Contents

WJEC GCSE in MATHEMATICS

For Examination from 2009

MATHEMATICS

SUMMARY OF ASSESSMENT

There are 2 tiers of entry for this examination.

Higher Tier: Grades A* - D
Foundation Tier: Grades C - G

Candidates for the Higher Tier who narrowly fail to achieve Grade D will be awarded Grade E.

All candidates are required to sit 2 written papers (weighted at 50% each).

The first paper in each tier will be a non-calculator paper.

The duration of the written papers are as follows:

Higher Tier: 2 hours
Foundation Tier: 2 hours

Qualification Accreditation Number: 100/6435/7

MATHEMATICS

1 INTRODUCTION

Criteria for GCSE

This specification meets the General Criteria for GCSE and the Subject Criteria for GCSE Mathematics issued by DELLS/QCA. Assessment for this qualification is carried out according to codes of practice published by the regulatory authorities. The qualification may be undertaken either through the medium of English or of Welsh.

GCSE qualifications are reported on an eight-point scale from A* to G, where A* is the highest grade. Candidates who fail to reach the minimum standard for a grade to be awarded are recorded as U (unclassified) and do not receive a qualification certificate.

GCSE qualifications are expected to show broad equivalence to General National Vocational Qualifications in the following terms:

Two GCSEs at grade D to G and two GCSEs at grade A* to C are equivalent to one three-unit GNVQ at foundation and intermediate level respectively;
four GCSEs at grades D to G and four GCSEs at grade A* to C are equivalent to one six-unit GNVQ at foundation level and intermediate level respectively.

Rationale

The specification is consistent with the Statutory Orders of the National Curriculum and with the national Criteria for Mathematics. It has been written against the Key Stage 4 Programme of Study for Wales. Candidates entering for this GCSE in England or Northern Ireland must be taught all the material required by the National Curriculum in their own country.

The specification sets out to assess what candidates know, understand and can do, enabling them to demonstrate their full potential.

The specification will encourage the teaching of links between different areas of the curriculum.

The specification is intended to promote a variety of styles of teaching and learning so that the courses are enjoyable for all participants. It will enable students to progress to higher level courses of mathematical studies.

Prior Learning

Although there is no specific requirement for prior learning, this specification builds upon the knowledge, skills and understanding developed in the Key Stage 3 Programmes of Study in Mathematics as defined by the National Curriculum in Wales.

Progression

This specification provides a basis for the study of Mathematics and related subjects at Advanced Subsidiary and Advanced GCE and also for further study leading to other qualifications.

Overlap and Restrictions on Entry

This specification does not overlap with any other qualification offered by WJEC and there are no restrictions on concurrent entry for other qualifications.

Candidates, however, may only enter for one tier of this examination at any particular examination sitting.

The classification code for this specification is 2210.

Centres should be aware that candidates who enter for more than one qualification with the same classification code will only have one grade (the highest) counted for the purpose of the School and College Performance Tables.

Candidates with Particular Requirements

Details of the special arrangements and special consideration for candidates with particular requirements are contained in the Joint Council for Qualifications document *Regulations and Guidance Relating to Candidates who are Eligible for Adjustments in Examinations*.. Copies of this document are available from WJEC.

2 AIMS

The aims describe the educational purposes of following a course in Mathematics suitable for pupils within the ability range of the target group for the GCSE examination. Some of these aims are reflected in assessment objectives; others refer to attributes and qualities which cannot readily be translated into measurable objectives. All, however, are essential aims.

A course based on this specification should enable pupils to:

(i) develop their mathematical knowledge and oral, written and practical skills in a manner which encourages confidence, enjoyment and perseverance;

(ii) read mathematics, and write and talk about the subject in a variety of ways;

(iii) develop a feel for number, carry out calculations and understand the significance of the results obtained;

(iv) apply mathematics in everyday situations and develop an understanding and appreciation of the part which mathematics plays and has played in the world around them;

(v) solve problems, present the solutions clearly, and check and interpret the results;

(vi) develop an understanding of mathematical principles;

(vii) recognise when and how a solution may be represented mathematically, identify and interpret relevant factors and, where necessary, select an appropriate mathematical method to solve the problem;

(viii) use mathematics as a means of communication with emphasis on the use of clear expression;

(ix) develop an ability to apply mathematics in other subjects, particularly science and technology;

(x) develop the abilities to reason logically, to classify, to generalise and to prove;

(xi) develop the skill to investigate mathematical ideas and to test and prove their own hypotheses;

(xii) appreciate the interdependence of different branches of mathematics;

(xiii) acquire a foundation appropriate to their further study of mathematics and of other disciplines.

This specification will enable centres to provide courses in Mathematics that will allow candidates to discriminate between truth and falsehood. The mathematical models of the real world will naturally raise for discussion moral and cultural issues. Candidates will be required to reason logically and consider the consequences of decisions.

This specification has been designed to take account of the 1998 Resolution of the Council of the European Community and the report 'Environmental Responsibility: An Agenda for Further and Higher Education (1993)'. Questions will be set to take account of such issues.

This specification is designed to make a contribution to the development of the knowledge, skills and understanding of citizenship. Opportunities for addressing citizenship will naturally arise particularly when candidates address problems in number and statistics.

This specification provides a range of opportunities for the use of ICT. The Programmes of Study in the specification content explicitly signpost opportunities for the use of ICT in the delivery of the course.

3 ASSESSMENT OBJECTIVES

The specification requires candidates to demonstrate their knowledge, skills and understanding in the following assessment objectives. These relate to the knowledge, skills and understanding in the relevant programme of study.

AO1 Using and Applying Mathematics
AO2 Number and Algebra
AO3 Shape, Space and Measures
AO4 Handling Data

Assessment Objective AO1 will be assessed in contexts provided by the other assessment objectives.

4 SCHEME OF ASSESSMENT

The scheme of assessment will include two terminal written papers.

The weighting will be as follows:

Terminal written papers 100 marks each.

The written papers will assess all assessment objectives.

A minimum of 20% of the assessment will be attributable to Assessment Objective 1.

The weightings of the other assessment objectives will be as follows:

AO	Weighting
2	50-55%
3	25-30%
4	18-22%

TIER OF ENTRY

Results will be reported on the grade A*-G scale.

There will be two overlapping tiers of entry.

A candidate may enter for **one** tier only at any particular examination sitting.

Tier	Grades Available
Higher	A*, A, B, C, D
Foundation	C, D, E, F, G

Candidates who narrowly fail to achieve Grade D on the Higher Tier will be awarded Grade E.

Differentiation will be achieved by setting questions which are designed to assess candidates at the appropriate levels of ability and which are intended to allow candidates to demonstrate what they know, understand and can do. The differentiated papers should enable candidates entered for the appropriate tier to show positive achievement.

WRITTEN PAPERS

In each tier there will be two written papers each carrying 100 marks.

In Paper 1 at each tier, the use of calculators is forbidden. A suitable calculator is required for use in Paper 2. All other forms of calculating aids (e.g. slide rules, logarithm tables) are forbidden in the examination.

Each paper in the Higher Tier will be of 2 hours' duration.
Each paper in the Foundation Tier will be of 2 hours' duration.

All papers will be question/answer booklets and will consist of questions which vary in length. Each written paper will sample as many topics in a tier as is possible within the time allocated to the paper. Candidates will be required to answer all the questions. The marks for each question or part-question will be printed on the paper.

Paper 1 may assess any topic in the subject content for its tier, except those which expressly require the use of a calculator. Paper 2 may assess any topic in the subject content for its tier, except those which expressly prohibit the use of a calculator.

For all examination papers, candidates should have a ruler, compasses and a protractor.

Formulae Lists

Formulae lists will be printed as part of each question paper.

Calculating Aids

It is expected that candidates will have access to calculators and other appropriate technological aids during the course.

In the examination the following rules will apply.

(i) The calculator must be of a size suitable for use on the desk at which the candidate will attempt the examination.

(ii) The power supply for the calculator is the responsibility of the candidate and must be integral.

(iii) The working condition of the calculator is the responsibility of the candidate.

(iv) A fault in a calculator will not normally be considered as justifying the giving of special consideration to the user.

(v) Calculator cases, instruction leaflets and similar materials must not be in the possession of candidates during the examination.

(vi) Calculators must not be borrowed from other candidates in the course of an examination for any reason, although the invigilator may provide a candidate with a replacement calculator.

(vii) Programmable calculators may be used but no prepared programs may be taken into the examination room.

(Information and/or programs stored in the calculator's memory must be cleared before the examination. Retrieval of information and/or programs during the examination is an infringement of the regulations.)

(viii) Candidates are responsible for clearing any information and/or programs stored in the calculator before the examination.

Calculators which have non-numerical functions or give non-numerical information are not permitted. Such prohibited facilities include data banks, dictionaries, language translators, text retrieval and calculators with facilities which are capable of carrying out symbolic algebra. The use of any calculators with facilities which are capable of communicating with other machines for sending/receiving messages is strictly prohibited and the use of such calculators by candidates will be regarded as malpractice.

5 SPECIFICATION CONTENT

The subject content for each tier is listed in the following pages.

The content of any tier which is not included in the tier immediately below it appears in bold.

In the column "Notes and Examples", appropriate examples are highlighted by shading.

In addition to the published Programmes of Study, it is important that, during the course, candidates should be given opportunities to:

- make mental calculations and calculations without the aid of a calculator;
- make estimates;
- understand 3-D shape;
- use computers;
- collect data.

