plane, parallel, right angle, clockwise and anticlockwise turns, perpendicular, horizontal, vertical, acute, obtuse and reflex angles, face, edge and vertex. Vocabulary of triangles, quadrilaterals and circles: isosceles, equilateral, scalene, exterior/interior angle, diagonal, square, rectangle, parallelogram, rhombus, kite, trapezium, polygon, pentagon, hexagon, radius, diameter, tangent, circumference, chord, arc, sector, segment. Simple solid figures: cube, cuboid, cylinder, prism, pyramid, cone, sphere, tetrahedron. Interpretation and drawing of nets. Using and drawing 2-D representations of 3-D shapes, including the use of isometric paper.	
Accurate use of ruler, pair of compasses and protractor. (Lengths accurate to 2mm and angles accurate to 2°.) Bisecting a given line, bisecting a given angle. Constructing the perpendicular from a point to a line. Essential properties of special types of quadrilateral, including square, rectangle, parallelogram, trapezium, kite and rhombus; classify quadrilaterals by their geometric properties. Constructing 2-D shapes from given information and drawing plans and elevations of any 3-D solid.	Use of ruler and pair of compasses to do constructions. Construction of triangles, quadrilaterals and circles. Constructing angles of 60°, 30°, 90° and 45°. The identification of congruent shapes. **Understanding and using SSS, SAS, ASA and RHS conditions to prove the congruence of triangles using formal arguments.** **Reasons may be required in the solution of problems involving congruent triangles.**
	Simple description of symmetry in terms of reflection in a line/plane or rotation about a point. Order of rotational symmetry.

Higher tier – Geometry and Measure

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Angles at a point. Angles at a point on a straight line. Opposite angles at a vertex. Parallel lines. Corresponding, alternate and interior angles. Angle properties of triangles. Using the fact that the angle sum of a triangle is 180°.	Using the fact that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices. Using angle properties of equilateral, isosceles and right-angled triangles; understand congruence; explain why the angle sum of any quadrilateral is 360°. Regular and irregular polygons. Sum of the interior and sum of the exterior angles of a polygon.
Using Pythagoras' theorem in 2-D **and 3-D,** including reverse problems.	
Using trigonometric relationships in right-angled triangles to solve problems, including those involving bearings and angles of elevation and depression. Calculating a side or an angle of a right-angled triangle in 2-D **and 3-D.**	
Extending trigonometry to angles of any size. **The application of trigonometric functions to the solution of problems in 2-D or 3-D, including appropriate use of the sine and cosine rules.** **Using the formula: area of a triangle = $\frac{1}{2}ab\sin C$.**	**The graphs and behaviour of trigonometric functions.** **Sketching of trigonometric graphs.**
	Using angle and tangent properties of circles. Understanding that the tangent at any point on a circle is perpendicular to the radius at that point. Using 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, that 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°. **Using the alternate segment theorem.** Understanding and using the fact that tangents from an external point are equal in length. **Understanding and constructing geometrical proofs using circle theorems.**

Higher tier – Geometry and Measure

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding and using properties of position, movement and transformation	
	Finding the coordinates of points identified by geometrical information, for example, finding the coordinates of the mid-point of the line segment *AB*, given points *A* and *B*; finding the coordinates of the fourth vertex of a parallelogram, given the coordinates of the other three vertices. Location determined by distance from a given point and angle made with a given line.

Using the knowledge that, for two similar 2-D or 3-D shapes, one is an enlargement of the other.
 	
Using the knowledge that, in similar shapes, corresponding dimensions are in the same ratio.
 	
Using the relationships between the ratios of:
  • **lengths and areas of similar 2-D shapes, and**
  • **lengths, areas and volumes of similar 3-D shapes.**
	Transformations, including:
	  • Reflection
	  • Rotation through 90°, 180°, 270°. Clockwise or anticlockwise rotations; centre of rotation
	  • Enlargement with positive, fractional **and negative** scale factors
	  • Translation; description of translations using column vectors.
	
	Candidates will be expected to draw the image of a shape under transformation.
	
	Questions may involve two successive transformations.