USING AND APPLYING MATHEMATICS

PROGRAMME OF STUDY

Pupils should be given opportunities to:

- use and apply mathematics in practical tasks, in real-life problems and within mathematics itself in ways that challenge and extend their understanding
- use mathematical language and notation to communicate findings
- encounter and compare various lines of mathematical argument

1. Making and Monitoring Decisions to Solve Problems

Pupils should be taught to:

1. find ways of overcoming difficulties that arise; develop and use their own strategies

2. select, trial and evaluate a variety of possible approaches; identify what further information may be required in order to pursue a particular line of enquiry; break complex problems into a series of tasks

3. select and organise mathematics and resources; extend their work to related tasks; select, follow and reflect on alternative approaches and ideas of their own

4. review progress while engaging in work; check and evaluate solutions

5. apply their knowledge, understanding and skills creatively to solve problems of increasing complexity in a wider range of contexts

6. explain and evaluate their choice of approach to solving problems set in contexts or areas of mathematics that are new to them.

2. Developing Mathematical Language and Communication

Pupils should be taught to:

1. understand and use mathematical language and notation

2. use mathematical forms of communication, including diagrams, tables, graphs and ICT

3. present work clearly, using diagrams, graphs and symbols appropriately, to convey meaning

4. interpret mathematics presented in a variety of forms; evaluate forms of presentation

5. examine critically, improve and justify their choice of mathematical presentation

6. express mathematical ideas unambiguously through the efficient use of conventional mathematical notations

3. Developing Mathematical Reasoning

Pupils should be taught to:

1. explain and justify how they arrived at a conclusion or solution to a problem

2. make conjectures and hypotheses, designing methods to test them, and analysing results to see whether they are valid

3. understand general statements, leading to making and testing generalisations; recognise particular examples, and appreciate the difference between mathematical explanation and experimental evidence

4. appreciate and use 'if ... then ...' lines of argument in number, algebra and geometry, and draw inferences from statistics

5. use mathematical reasoning, initially when explaining, and then when following a line of argument, recognising inconsistencies

6. extend their mathematical reasoning and understanding; use more rigorous argument, leading to notions of proof

7. understand the necessary and sufficient conditions under which generalisations, inferences and solutions to problems remain valid

CONTENT – FOUNDATION TIER

NUMBER – FOUNDATION TIER

PROGRAMME OF STUDY		NOTES AND EXAMPLES
Understanding number and place value.		
1	Understand and use the concept of place value in whole numbers and decimals, relating this to computation and the metric system of measurement.	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. Rounding numbers to a given number of significant figures.
2	Understand and use decimals, ratios, fractions and percentages, and the interrelationships between them; understand and use negative numbers.	Equivalences between decimals, fractions, ratios and percentages. Ordering whole numbers, decimals, fractions and percentages. List in ascending order: 0·25, $^1/_3$, 10%. Directed numbers in practical situations. Ordering directed numbers.
3	Understand and use index notation.	Understanding and using index notation for positive integral indices. $8 = 2^3$; the words 'square' and 'cube'. Writing whole numbers in index form. Write 360 as the product of its prime factors in index form. Use of the rules of indices. Positive indices.

Understanding number relationships and methods of calculation.

1 Consolidate their knowledge of number facts, including the quick recall of multiplication to 10 × 10 and the corresponding division facts; develop the use of methods for finding quickly from known facts, those that they have not learned,
e.g. $17 \times 13 = 170 + 3 \times 17$
$= 170 + 51$
$= 221;$
use some common properties of numbers, including multiples, factors and primes, leading to powers and roots.

Odd, even, prime, square numbers, square root, cube and cube root.
Find 3^2, $\sqrt{25}$, 10^3, the square of 7, $\sqrt[3]{64}$.
Reciprocals.
Least common multiple. Highest common factor. Candidates may be required to find the LCM and HCF of numbers written as the product of their prime factors.

2 Extend mental methods of computation, to consolidate a range of non-calculator methods of addition, subtraction, multiplication and division of integers; understand, use accurately and explain the methods they use.

The understanding and 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.

3 Calculate with negative numbers, decimals, fractions, percentages and ratio, under-standing the effects of operations, *e.g. squaring, multiplying and dividing by numbers between 0 and 1*, and selecting an appropriate non-calculator or calculator method.

The four rules applied to decimals, fractions and negative numbers.
Converting numbers from one form into another.
Write ¼ as a percentage.
Write 0·2 as a fraction.
Write 75% as a decimal.
Finding a fraction or percentage of a quantity.
Expressing one number as a fraction or percentage of another.
Fractional and percentage changes.
Increase and decrease.
Reverse percentage problems will NOT be expected.
Calculating using ratios in a variety of situations, in context.
Proportional division.
Divide £1520 in the ratio 5:3:2.
Repeated proportional changes; appreciation and depreciation.
The value of a car is £12000. Each year its value decreases by 10%. Find the value of the car at the end of three years.

4 Understand when and how to use fractions and percentages to make proportional comparisons.

Compare pass rates in fractional and percentage forms.
In class 11X, $^1/_3$ of the class passed a test. In class 11Y, 25% passed the same test. Which class had the better pass rate?

5	Understand and use the facilities of a calculator, including the constant function, memory and brackets, to plan a calculation and evaluate expressions.	Use of addition, subtraction, multiplication, division, square, square root, power, root, constant, memory, brackets and appropriate trigonometric and statistical functions. Knowing how a calculator may order its operations. Candidates will not be expected to list the key depressions that they have made. Reading a calculator display correct to a specified number of decimal places or significant figures.
6	Mentally estimate and approximate solutions to numerical calculations, leading to multiplication and division with numbers of any size rounded to one significant figure.	Use estimation in multiplication and division problems with whole numbers to obtain approximate answers. Multiplying and dividing mentally numbers rounded to one significant figure. Candidates must show sufficient working in order to demonstrate how they have obtained their estimate. $\frac{2{\cdot}8 \times 4{\cdot}23}{61} \approx \frac{3 \times 4}{60} = 0{\cdot}2$

Solving numerical problems

1	Develop their understanding of the four operations and the relationship between them, apply this knowledge to solve problems, including those that involve ratios, proportions and compound measures, using metric or common Imperial units where appropriate.	Interpretation and use of mathematical information presented in written or visual form when solving problems. Understanding the basic principles of personal and household finance. Simple and compound interest. Profit and loss. Money, including the use of foreign currencies and exchange rates. TV programme schedules, bus/rail timetables, distance charts, holiday booking information. Fuel and other bills, hire purchase, VAT, taxation, discount , best buys, wages and salaries. Candidates will not be required to find the original quantity given the result of a proportional change. Average speed. Use of compound measures such as m/s, km/h, mph, mpg, population per km^2.
2	Select suitable sequences of operations and methods of computation, including trial-and-improvement methods, to solve problems involving integers, decimals, fractions, ratios and percentages, *e.g. using a spreadsheet to consider sets of numbers that have a given sum and find the set that has the maximum product.*	

3	Use a variety of checking strategies and apply them appropriately to calculations; use estimation and inverse operations, and confirm that results are of the right order of magnitude.	Checking the reasonableness of results by reference to knowledge of the context or to the size of the numbers.
4	Give solutions in the context of the problem, selecting an appropriate degree of accuracy**,** interpreting the display on a calculator, and recognising limitations on the accuracy of data and measurements.	Knowing whether to round up or down as appropriate. Candidates may, for example, be expected (i) when working in £, to interpret a calculator display of 49.9 as £49.90, (ii) to find how many 47-seater coaches will be needed for a school trip for a party of 352. Recognising that measurement is approximate and that a measurement expressed to a given unit is in possible error of half a unit. The lower and upper bounds of 140 (to the nearest 10) are 135 and 145 respectively The lower and upper bounds of numbers expressed to a given degree of accuracy. Rounding an answer to a reasonable degree of accuracy in the light of the context.

ALGEBRA – FOUNDATION TIER

PROGRAMME OF STUDY	NOTES AND EXAMPLES
Understanding and using functional relationships	
1 Appreciate the use of letters to represent variables.	
2 Explore number patterns arising from a variety of situations, using computers where appropriate; generate rules for number sequences; interpret, generalise and use simple relationships ; express simple functions initially in words and then symbolically; make and interpret tables and graphs of functions.	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 *n*th term of a sequence where the rule is linear.
3 Construct and interpret graphs that describe real-life situations.	Construction and interpretation of travel graphs and conversion graphs. Interpretation of graphical representation used in the media.
4 Explore the properties of standard mathematical functions, including linear, quadratic, higher order polynomial functions; interpret their graphs, and use graphical calculators and computers to understand their behaviour.	Use of coordinates in 4 quadrants. Drawing, interpretation and recognition of the graphs of $x = a$ $y = b$, $y = ax + b$ Understanding 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. Recognition that $y = 3x$ is steeper than $y = x$ and that the line $y = 2x + 3$ and the line $y = 2x - 1$ are parallel. Drawing and interpretation of graphs of $y = ax^2 + bx + c$ $y = ax^3 + b$ Draw the curve $y = x^2 - 1$ from $x = -2$ to $x = 4$. Write down the coordinates of the points where the line $y = 2$ meets this curve. Draw the curve $y = 2x^2 - 3x - 4$ from $x = -2$ to $x = 3$. Write down the value of x for which $2x^2 - 3x - 4$ is a minimum. Write down this minimum value.

Understanding and using equations and formulae

1 Appreciate the use of letters to represent unknowns.

2 Construct, interpret and evaluate formulae and expressions, given in words or symbols, related to mathematics or other subjects, or real-life situations, using computers and calculators where appropriate.

Substitution of positive and negative whole numbers, fractions and decimals into simple formulae expressed in words or symbols.

Wage earned = hours worked × rate per hour
Find the wage earned if a man worked for 30 hours and was paid at the rate of £4.50 per hour.

$v = u + at$
Find v when $u = 20$, $a = -2$ and $t = 3$.

3 Manipulate algebraic expressions; form and manipulate equations or inequalities in order to solve problems.

Understanding basic conventions.
$a + a + a = 3a$
$a \times a \times a = a^3$
$a \times b \times 2 = 2ab$
$2(a + b) = 2a + 2b$
Formation and simplification of expressions involving sums, differences, products and powers.
Simplify
(i) $2x^2 \times 3x^3$ (ii) $(3x^2)^3$
(iii) $\frac{6x^5}{3x^2}$
Collection of like terms.
Simplify
(i) $3a - 4b + 4a + 5b$
(ii) $2(3x - 1) - (x - 4)$
(iii) $x(x - 1) + 2(x^2 - 3)$.
Extraction of common factors e.g. $6x + 4 = 2(3x + 2)$
Changing the subject of a formula when the subject appears in one term only.
Given that $m = 7n - 3$, find n in terms of m.
Formation and manipulation of linear equations.
Formation and manipulation of simple linear inequalities.
Three times a number n plus 6 is less than 27. Write down an inequality which is satisfied by n and rearrange it in the form $n < a$ where a is a rational number.

4 Solve a range of linear equations and simple inequalities

Solution of linear equations and simple linear inequalities with whole number and fractional coefficients.
Solve $3(1 - x) = 5(2 + x)$.
Solve $3 = 12/x$.
Solve $4 - x \geq 5$.
Solve $\frac{1}{2}(x - 1) = 3x + 1$.

Solve a range of quadratic and cubic equations by trial-and-improvement methods.

Find, by trial-and-improvement, the solution of the equation $x^3 - 5x = 80$ which lies between 4 and 5. Give your answer correct to 1 decimal place.

SHAPE, SPACE AND MEASURES – FOUNDATION TIER

PROGRAMME OF STUDY		NOTES AND EXAMPLES
Understanding and using properties of shape		
1	Visualise, describe and represent shapes, including 2-D representations of 3-D objects, using geometrical language with increasing precision.	The geometrical terms: point, line, plane, parallel, right angle, clockwise and anti-clockwise turns, acute, obtuse and reflex angles, perpendicular, horizontal, vertical, 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, chord, tangent, arc, circumference, sector. Simple solid figures: cube, cuboid, cylinder, prism, pyramid, tetrahedron, cone and sphere. Interpretation and drawing of nets.
2	Construct 2-D and 3-D shapes from given information; understand the congruence of simple shapes, and classify triangles, quadrilaterals, polygons and other shapes, knowing and using their properties.	Accurate use of ruler, compasses and protractor. Lengths accurate to 1mm and angles accurate to 1° Construction of triangles, quadrilaterals and circles. "Ruler and compasses" construction of angles will not be required. The identification of congruent shapes. Essential properties of special types of quadrilateral, including square, rectangle, parallelogram, trapezium and rhombus; classify quadrilaterals by their geometric properties.
3	Understand the symmetry properties of 2-D and 3-D shapes and use these to solve problems in two- and three-dimensions.	Simple description of symmetry in terms of reflection in a line/plane or rotation about a point. Order of rotational symmetry.
4	Measure angles, and use the language associated with them; explain and use the angle properties of polygons and other 2-D configurations, including those associated with parallel and intersecting lines.	Angles at a point. Adjacent angles on a straight line. Vertically opposite angles. Parallel lines. Corresponding and alternate angles. Angle properties of triangles. Use the fact that the angle sum of a triangle is 180°. Use the fact that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices. Use angle properties of equilateral, isosceles and right-angled triangles, understand congruence; explain why the angle sum of any quadrilateral is 360°. Understand and use the properties of parallelograms. Regular and irregular polygons. Sum of the interior and sum of the exterior angles of a polygon.
5	Understand and use Pythagoras' theorem**.**	2-D only, including reverse problems.

Understanding and using properties of position, movement and transformation.

1	Use coordinate systems to specify location, initially using rectangular Cartesian coordinates in the first quadrant.	Use of Cartesian coordinates in 4 quadrants. Locating points with given coordinates. Finding 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). Finding the coordinates of the mid-point of the line segment *AB*, given points *A* and *B*. Location determined by distance from a given point and angle made with a given line.
2	Recognise and visualise the transformations of translation, reflection, rotation and enlargement, and their combination in two dimensions; understand the notations used to describe them.	Rotations through 90°, 180°, 270°. Centre of rotation. Enlargements with positive scale factors. Centre of enlargement. Candidates will be expected to draw the image of a shape under transformation. The vector form of a translation will not be required.
3	Understand and use the properties of transformations to create and analyse patterns, and to investigate the properties of shapes and to derive results, including congruence.	Tessellations.
4	Develop an understanding of scale, including using and interpreting maps and drawings, and enlarging shapes by different scale factors.	Interpretation and construction of scale drawings. Scales may be written in the form 1 cm represents 5 m, or 1:500. Use of bearings. (Only three figure bearings will be used.e.g 065°, 237°.)
5	Determine the locus of an object moving according to a given rule, including, where appropriate, using practical methods and the devising of instructions for a computer to produce desired shapes and paths.	Constructing the locus of a point which moves such that it is (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.

Understanding and using measures

1	Choose appropriate instruments and standard units of length, mass, capacity and time, and make sensible estimates in everyday situations extending to less familiar contexts; develop an understanding of the relationship between units, converting one metric unit to another; know Imperial units in daily use and their approximate metric equivalents.	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. 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
2	Develop an understanding of the difference between discrete and continuous measures**;** read and interpret scales, including decimal scales, and understand the degree of accuracy that is possible, or appropriate, for a given purpose.	
3	Understand and use compound measures including speed and density**.**	Use of compound measures such as m/s, km/h, mph, mpg, kg/m^3.
4	Find perimeters, areas and volumes of common shapes including circles and cylinders, by counting and dissection methods, progressing to the derivation and use of standard formulae.	Perimeters and areas of squares, rectangles, triangles, parallelograms, circles, semicircles and composite shapes. Estimation of the area of an irregular shape drawn on a square grid. Volumes of cubes, cuboids, prisms, cylinders, and composite solids.

HANDLING DATA –FOUNDATION TIER

PROGRAMME OF STUDY		NOTES AND EXAMPLES
Processing and interpreting data		
1	Design and use data collection sheets, access required information from tables, lists and computer databases, and make frequency tables for grouped data, where appropriate.	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. The class intervals will be given Understanding and using tallying methods.
2	Design a questionnaire or an experiment to capture the data needed to follow lines of enquiry and to test hypotheses, taking possible bias into account.	Designing and criticising questions for a questionnaire. Includes notion of 'fairness' (in experimental design). Testing a hypothesis such as "Girls tend to do better than boys in Biology tests."
3	Construct appropriate diagrams and graphs to represent discrete and continuous data, including bar charts, line graphs, pie charts, frequency polygons and scatter diagrams**.**	Pictograms, bar charts and pie charts for qualitative data. Vertical line diagrams for discrete data. A line graph for the values of a variable at different points in time. Temperature charts. Knowing that intermediate values in a line graph may or may not have meaning. Grouped frequency diagrams and frequency polygons. Scatter diagrams for data on paired variables.
4	Calculate or estimate values of the mode, median and mean, and use these as measures of central tendency, initially with discrete data, progressing to grouped and continuous data.	Selecting and using an appropriate measure of central tendency. Mean, median and mode for a discrete (ungrouped) frequency distribution. Modal category for qualitative data. Modal class for grouped data. Estimates for the mean of grouped frequency distributions and the identification of the class containing the median.

6	Draw inferences based on a wide range of graphs, diagrams and statistics; looking critically at some of the ways in which representation of data can be misleading; compare sets of data and their distributions using appropriate methods including those that involve correlation and lines of best fit.	Comparison of two distributions using one measure of central tendency (i.e. the mean or the median) and/or the range. Recognising that graphs may be misleading. Drawing of conclusions from scatter diagrams using terms such as positive correlation, negative correlation, little or no correlation. Drawing 'by eye' a line of 'best fit' on a scatter diagram. 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.
7	Evaluate results critically by relating them to the initial question or problem; communicate their findings using appropriate language; and develop an understanding of the reliability of results.	
8	Recognise that inferences drawn from data analysis may suggest the need to refine the questions asked, or may lead to further questions for investigation.	

Estimating and calculating the probabilities of events.

1	Understand and use the vocabulary of probability, through experience, experiment and theory, leading to understanding and using the probability scale from 0 to 1.	Includes the terms 'fair', 'evens', 'certain', 'likely', 'unlikely ' and 'impossible'. Knowledge and use of: the probability of an event not occurring is one minus the probability that it occurs. Probabilities may be expressed as fractions, decimals or percentages.
2	Give and justify estimates of probability to an appropriate degree of accuracy.	Estimating the probability of an event as the proportion of times it has occurred.
3	Understand and use relative frequency as an estimate of probability, and judge when sufficient trials have been carried out.	Graphical representation of relative frequency against the number of trials. Comparing an estimated probability from experimental results with a theoretical probability. An understanding of the long-term stability of relative frequency is expected.

4	Recognise situations where probabilities can be based on equally likely outcomes, and others where estimates must be based on experimental evidence, calculate and make these estimates as appropriate.	Calculating theoretical probabilities based on equally likely outcomes. Estimating probabilities based on experimental evidence.
5	Identify all the outcomes of a combination of two experiments, *e.g. throwing two dice;* use tabulation or other diagrammatic representations of compound events.	
6	Recognise the conditions when the addition of probabilities for mutually exclusive events and the multiplication of probabilities for two independent events apply, and make the appropriate calculations.	If *A* and *B* are mutually exclusive, then the probability of *A* or *B* occurring is $P(A) + P(B)$. If *A* and *B* are independent events, the probability of *A* and *B* occurring is $P(A) \times P(B)$. Knowledge that the total probability of all the possible outcomes of an experiment is 1.