Solving problems in the context of tiling patterns and tessellation.	
Using and interpreting maps. Interpretation and construction of scale drawings. Scales may be written in the form 1 cm represents 5 m, or 1:500. Use of bearings. (Three figure bearings will be used e.g. 065°, 237°.)	
Constructing the locus of a point which moves such that it satisfies certain conditions, for example, (i) a given distance from a fixed point or line, (ii) equidistant from two fixed points or lines. Solving problems involving intersecting loci in two dimensions. Questions on loci may involve inequalities.	

Higher tier – Geometry and Measure

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding and using measures	
Standard metric units of length, mass and capacity. The standard units of time; the 12- and 24- hour clock. (The notation for the 12- and 24- hour clock will be 1:30 p.m. and 13:30.) Knowledge and use of the relationship between metric units of length, mass, capacity, area and volume. Making sensible estimates of measurements in everyday situations, recognising the appropriateness of units in different contexts. Conversion between the following metric and Imperial units: km - miles; cm, m - inches, feet; kg - lb; litres - pints, gallons. Candidates will be expected to know the following approximate equivalences: $8km \approx 5$ miles, $1kg \approx 2 \cdot 2$ lb, 1 litre $\approx 1 \cdot 75$ pints	
Reading and interpreting scales, including decimal scales.	
<u>Distinguishing between formulae for length, area and volume by considering dimensions.</u> Using compound measures including speed, <u>density and population density.</u> Using compound measures such as m/s, km/h, mph, mpg, <u>kg/m^3, g/cm^3, population per km^2</u>	
Estimating of the area of an irregular shape drawn on a square grid. Calculating: - perimeter and area of a square, rectangle, triangle, parallelogram, trapezium, circle, semicircle and composite shapes. - surface area, cross-sectional area and volume of cubes, cuboids, <u>prisms, cylinders and composite solids.</u>	
Lengths of circular arcs. **Perimeters and areas of sectors and segments of circles.** **Surface areas and volumes of spheres, cones, pyramids and compound solids.**	

Higher tier – Statistics

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Understanding and using the statistical problem solving process: specifying the problem/planning; collecting, processing and representing data; interpreting and discussing results.	
Specifying the problem and planning	
Specifying and testing hypotheses, taking account of the limitations of the data available. <u>Testing an hypothesis such as 'Girls tend to do better than boys in biology tests'.</u> <u>Specifying the data needed and considering potential sampling methods.</u> <u>Sampling systematically.</u> **Working with stratified sampling techniques and defining a random sample.** Designing and criticising questions for a questionnaire, including notions of fairness and bias. <u>Considering the effect of sample size and other factors that affect the reliability of conclusions drawn.</u>	
Processing, representing and interpreting data	
Sorting, classification and tabulation of qualitative (categorical) data, discrete or continuous quantitative data. Grouping of discrete or continuous data into class intervals of equal <u>or unequal</u> widths. Understanding and using tallying methods.	
Constructing and interpreting pictograms, bar charts and pie charts for qualitative data. Constructing and interpreting vertical line diagrams for discrete data. Constructing line graphs for the values of a variable at different points in time; understanding that intermediate values in a line graph may or may not have meaning. Constructing and interpreting grouped frequency diagrams <u>and frequency polygons.</u> Temperature charts. Constructing and interpreting scatter diagrams for data on paired variables. <u>Constructing and interpreting cumulative frequency tables and diagrams using the upper boundaries of the class intervals.</u>	

Higher tier – Statistics

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Extending skills in handling data into constructing and interpreting histograms with unequal class widths. **Frequency density.** **Interpreting shapes of histograms representing distributions (with reference to mean and dispersion).**	
Selecting and using an appropriate measure of central tendency. Mean, median and mode for a discrete (ungrouped) frequency distribution. Estimates for the median and mean of grouped frequency distributions. Comparison of two distributions using one measure of central tendency (i.e. the mean or the median) and/or one measure of spread. Modal category for qualitative data. Modal class for grouped data. Estimating the median from a cumulative frequency diagram. Selecting and calculating or estimating appropriate measures of spread, including the range and interquartile range applied to discrete, grouped and continuous data. Producing and using box-and-whisker plots to compare distributions. Drawing 'by eye' a line of 'best fit' on a scatter diagram, understanding and interpreting what this represents. [In questions where the mean point has been given, calculated or plotted, candidates will be expected to draw the line of 'best fit' through that point.]	
Discussing results	
Recognising that graphs may be misleading. Looking at data to find patterns and exceptions. Drawing inferences and conclusions from summary measures and data representations, relating results back to the original problem. Drawing of conclusions from scatter diagrams; using terms such as positive correlation, negative correlation, little or no correlation. Appreciating that correlation does not imply causality.	.