CONTENT – HIGHER TIER

NUMBER – HIGHER TIER

PROGRAMME OF STUDY		NOTES AND EXAMPLES
Understanding number and place value		
1	Understand and use the concept of place value in whole numbers and decimals, relating this to computation and the metric system of measurement.	Reading and writing whole numbers 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. Rounding numbers to a given number of significant figures.
2	Understand and use decimals, ratios, fractions and percentages, and the interrelationships between them; understand and use negative numbers.	Equivalences between decimals, fractions, ratios and percentages. Ordering whole numbers, decimals, fractions and percentages. List in order 0·25, $^1/_3$, 10%. Directed numbers in practical situations. Ordering directed numbers.
3	Understand and use index notation, **leading to standard form**.	Writing whole numbers in index form. Write 360 as the product of its prime factors in index form Use of the rules of indices. Positive, **negative, zero and fractional** indices. **Simplify $81^{3/4}$, $8^{-2/3}$.** **Expressing and using numbers in standard form with positive and negative powers of 10.**
4	**Understand and use direct and inverse proportion.**	
5	**Distinguish between rational and irrational numbers, and appreciate that with the inclusion of irrational numbers, the number system is complete.**	**Classify as rational or irrational $\sqrt{2}$, π, $\sqrt{64}$, $(1+\sqrt{2})^2$, $(\sqrt{5}-\sqrt{2})(\sqrt{5}+\sqrt{2})$.** **Converting recurring decimals to fractional form.** **The following notation may be used for recurring decimals;** **$0\cdot\dot{2}$ = 0·222222……..** **$0\cdot\dot{1}\dot{2}$ = 0·121212……..** **$0\cdot\dot{1}2\dot{3}$ = 0·123123123….** **0·142857142857 …= $^1/_7$** **0·12121212.. = $^{12}/_{99}$** **0·1010010001…. Cannot be expressed as a fraction.**

Understand number relationships and methods of calculation

1 Consolidate their knowledge of number facts, including the quick recall of multiplication to 10 × 10 and the corresponding division facts; develop the use of methods for finding quickly from known facts, those that they have not learned,

e.g. $17 \times 13 = 170 + 3 \times 17$
$= 170 + 51$
$= 221;$

use some common properties of numbers, including multiples, factors and primes, leading to powers and roots.

Odd, even, prime, square numbers, square root, cube and cube root.

Find 3^2, $\sqrt{25}$, 10^3, the square of 7, $\sqrt[3]{64}$

Reciprocals.

Least common multiple. Highest common factor.

Candidates may be required to find the LCM and HCF of sets of numbers written as the product of their prime factors

2 Extend mental methods of computation, to consolidate a range of non-calculator methods of addition, subtraction, multiplication and division of integers, , understand, use accurately and explain the methods they use.

The understanding and 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.

3 Calculate with negative numbers, decimals, fractions, percentages and ratio, understanding the effects of operations, *e.g. squaring, multiplying and dividing by numbers between 0 and 1*, and selecting an appropriate non-calculator or calculator method.

The four rules applied to decimals, fractions and negative numbers.

Finding a fraction or percentage of a quantity.

Expressing one number as a fraction or percentage of another.

Fractional and percentage changes**; reverse percentage problems**

Given that a meal in a restaurant costs £36 with VAT at 17·5%, its price before VAT is calculated as £$^{36}/_{1.175}$.

Increase and decrease. Calculating using ratios in a variety of situations, in context.

Proportional division.

Divide £1520 in the ratio 5:3:2.

Repeated proportional changes; appreciation and depreciation.

The value of a car is £12000. Each year its value decreases by 10%. Find the value of the car at the end of three years.

4 Understand when and how to use fractions and percentages to make proportional comparisons.

5	Understand and use the facilities of a calculator including the use of the constant function, memory and brackets, to plan a calculation and evaluate expressions.	Use of addition, subtraction, multiplication, division, square, square root, power, root, constant, memory, brackets and appropriate trigonometric and statistical functions. Knowing how a calculator may order its operations. Candidates will not be expected to list the key depressions that they have made. Reading a calculator display correct to a specified number of decimal places or significant figures.
6	Mentally estimate and approximate solutions to numerical calculations, leading to multiplication and division with numbers of any size rounded to one significant figure.	Use estimation in multiplication and division problems to obtain approximate answers. Multiplying and dividing mentally numbers rounded to one significant figure. Candidates must show sufficient working in order to demonstrate how they have obtained their estimate. $\frac{2{\cdot}8 \times 4{\cdot}23}{61} \approx \frac{3 \times 4}{60} = 0{\cdot}2$
7	**Simplify numerical expressions involving surds; understand and use indices with negative and fractional values.**	**Simplification of expressions involving surds.** **$(\sqrt{3} + \sqrt{2})^2 - (\sqrt{3} - \sqrt{2})^2 = 4\sqrt{6}$** **Excluding the rationalisation of the denominator of a fraction such as** $\frac{1}{(2-\sqrt{3})}$

Solving numerical problems

1	Develop their understanding of the four operations and the relationship between them, and apply them to solving problems, including those that involve ratios, proportions and compound measures, using metric or common Imperial units where appropriate.	Interpretation and use of mathematical information presented in written or visual form when solving problems. Understanding the basic principles of personal and household finance. Simple and compound interest. Profit and loss. Money, including the use of foreign currencies and exchange rates. TV programme schedules, bus/rail, timetables, distance charts, holiday booking information. Fuel and other bills, hire purchase, VAT, taxation, discount, best buys, wages and salaries. **Candidates may be required to find the original quantity given the result of a proportional change.** Average speed. Use of compound measures such as m/s, km/h, mph, mpg, population per km^2.

2	Select suitable sequences of operations and methods of computation, including trial-and-improvement methods, to solve problems involving integers, decimals, fractions, ratios and percentages, *e.g. using a spreadsheet to consider sets of numbers that have a given sum and find the set that has the maximum product.*	
3	Use a variety of checking strategies and apply them appropriately to calculations; use estimation and inverse operations, and confirm that results are of the right order of magnitude.	Checking the reasonableness of results by reference to knowledge of the context or to the size of the numbers.
4	Give solutions in the context of the problem, selecting an appropriate degree of accuracy, interpreting the display on a calculator, and recognising limitations on the accuracy of data and measurements.	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 lower and upper bounds of 140 (to the nearest 10) are 135 and 145 respectively. The lower and upper bounds of numbers expressed to a given degree of accuracy. **Calculating the lower and upper bounds in the addition and subtraction of numbers expressed to a given degree of accuracy.** Rounding off an answer to a reasonable degree of accuracy in the light of the context.
5	**Understand and calculate the upper and lower bounds of numerical solutions, particularly in the context of measurement.**	**Calculating the upper and lower bounds in calculations involving multiplication and division of numbers expressed to given degrees of accuracy.**

ALGEBRA – HIGHER TIER

PROGRAMME OF STUDY	NOTES AND EXAMPLES
Understanding and using functional relationships	
1 Appreciate the use of letters to represent variables.	
2 Explore number patterns arising from a variety of situations, using computers where appropriate; generate rules for number sequences; interpret, generalise and use simple relationships; express simple functions initially in words and then symbolically; make and interpret tables and graphs of functions.	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 *n*th term of a sequence where the rule is linear **or quadratic.**
3 Construct and interpret graphs that describe real-life situations.	Construction and interpretation of travel graphs and conversion graphs. Interpretation of graphical representation used in the media.

4 Explore the properties of standard mathematical functions, including linear, quadratic, higher order polynomial and **reciprocal** functions; **sketch** and interpret their graphs and use graphical calculators and computers to understand their behaviour.

Use of coordinates in 4 quadrants.
Drawing, interpretation, recognition and **sketching** the graphs of
$x = a$ $y = b$, $y = ax + b$
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.
Find the equation of the straight line which has gradient 2 and passes through the point (1,1).
Draw graphs when y is given implicitly in terms of x
Draw $2x + y = 7$
The gradients of parallel lines.
Drawing, interpretation, recognition and sketching the graphs of

$$y = a x^2 + b, \quad y = \frac{a}{x}, \quad y = ax^3 .$$

Sketch the curve $y = x^2$.
Draw the curve $y = x^2 - 1$ from $x = -2$ to $x = 4$. Write down the coordinates of the points where the line $y = 2$ meets this curve.
Drawing and interpretation of graphs of
$y = Ax^2 + Bx + C$
$y = Ax + B + \frac{C}{x}$
$y = Ax^3 + Bx^2 + Cx + D$
Draw the curve $y = 2x^2 - 3x - 4$ from $x = -2$ to $x = 3$. Write down the value of x for which $2x^2 - 3x - 4$ is a minimum. Write down this minimum value.

Draw the curve $y = x + \frac{2}{x}$ from $x = 0{\cdot}5$ to $x = 4$.
Using the same axes, draw the line $y = 5 - 2x$.
Write down the values of x at the points of intersection of the line and the curve. Write down and simplify the equation satisfied by these values of x.

5 **Interpret and apply the transformation of functions in the context of their graphical representation, including $y = f(x + a)$, $y = f(kx)$ and $y = f(x) + a$, applied to $y = f(x)$.**

6 **Construct and use tangents to curves to estimate rates of change for non-linear functions, and use appropriate compound measures to express results.**

Including finding velocity in distance - time graphs and acceleration in velocity-time graphs.

7 **Interpret the meaning of the area under a graph and apply this to the solution of numerical and statistical problems.**

Using the trapezium rule to estimate the area under a curve.
Area under a velocity-time graph.

Understanding and using equations and formulae

1 Appreciate the use of letters to represent unknowns.

2 Construct, interpret and evaluate formulae and expressions, given in words or symbols, related to mathematics or other subjects, or real-life situations, using computers and calculators where appropriate.