Higher tier – Statistics

GCSE Mathematics – Numeracy and GCSE Mathematics	GCSE Mathematics only*
Estimating and calculating the probabilities of events	
Understanding and using the vocabulary of probability, including notions of uncertainty and risk. The terms 'fair', 'evens', 'certain', 'likely', 'unlikely ' and 'impossible'.	Understanding and using the probability scale from 0 to 1. Use of: the probability of an event not occurring is one minus the probability that it occurs. (Probabilities must be expressed as fractions, decimals or percentages.)
	Estimating the probability of an event as the proportion of times it has occurred. Relative frequency. An understanding of the long-term stability of relative frequency is expected. <u>Graphical representation of relative frequency against the number of trials.</u> Calculating theoretical probabilities based on equally likely outcomes. Estimating probabilities based on experimental evidence. Comparing an estimated probability from experimental results with a theoretical probability.
	Identifying all the outcomes of a combination of two experiments, *e.g. throwing two dice;* use tabulation, <u>tree diagrams</u>, Venn diagrams, or other diagrammatic representations of compound events.
	Knowledge that the total probability of all the possible outcomes of an experiment is 1. <u>Recognising the conditions when the addition of probabilities for mutually exclusive events and the multiplication of probabilities for two independent events apply, and making the appropriate calculations.</u> <u>If *A* and *B* are mutually exclusive, then the probability of *A* or *B* occurring is *P(A) + P(B).*</u> <u>If *A* and *B* are independent events, the probability of *A* and *B* occurring is *P(A)* × *P(B).*</u>
	Understanding when and how to estimate conditional probabilities. **The multiplication law for dependent events.** **Sampling without replacement.**

3 ASSESSMENT

3.1 Assessment objectives and weightings

This specification requires candidates to demonstrate their knowledge, skills and understanding in the following assessment objectives.

	Assessment Objectives	Weighting
AO1	**Recall and use their knowledge of the prescribed content** • Recall and use mathematical facts and concepts. • Recall and use standard mathematical methods. • Follow direct instructions to solve problems involving routine procedures.	**50% - 60%**
AO2	**Select and apply mathematical methods** • Select and use the mathematics and resources needed to solve a problem. • Select and apply mathematical methods to solve non-standard or unstructured, multi-step problems. • Make decisions when tackling a given task, for example, choose how to display given information.	**10% - 20%**
AO3	**Interpret and analyse problems and generate strategies to solve them** • Devise strategies to solve non-routine or unfamiliar problems, breaking them into smaller, more manageable tasks, where necessary. • Communicate mathematically, using a wide range of mathematical language, notation and symbols to explain reasoning and to express mathematical ideas unambiguously. • Construct arguments and proofs using logical deduction. • Interpret findings or solutions in the context of the original problem. • Use inferences and deductions made from mathematical information to draw conclusions. • Reflect on results and evaluate the methods employed.	**25% - 35%**

3.2 Use of formulae and calculators

Formulae: Lists are provided at **Appendix A** of the formulae that will be provided in the examination, at each tier. Learners should be able to use the formulae but they do not need to memorise them.

Calculators: advice is provided at **Appendix B** in relation to the characteristics of calculators that are permitted for use in Unit 2 at all tiers.

3.3 Organising, communicating and writing accurately

Two marks will be awarded on each examination paper, at each tier, for the assessment of 'communicating, organising and writing accurately'. These marks will be in addition to the marks allocated to the mathematics. One mark will be awarded for communicating and organising. The other mark will be awarded for writing accurately (incorporating language, grammar, punctuation, spelling and mathematical notation). These questions will be clearly indicated on each examination paper.

Mark schemes for all units include the following specific criteria for the assessment of written communication (including mathematical communication):

- accuracy of spelling, punctuation and grammar; clarity of meaning;

- selection of a form and style of writing appropriate to purpose and to complexity of subject matter;

- organisation of information clearly and coherently; use of specialist vocabulary where appropriate.