Substitution of positive and negative whole numbers, fractions and decimals into simple formulae expressed in words or symbols.

Wage earned = hours worked × rate per hour
Find the wage earned if a man worked for 30 hours and was paid at the rate of £4.50 per hour.

$v = u + at$
Find v when $u = 20$, $a = -2$ and $t = 3$

3 Manipulate algebraic expressions; form and manipulate equations or inequalities in order to solve problems.

Understanding basic conventions.

$a + a + a = 3a$

$a \times a \times a = a^3$

$a \times b \times 2 = 2ab$

$2(a + b) = 2a + 2b$

Formation and simplification of expressions involving sums, differences, products and powers.

Simplify

(i) $2x^2 \times 3x^3$ (ii) $(3x^2)^3$

(iii) $\frac{6x^5}{3x^2}$ (iv) $\frac{\mathbf{2(x+1)^2}}{\mathbf{(x+1)}}$

Collection of like terms.

Simplify (i) $3a - 4b + 4a + 5b$

(ii) $2(3x - 1) - (x - 4)$

(iii) $x(x - 1) + 2(x^2 - 3)$.

Multiplication of two linear expressions.

Expand $(ax + by)(cx + dy)$ and $(ax + by)^2$ where a, b, c, d are integers.

$\mathbf{(2x - y)(3x + 4y) = 6x^2 + 5xy - 4y^2}$

$\mathbf{(3x - 2y)^2 = 9x^2 - 12xy + 4y^2}$

Extraction of common factors e.g. $6x + 4 = 2(3x + 2)$.

Factorisation of quadratic expressions of the form $ax^2 + bx + c$.

Factorise (i) $3x^2 - 6x$ (ii) $x^2 + 3x + 2$

(iii) $x^2 - 5x - 6$ (iv) $x^2 - 9$ (v) $3x^2 - 48$

(vi) $3m^2 - 10m + 3$ (vii) $12d^2 + 5d - 2$

Changing the subject of a formula when the subject appears in one term **or more.**

Given that $\frac{1}{a} = \frac{1}{b} + \frac{1}{c}$

find b in terms of a and c.

Formation and manipulation of linear equations.

Formation and manipulation of quadratic equations.

A rectangle has longer side $(x + 3)$ m and shorter side $(x + 1)$ m. Its area is 24 m^2.

Write down a quadratic equation which is satisfied by x and arrange it in the form $x^2 + ax + b = 0$ where a and b are integers.

Formation and manipulation of linear inequalities.

Four times a number n minus 3 is less than twice the number n plus 5. Write down an inequality which is satisfied by n and arrange it in the form $an < b$ where a and b are integers.

4 Solve a range of linear equations, **simple linear simultaneous equations, inequalities, and quadratic and higher-order polynomial equations, selecting the most appropriate method for the problem concerned, including trial-and-improvement methods.**

Solution of linear equations and linear inequalities with whole number and fractional coefficients.

Solve $3(1 - x) = 5(2 + x)$.

Solve $3 = 12/x$.

Solve $\frac{1}{2}(x - 1) = 3x + 1$.

Solve $\frac{x - 2}{2} - \frac{2x - 1}{3} = 1$.

Solve $3x + 1 < x + 9$.

Solve $4 - x < 2x - 1$.

The solution of two linear simultaneous equations with whole number coefficients by graphical and algebraic methods.

Both equations may be of the form $ax + by = c$.

Solve the simultaneous equations

$$2x + 3y = 1$$
$$5x - 4y = 37.$$

The solution by factorisation, graphical methods and formula, of quadratic equations of the form

$ax^2 + bx + c = 0$.

Solve $x^2 - 49 = 0$.

Solve $x^2 - 5x + 4 = 0$.

Solve $x^2 + x = 6$.

Solve $x^2 - 7x = 0$.

Solve $x^2 - 2x - 3 = 0$.

Solve $3x^2 + 5x - 28 = 0$.

Find, correct to 2 decimal places, the roots of the equation $3x^2 - 7x - 2 = 0$.

Use the graph of $y = 2x^2 + 5x$ to solve $2x^2 + 5x = 7$.

The solution of cubic equations by graphical and trial-and-improvement methods.

Find, by trial-and-improvement, the solution of the equation $x^3 - 5x = 80$ which lies between 4 and 5. Give your answer correct to 1 decimal place.

The use of straight line graphs to locate regions given by linear inequalities.

Indicate by shading the region defined by $x > 0$, $y > 0$, $2x + 3y \leq 15$, $3x + y \leq 12$.

5 **Simplify algebraic expressions; solve equations and inequalities by algebraic and graphical methods, selecting the most appropriate method for the problem concerned.**

Solve $\frac{1}{x - 3} - \frac{2}{x - 2} = \frac{3}{2}$.

Use the graph of $y = x^2 + 5x + 1$ to solve $x^2 + 4x - 7 = 0$.

Use the graphs of $y = 2x^2 + 5x$ and $y = x^3$ to solve $x^3 - 2x^2 - 5x = 0$.

Find the points with integer coordinates which lie within the region defined by $x > 0$, $y > 0$, $2x + 3y \leq 15$, $3x + y \leq 12$.

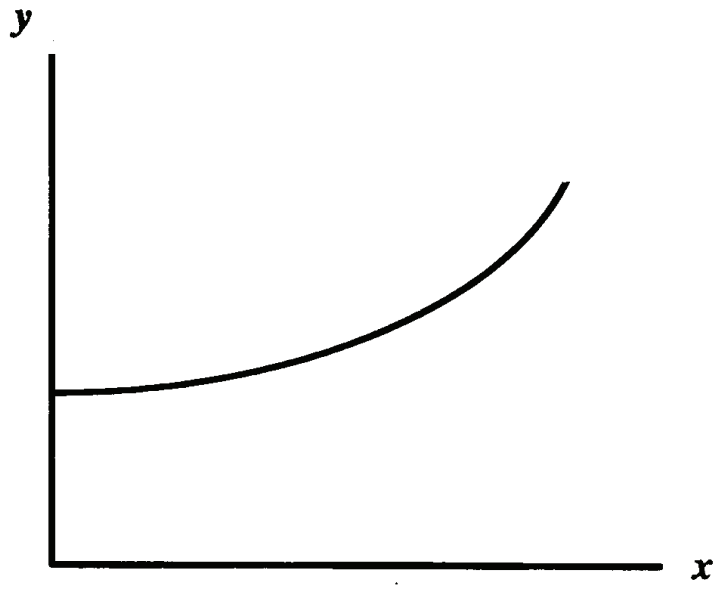
6 **Select mathematical functions, *e.g. exponential or trigonometric functions*, to fit sets of data that model increasingly complex situations, and use them to solve problems.**

(i)

x	1	2	3	4	5
y	2·5	8·4	18·2	32·0	51

y is approximately equal to $ax^2 + b$.
Plot y against x^2 and use the graph to estimate a and b.

(ii)



Given that $y = pq^x$, use the graph above to find the values of p and q.

SHAPE, SPACE AND MEASURES – HIGHER TIER

PROGRAMME OF STUDY		NOTES AND EXAMPLES
Understanding and using properties of shape		
1	Visualise, describe and represent shapes, including 2-D representations of 3-D objects, using geometrical language with increasing precision.	The geometrical terms: point, line, plane, parallel, right angle, clockwise and anti-clockwise turns, acute, obtuse and reflex angles, perpendicular, horizontal, vertical, 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, chord, tangent, arc, circumference, sector, **segment**. Simple solid figures: cube, cuboid, cylinder, prism, pyramid, tetrahedron, cone and sphere. Interpretation and drawing of nets.
2	Construct 2-D and 3-D shapes from given information; understand the congruence of simple shapes, and classify triangles, quadrilaterals, polygons and other shapes, knowing and using their properties.	Accurate use of ruler, compasses and protractor. Lengths accurate to 1mm and angles accurate to 1°. Construction of triangles, quadrilaterals and circles. "Ruler and compasses" construction of angles will not be required. The identification of congruent shapes. **Understand and use 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.** Essential properties of special types of quadrilateral, including square, rectangle, parallelogram, trapezium and rhombus; classify quadrilaterals by their geometric properties.
3	Understand the symmetry properties of 2-D and 3-D shapes and use these to solve problems in two- and three-dimensions.	Simple description of symmetry in terms of reflection in a line/plane or rotation about a point. Order of rotational symmetry.

4	Measure angles, and use the language associated with them; explain and use the angle properties of polygons and other 2-D configurations, including those associated with parallel and intersecting lines.	Angles at a point. Adjacent angles on a straight line. Vertically opposite angles. Parallel lines. Corresponding and alternate angles. Angle properties of triangles. Understand and use the properties of parallelograms. Use the fact that the angle sum of a triangle is 180°. Use the fact that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices. Use 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.
5	Understand and use Pythagoras' theorem.	2-D **and 3-D**, including reverse problems.
6	**Understand the trigonometrical relationships in right-angled triangles, and use these to solve problems, including those involving bearings.**	**2-D and 3-D. Calculating a side or an angle of a right-angled triangle.** **Problems including bearings, angles of elevation and depression.** **(Only three figure bearings will be used e.g 065°, 237°.)**
7	**Extend their understanding of trigonometry to angles of any size, the graphs and behaviour of trigonometric functions, and the application of these to the solution of problems in two or three-dimensions, including appropriate use of the sine and cosine rules**	**Sketching of trigonometric graphs.** **Use of the formula:** **Area of a triangle =** $\frac{1}{2}ab\sin C$
8	**Use angle and tangent properties of circles.**	**Understand that the tangent at any point on a circle is perpendicular to the radius at that point.** **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°; Use the alternate segment theorem.** **Understand and use the fact that tangents from an external point are equal in length.**

Understanding and using properties of position, movement and transformation.

1	Use coordinate systems to specify location, initially using rectangular Cartesian coordinates in the first quadrant.	Use of Cartesian coordinates in 4 quadrants. Locating points with given coordinates. Finding 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). Finding the coordinates of the midpoint of the line segment AB, given points A and B. Location determined by distance from a given point and angle made with a given line.
2	Recognise and visualise the transformations of translation, reflection, rotation and enlargement, and their combination in two dimensions; understand the notations used to describe them.	Rotations through 90°, 180°, 270°. Centre of rotation. Enlargements with positive **and negative** scale factors. Centre of enlargement. **Questions may involve two successive transformations.** Candidates will be expected to draw the image of a shape under transformation. **The vector form for a translation may be required.**
3	Understand and use the properties of transformations to create and analyse patterns, and to investigate the properties of shapes and to derive results, including congruence.	Tessellations.
4	Develop an understanding of scale, including using and interpreting maps and drawings, and enlarging shapes by different scale factors; **develop an understanding of and use mathematical similarity.**	Interpretation and construction of scale drawings. Scales may be written in the form 1 cm represents 5 m, or 1:500. Use of bearings. (Only three figure bearings will be used. e.g 065°, 237°.) **Knowledge that, in similar figures, corresponding sides are in the same ratio.**
5	Determine the locus of an object moving according to a given rule, including, where appropriate, using practical methods and the devising of instructions for a computer to produce desired shapes and paths.	Constructing the locus of a point which moves such that it is (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.
6	**Apply simple vector methods to the solution of problems.**	**Magnitude of a vector.** **Sum and difference of vectors; commutative and associative properties of vector addition; multiplication of vector by a scalar; simple applications to geometry in two-dimensions.** **Examination questions will use the following notation.** **a**, **AB**, $\begin{pmatrix} x \\ y \end{pmatrix}$

Understanding and using measures

1	Choose appropriate instruments and standard units of length, mass, capacity and time, and make sensible estimates in everyday situations extending to less familiar contexts; develop an understanding of the relationship between units, converting one metric unit to another; know Imperial units in daily use and their approximate metric equivalents.	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. 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. $8\,\text{km} \approx 5\,\text{miles}$ $1\,\text{kg} \approx 2.2\,\text{lb}$ $1\,\text{litre} \approx 1 \cdot 75\,\text{pints}$
2	Develop an understanding of the difference between discrete and continuous measures; read and interpret scales, including decimal scales, and understand the degree of accuracy that is possible, or appropriate, for a given purpose.	
3	Understand and use compound measures including speed and density.	Use of compound measures such as m/s, km/h, mph, mpg, kg/m^3.
4	Find perimeters, areas and volumes of common shapes including circles and cylinders, by counting and dissection methods, progressing to the derivation and use of standard formulae**; distinguish between formulae by considering dimensions, *e.g. recognise that* $^4/_3\pi r^2$ *cannot represent the volume of a sphere*.**	Perimeters and areas of squares, rectangles, triangles, parallelograms, circles, semicircles and composite shapes. Estimation of the area of an irregular shape drawn on a square grid. Volumes of cubes, cuboids, prisms, cylinders, and composite solids.
5	**Extend measurement, including distances and angles, to more complex plane shapes and solids, including circular arcs, cylinders, cones and spheres; understand and use relationships between similar figures and solids.**	**Volumes of spheres, cones and pyramids.** **Lengths of circular arcs.** **Areas of sectors and segments of circles.** **Relationships between the ratios of lengths, areas and volumes of similar solids.**

HANDLING DATA – HIGHER TIER

PROGRAMME OF STUDY		NOTES AND EXAMPLES
Processing and interpreting data		
1	Design and use data collection sheets, access required information from tables, lists and computer databases, and make frequency tables for grouped data, where appropriate.	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. The class intervals will be given. Understanding and using tallying methods.
2	Design a questionnaire or an experiment to capture the data needed to follow lines of enquiry and to test hypotheses, taking possible bias into account.	Designing and criticising questions for a questionnaire. Includes notion of 'fairness' (in experimental design). Testing a hypothesis such as "Girls tend to do better than boys in Biology tests."
3	Construct appropriate diagrams and graphs to represent discrete and continuous data, including bar charts, line graphs, pie charts, frequency polygons, scatter diagrams and **cumulative frequency diagrams.**	Pictograms, bar charts and pie charts for qualitative data. Vertical line diagrams for discrete data. A line graph for the values of a variable at different points in time. Temperature charts. Knowing that intermediate values in a line graph may or may not have meaning. Grouped frequency diagrams and frequency polygons**. Constructing cumulative frequency tables and diagrams using the upper boundaries of the class intervals.** Scatter diagrams for data on paired variables.
4	Calculate or estimate values of the mode, median and mean, and use these as measures of central tendency, initially with discrete data, progressing to grouped and continuous data.	Selecting and using an appropriate measure of central tendency. Mean, median and mode for a discrete (ungrouped) frequency distribution. Modal category for qualitative data. Modal class for grouped data. Estimates for the median and mean of grouped frequency distributions**, including estimating the median from a cumulative frequency diagram**.
5	**Select and calculate or estimate appropriate measures of spread, including the range and interquartile range applied to discrete, grouped and continuous data.**	

6	Draw inferences based on a wide range of graphs, diagrams and statistics; looking critically at some of the ways in which representation of data can be misleading; compare sets of data and their distributions using appropriate methods including those that involve correlation and lines of best fit.	Comparison of two distributions using one measure of central tendency (i.e. the mean or the median) and/or one measure of spread. Recognising that graphs may be misleading. Drawing of conclusions from scatter diagrams using terms such as positive correlation, negative correlation, little or no correlation. Drawing 'by eye' a line of 'best fit' on a scatter diagram. 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.
7	Evaluate results critically by relating them to the initial question or problem; communicate their findings using appropriate language; and develop an understanding of the reliability of results.	
8	Recognise that inferences drawn from data analysis may suggest the need to refine the questions asked, or may lead to further questions for investigation.	
9	**Use sampling methods, considering their reliability.**	**Using and understanding how different methods of sampling and different sample sizes may affect the reliability of conclusions drawn.** **Selecting a sampling method to investigate a population.** **Simple random sampling.** **Simple stratified sampling.** **Use of random digits to obtain a random sample from a numbered list.** **A list of random digits will be given.**
10	**Extend skills in handling data into constructing and interpreting histograms.**	**Frequency density.** **Emphasis will be placed on unequal class intervals.** **Interpreting shapes of histograms representing distributions (with reference to mean and dispersion).**
11	**Describe the dispersion of a set of data; find and interpret the standard deviation of a set of data.**	**Standard deviation of ungrouped data.** **Estimating the standard deviation from grouped data.** **Using the mean and standard deviation to compare distributions and draw conclusions.** **Use of the statistical functions on a calculator is expected.**

Estimating and calculating the probabilities of events

1	Understand and use the vocabulary of probability, through experience, experiment and theory, leading to understanding and using the probability scale from 0 to 1.	Includes the terms 'fair', 'evens', 'certain', 'likely', 'unlikely', and 'impossible'. Knowledge and use of: the probability of an event not occurring is one minus the probability that it occurs. Probabilities can be expressed as fractions, decimals or percentages.
2	Give and justify estimates of probability to an appropriate degree of accuracy.	Estimating the probability of an event as the proportion of times it has occurred.
3	Understand and use relative frequency as an estimate of probability, and judge when sufficient trials have been carried out.	Graphical representation of relative frequency against the number of trials. Comparing an estimated probability from experimental results with a theoretical probability. An understanding of the long-term stability of relative frequency is expected.
4	Recognise situations where probabilities can be based on equally likely outcomes, and others where estimates must be based on experimental evidence, calculate and make these estimates as appropriate.	Calculating theoretical probabilities based on equally likely outcomes. Estimating probabilities based on experimental evidence.
5	Identify all the outcomes of a combination of two experiments, *e.g. throwing two dice*; use tabulation, **tree diagrams** or other diagrammatic representations of compound events.	
6	Recognise the conditions when the addition of probabilities for mutually exclusive events and the multiplication of probabilities for two independent events apply, and make the appropriate calculations.	If A and B are mutually exclusive, then the probability of *A* or *B* occurring is $P(A) + P(B)$. If *A* and *B* are independent events, the probability of *A* and *B* occurring is $P(A) \times P(B)$. Knowledge that the total probability of all the possible outcomes of an experiment is 1.
7	**Understand when and how to estimate conditional probabilities.**	**The multiplication law for dependent events.** **Sampling without replacement.**

6 KEY SKILLS

Key skills are integral to the study of Mathematics and a number of them may be assessed in the context of the subject as indicated in the Appendix to the specification. In particular, candidates may be assessed on their ability in each of the Key Skills, Application of Number, Communication and IT. This will involve the organisation and presentation of information, ideas, descriptions and arguments clearly and logically, the planning and interpretation of information from different types of sources including a large data set, the carrying out multi-stage calculations, the interpretation of results of calculations and the presentation of findings. In addition, candidates will have the opportunity for developing and, where appropriate, being assessed on the wider key skills of Working with Others, Improving Own Learning and Performance, and Problem Solving.

7 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 co-ordinates 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 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.

APPENDIX

EXEMPLIFICATION OF KEY SKILLS

Note: If producing certain types of evidence creates difficulties, due to disability or other factors, the student may be able to use other ways to show achievement. The student should ask the tutor or supervisor for further information.