4 TECHNICAL INFORMATION

4.1 Making entries

This is a linear qualification in which all assessments must be taken at the end of the course. Assessment opportunities will be available in the summer and November series each year, until the end of the life of this specification. November 2016 will be the first assessment opportunity.

A qualification may be taken more than once. Candidates must resit all examination units in the same series.

The entry codes appear below.

Qualification title	Entry codes	
	English-medium	Welsh-medium
WJEC GCSE Mathematics (Foundation Tier)	3300PF	3300LF
WJEC GCSE Mathematics (Intermediate Tier)	3300PN	3300LN
WJEC GCSE Mathematics (Higher Tier)	3300PH	3300LH

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

4.2 Grading, awarding and reporting

GCSE qualifications in Wales are reported on an eight point scale from A* to G, where A* is the highest grade. The attainment of learners, who do not succeed in reaching the lowest possible standard to achieve a grade, is recorded as U (unclassified) and they do not receive a certificate.

The assessment of GCSE Mathematics will be tiered as follows:

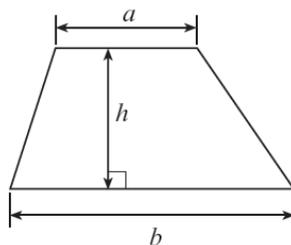| Higher	A*	A	B	C				
Intermediate			B	C	D	E		
Foundation#					D	E	F	G

APPENDIX A

Formula list – Foundation tier
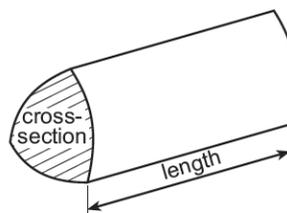
Area of a trapezium $= \frac{1}{2}(a+b)h$
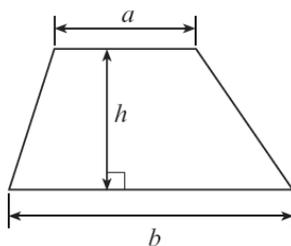
Formula list – Intermediate tier
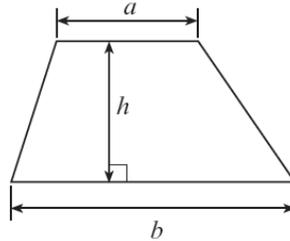
Area of a trapezium = $\frac{1}{2}(a+b)h$
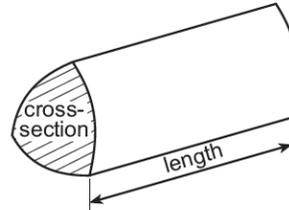

Volume of a prism = area of cross section × length

Formula list – Higher tier

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

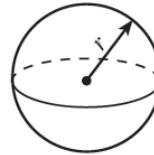**Volume of a prism** = area of cross section × length

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

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

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

Curved surface area of a cone $= \pi r l$
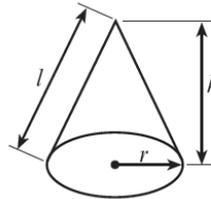
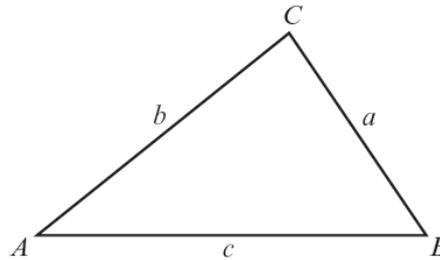**In any triangle** ABC

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 triangle $= \dfrac{1}{2}ab\sin C$

The Quadratic Equation

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

Annual Equivalent Rate (AER)

AER, as a decimal, is calculated using the formula $\left(1 + \dfrac{i}{n}\right)^n - 1$, where i is the nominal interest rate per annum as a decimal and n is the number of compounding periods per annum.

APPENDIX B

Use of calculators

In the examination the following rules will apply.

Calculators must be:

- of a size suitable for use on the desk;

- either battery or solar powered; and

- free of lids, cases and covers which have printed instructions or formulas.

Calculators must not:

- be designed or adapted to offer any of these facilities:

  o language translators,
  o symbolic algebra manipulation,
  o symbolic differentiation or integration,
  o communication with other machines or the internet.

- be borrowed from another learner during an examination for any reason.

- have retrievable information stored in them including, (but not limited to):

  o databanks,
  o dictionaries,
  o mathematical formulae,
  o text.