COMMUNICATION

COMMUNICATION: LEVEL 1			
C1.1 TAKE PART IN A DISCUSSION			
C1.1 Students must:	**Evidence must show students can:**	**Examples of evidence**	**Suggested context:**
Take part in either a **one-to-one** discussion or a **group** discussion.	provide information that is relevant to the subject and purpose of the discussion communicate clearly in a way that suits the situation and responds appropriately to others.	**Discussion** Records from an assessor who observed each discussion and noted how the student met the requirements of the Unit, or an audio/video tape of the discussions.	Classroom discussion, possibly in Q & A form, relating a straight-forward topic e.g. graphical presentation of data.
C1.2 READ AND OBTAIN INFORMATION			
C1.2 Students must:	**Evidence must show students can:**	**Examples of evidence**	**Suggested context:**
Read and obtain information from at least one document. Evidence shows the candidate can:	read relevant material identified accurately the main points and ideas use the information to suit their purpose.	**Reading** A record of what the student reads and why, including a note or copy of the image. Notes, highlighted text or answers to questions about the material read. Records of how the student used the information. E.g. in discussions for **C1.1** or writing for **C1.3**.	Collection of data from (a) the media and (b) a survey in order to present information graphically.
C1.3 WRITE TWO DIFFERENT TYPES OF DOCUMENT			
C1.3 Students must:	**Evidence must show students can:**	**Examples of evidence**	**Suggested context:**
Write two different types of documents. Evidence shows the candidate can:	present relevant information in a format that suits their purpose spell, punctuate and use grammar accurately make their meaning clear.	**Writing** Two different documents might include a letter, a short report or essay, with an image such as a chart or sketch.	Presentation of statistical information by (a) drawing a diagram (b) compiling a short written report.

COMMUNICATION: LEVEL 2			
C2.1a CONTRIBUTE TO A DISCUSSION			
C2.1a Students must:	**Evidence must show students can:**	**Examples of evidence**	**Suggested context:**
Take part in a group discussion.	make clear and relevant contributions in a way that suits their purpose and situation respond appropriately to others help to move the discussion forward.	**Discussion** A record from an assessor who observed the discussion and noted how the student met the requirements of the Unit, or an audio/video tape of the discussion.	Discussion on how a spreadsheet can be used to assist in calculations involving number.
C2.1b GIVE A SHORT TALK			
C2.1b Students must:	**Evidence must show students can:**	**Examples of evidence**	**Suggested context:**
Give a talk of at least four minutes.	speak clearly in a way that suits their subject, purpose and situation keep to the subject and structure their talk to help listeners follow what they are saying use appropriate ways to support their main points.	**Short talk** A record from an assessor who observed the talk, or an audio/video tape of the talk. Notes from preparing and giving the talk. A copy of the image used.	A short talk on the construction of 3D models from nets.
C2.2 READ AND SUMMARISE INFORMATION			
C2.2 Students must:	**Evidence must show students can:**	**Examples of evidence**	**Suggested context:**
Read and summarise information from at least **two** documents about the same subject. Each document must be a minimum of 500 words long.	select and read relevant documents identify accurately the main points, ideas and lines of reasoning summarise the information to suit their purpose.	**Reading** A record of what is read and why, including a note or copy of the image. Notes, highlighted text or answers to questions about the material read. Evidence of summarising information could include the student's notes for the talk, or one of the documents written.	Substantial collection of data from (a) the media (b) a survey in order to present a summary of the information graphically.
C2.3 WRITE DIFFERENT TYPES OF DOCUMENT			
C2.3 Students must:	**Evidence must show students can:**	**Examples of evidence**	**Suggested context:**
Write **two different** types of documents each one giving different information. **One** document must be at least 500 words long.	present relevant information in a format that suits their purpose use a structure and style of writing to suit their purpose spell, punctuate and use grammar accurately make their meaning clear.	**Writing** Two different documents might include a report or an essay, with an image such as a chart, graph or diagram, a business letter or notes.	Presentation of statistical information by (a) drawing suitable diagrams, (b) compiling an extended report.

APPLICATION OF NUMBER

APPLICATION OF NUMBER: LEVEL 1			
N1.1 INTERPRET STRAIGHTFORWARD INFORMATION			
N1.1 Students must:	**Evidence must show students can:**	**Examples of evidence**	**Suggested context:**
Interpret information from two different sources. At least one source must include a table, chart, graph or diagram.	obtain the information needed to meet the purpose of their task identify suitable calculations to get the results they need.	**Interpret information** Interpret straightforward information from **two** different sources. At least **one** source should be a table, chart, diagram or line graph. A statement from an assessor who checked the accuracy of the student's measurements or observations (if this was done). Records of the information obtained and the types of calculations identified to get the results needed.	Interpretation of train/bus timetables.
N1.2 CARRY OUT STRAIGHTFORWARD CALCULATIONS			
N1.2 Students must:	**Evidence must show students can:**	**Examples of evidence**	**Suggested context:**
Carry out and check calculations to do with: a. amounts or sizes b. scales or proportion c. handling statistics.	carry out calculations to the levels of accuracy they you have been given check their results make sense.	**Carry out calculations** Records of the calculations (for a, b and c) and how the student checked them.	Calculations involving, for instance, (a) areas and volumes (b) scale drawings (c) tally charts and frequency diagrams.
N1.3 INTERPRET THE RESULTS OF CALCULATIONS			
N1.3 Students must:	**Evidence must show students can:**	**Examples of evidence**	**Suggested context:**
Interpret the results of your calculations and present your findings — in two different ways using charts or diagrams.	choose suitable ways to present their findings use more than one way of presenting their findings present their findings clearly using a chart or diagram describe what their results tell them.	**Interpret results and present findings** Descriptions of the findings and how the results of the calculations met the purpose of the tasks. At least one chart and one diagram presenting the findings.	The planning of a school trip making use of (a) a plan of the venue e.g. museum (b) a time chart relating to the ages of objects.

APPLICATION OF NUMBER: LEVEL 2

The student must carry through at least one substantial activity that includes straightforward tasks for N2.1, N2.2 and N2.3.

N2.1 INTERPRET INFORMATION			
N2.1 Candidates must:	**Evidence must show that students can:**	**Example of evidence**	**Suggested context:**
Interpret information from a suitable source.	choose how to get the information they need to meet the purpose of their activity obtain relevant information choose appropriate methods to get the results they need.	**Interpret information** A description of the substantial activity. Copies of source material, including the graph, and/or a statement from someone who has checked the accuracy of the student's measurements and observations. Records of the information obtained and the methods selected for getting the results needed.	Planning a holiday with reference to a variety of timetables, weather charts and information contained in brochures.
N2.2 CARRY OUT CALCULATIONS			
N2.2 Students must:	**Evidence must show students can:**	**Examples of evidence**	**Suggested context:**
Use your information to carry out calculations to do with: a amounts or sizes b scales or proportion c handling statistics d using formulae.	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.	**Carry out calculations** Records of calculations (for a, b, c and d), showing methods used and levels of accuracy. Notes on how the student checked methods and results.	Calculation involving, for instance (a) areas and volumes (b) scale drawing (c) tally charts and frequency diagrams (d) manipulation of algebraic formulae.
N2.3 INTERPRETING THE RESULTS OF CALCULATIONS			
N2.3 Students must:	**Evidence must show students can:**	**Examples of evidence**	**Suggested context:**
Interpret the results of your calculations and present your findings.	select effective ways to present their findings present their findings clearly using a chart, graph or diagram and describe their methods use more than one way of presenting their findings describe what their results tell them and how these meet their purpose.	**Interpret results and present findings** Descriptions of findings and methods. Notes on how the results from the calculations met the purpose of the activity. At least one graph, one chart and one diagram presenting the findings.	The planning of a school holiday making use of (a) plans of towns (b) weather charts (c) foreign currency conversion graphs.

INFORMATION TECHNOLOGY

INFORMATION TECHNOLOGY: LEVEL 1			
IT1.1 FINDING, EXPLORING AND DEVELOPING INFORMATION			
IT1.1 Students must:	**Evidence must show students can:**	**Examples of evidence**	**Suggested context:**
Find and select relevant information.	choose information that is relevant to their tasks.	**Find and develop information** Print-outs and copies of the information the student selects to use. A record from an assessor who observed the student using IT when exploring and developing information or working drafts with notes of how the student met the requirements of the Unit.	Use of internet to explore (a) weather forecasts (b) train timetable.
IT1.2 PRESENTING INFORMATION			
IT1.2 Students must:	**Evidence must show students can:**	**Examples of evidence**	**Suggested context:**
Enter and develop information to suit the task	enter information using formats that help development save information so it can be found easily.	**Present information** Working drafts showing how the student developed the presentation or records from an assessor who saw the presentation or records from an assessor who saw the student's screen displays. Print-outs or prints of a static or dynamic screen display of the student's final work, including examples of text, images and numbers. Records of how the student saved information.	Use of a word processor to present a coursework report, making use of text and graphics facilities. Use of a spreadsheet to present numerical calculations.

INFORMATION TECHNOLOGY: LEVEL 2

IT2.1 SEARCHING FOR AND SELECTING INFORMATION

IT2.1 Students must:	**Evidence must show students can:-**	**Examples of evidence**	**Suggested context:**
Search for and select information to meet your needs. Use different information sources for each task and multiple search criteria in at least one case.	select information relevant to the tasks.	**Search for and select information** Print-outs of the relevant information with notes of sources and how the student made searches, or a record from an assessor who observed the student using IT when searching for information.	Use of Internet to search for and select (a) census information (b) information on the history of mathematics.
IT2.2 EXPLORING AND DEVELOPING INFORMATION			
IT2.2 Students must:	**Evidence must show students can:**	**Examples of evidence**	**Suggested context:**
Enter and develop the information to suit the task and derive new information.	enter and combine information using formats that help development develop information and derive new information as appropriate.	**Develop information** Print-outs, or a record from an assessor who observed the student using IT, with notes to show how the student explored and developed information and derived new information.	Enter information gathered from a variety of sources into a database. Search the database for specific information which can be used either (i) in the production of a coursework report, or (ii) in a graphical presentation of data.
IT2.3 PRESENT COMBINED INFORMATION			
IT2.3 Students must:	**Evidence must show students can:**	**Examples of evidence**	**Suggested context:**
Present combined information such as text with image, text with number, image with number.	develop the presentation so that the final output is accurate and shows consistent use of formats; use layout appropriate to the types of information.	**Present information** Working drafts, or a record from an assessor who observed the screen displays, with notes to show how the student developed content and presentation. Print-outs, or prints of static or dynamic screen displays, of the final work, including examples of text, images and numbers. Records of how the information was saved.	Use of a word processing package to present an extensive coursework report, making use of text and graphics facilities. Use of a spreadsheet to present numerical calculations.

WORKING WITH OTHERS

WORKING WITH OTHERS LEVEL 1

Students must carry through at least:

- **one** straightforward activity in a one-to-one situation;
- **one** straightforward activity in a group situation.

Each activity must include tasks for WO1.1, WO1.2 and WO1.3.

Students must:	Evidence must show students can:	Examples of evidence	Suggested context :
WO1.1 Confirm you understand the given objectives, and plan for working together.	check that they clearly understand what they have to achieve together identify what needs to be done and their individual responsibilities make sure they understand the arrangements for working together.	**Planning activities** Records from an assessor who observed the student's discussions with others or audio/video tapes. Notes of the objectives, responsibilities and working arrangements for each activity.	Plan an investigation into a mathematical problem with others in the class or with selected individuals e.g. gather information from pupils in school using stratified sampling techniques.
WO1.2 Work with others towards achieving the given objectives.	carry out tasks to meet their responsibilities work safely, following the working methods they have been given check progress, asking for help and offering support to others, when appropriate	**Working towards objectives** Records of how the student carried out tasks to meet responsibilities. Notes of the help given and the support the student offered others. These records could include a log, statements written by others with whom the student worked, audio/video tape recordings, photographs with notes and assessor records.	Establish links with other individuals with the class or outside with a view to collecting relevant data to investigate a mathematical problem e.g. by using stratified sampling techniques.
WO1.3 Identify ways you helped to achieve things and how to improve your work with others.	identify what went well and less well in working with others identify how they helped to achieve things together suggest ways of improving their work with others for next time.	**Identifying progress** Statements from both the student and others on progress (written or recorded). Records of answers to questions from an assessor about any difficulties and what the student did about them. Notes of ways to improve work with others.	Develop a time-plan. Arrange meetings to monitor progress. Reflect on ways in which collaborative working could be improved.

WORKING WITH OTHERS LEVEL 2

Students must carry through at least:

- **one** straightforward activity in a one-to-one situation;
- **one** straightforward activity in a group situation.

Each activity must include tasks for WO2.1, WO2.2 and WO2.3.

Students must:-	**Evidence must show students can:**	**Examples of evidence**	**Suggested context:**
WO2.1 Plan work with others	identify what they need to achieve together share relevant information to identify what needs to be done and individual responsibilities confirm the arrangements for working together.	**Planning activities** Records from an assessor who observed the student's discussions with others or audio/video tapes. Note of the information provided, with details of the identified objectives, responsibilities and working arrangements for each activity.	Plan an investigation into a mathematical problem with others in the class or with selected individuals e.g. a traffic census.
WO2.2 Work co-operatively towards achieving the identified objectives.	organise and carry out tasks safely using appropriate methods, to meet their responsibilities support co-operative ways of working to help achieve the objectives for working together check progress, seeking advice from an appropriate person when needed.	**Working towards objectives** Records of how the student organised and carried out tasks, supported co-operative work and sought advice. These records could include a log, statements written by others with whom the student worked, audio/video tape recordings, photographs with notes and assessor records.	Establish links with other individuals within the class with a view to collecting relevant data to investigate a mathematical problem e.g. a traffic census.
WO2.3 Review your contributions and agree ways to improve work with others.	share relevant information on what went well and less well in working with others identify their role in helping to achieve things together agree ways of improving their work with others.	**Exchanging information on progress** Statements on progress (written or recorded) including details about the quality of work and how the student responded to other reports on progress. Notes of what the student agreed to do to improve work with others and help achieve objectives.	Develop a time-plan. Arrange meetings to monitor progress. Reflect on ways in which collaborative working could be improved.

IMPROVING OWN LEARNING AND PERFORMANCE

IMPROVING OWN LEARNING AND PERFORMANCE LEVEL 1

Students must carry through at least:

- **one** example of study-based learning;
- **one** example of activity-based learning.

The whole process must be completed twice.

Students must:	Evidence must show students can:	Examples of evidence -	Suggested context:
LP1.1 Confirm your targets and plan how to meet these with the person setting them.	make sure targets clearly show what they want to achieve identify clear action points and deadlines for each target identify how to get the support they need and the arrangements for reviewing their progress.	**Understanding targets** Records of discussions which show the student checked her/his understanding of targets and knew how to get the support needed.	Establish, with teachers and others, through 1-1 discussion, targets for enhancing performance e.g. in coursework.
LP1.2 Follow your plan, to help meet targets and Improve your performance.	work through their action points to complete these on time use ways of learning suggested by their supervisor, making changes, when needed, to improve their performance use support given by others to help them meet targets.	**Following plans** A log of study-based and activity-based learning, with notes of the support given. Records from those who have seen the work and which shows the tasks were completed on time and how any suggested changes were made.	Monitor progress by producing a log, seeking teacher support as or when necessary.
LP1.3 Review your progress and achievements in meeting targets, with an appropriate person.	say what they learned and how they learned, including what has gone well and what has gone less well identify targets they have met and their achievements check what they need to do to improve their performance.	**Reviewing progress** Records of discussions which show what the student said about her/his progress and had checked s/he knew how to improve performance. Examples of work which show the student learned from two study-based and two activity-based activities. Notes on action plans to show targets met.	Keep a record of all work completed and marked during the course and how you have learnt and improved from the comments made.

IMPROVING OWN LEARNING AND PERFORMANCE LEVEL 2

Students must carry through tasks for LP2,1, LP2.2 and LP2.3 that include at least:

- **one** example of study-based learning;
- **one** example of activity-based learning.

The student must complete this whole process twice and include at least **one** example of working without close supervision and **one** example of using learning from one task to meet the demands of a new situation.

Students must:	**Evidence must show students can:**	**Examples of evidence -**	**Suggested context:**
LP2.1 Help set targets with an appropriate person and plan how these will be met.	provide information to help set realistic targets for what they want to achieve identify clear action points for each target and how they will manage their time identify how to get the support they need and arrangements for reviewing their progress.	**Setting targets** Records of discussions which show the information provided to help set targets. Two action plans with action points, timetable and notes of support needed.	Establish, with teachers and others, through 1-1 discussion, targets for enhancing performance e.g. in coursework.
LP2.2 Take responsibility for some decisions about your learning, using your plan to help meet targets and improve your performance.	use their action points to help manage their time well, revising their plan when needed choose ways of learning to improve their performance, working for short periods without close supervision identify when they need support and use this effectively to help meet targets	**Using plans** A log of the study-based and activity-based learning, with notes of: • When the student asked for support and it was used; • When and how the student took responsibility for own learning; • How own learning from one task was used to meet the demands of a new situation; • Any changes made to the plan.. • Records from those who saw the work which show the student managed her/his time well and completed tasks.	Establish, with teachers and others, through 1-1 discussion, targets for enhancing performance e.g. in coursework.
LP2.3 Review progress with an appropriate person and provide evidence of your achievements.	identify what they learned, and how they have used their learning in another task identify targets they have met and evidence of their achievements identify ways they learn best and how to further improve their performance**.**	**Reviewing progress** Records of information provided on progress and ways of improving performance. Examples of work which show what was learned from two study-based and two activity-based learning activities. Notes on personal action plans to show targets met.	Establish, with teachers and others, through 1-1 discussion, targets for enhancing performance e.g. in coursework.

PROBLEM SOLVING

PROBLEM SOLVING LEVEL 1

The student must: carry through a straightforward activity, which includes tasks for PS1.1, PS1.2 and PS1.3, for each of **two** given problems.

Students must:	**Evidence must show students can:**	**Examples of evidence -**	**Suggested context:**
PS1.1 Confirm with an appropriate person that you understand the given problem and identify different ways of tackling it.	check that they clearly understand the problem they have been given check how they will know it has been solved come up with different ways of tackling the problem.	**Confirm problems and identify options** Descriptions of the two problems and how success in solving the problem would be shown. Descriptions of ways for solving the two problems and the most realistic options to try. Records of help given.	Identify a topic for investigation e.g. tossing a coin and two possible techniques or carrying out the investigation e.g. (a) by experiment (b) by theoretical techniques based on equally likely outcomes.
PS1.2 Confirm with an appropriate person what you will do and follow your plan for solving the problem.	help decide how they will try to solve the problem plan what they need to do follow their plan, working safely and using support given by others to help tackle the problem.	**Plan and try out options** Statements on how the student confirmed the options to be tried out. A plan for trying out each option. Records of what was done in following the plan, with notes on the advice and support given.	Discuss an appropriate plan of action with the class teacher for carrying out the above investigation.
PS1.3 Check with an appropriate person if the problem has been solved and how to improve your problem solving skills.	check if the problem has been solved using the methods they have been given identify clearly what went well and less well in tackling the problem check what they need to do to improve their problem-solving skills.	**Check and describe results** Records of the methods given and why they were used. Descriptions of the results of the problem solving activities and ways to improve the approach to problem solving.	Produce a suitable report on an investigation identifying the methods used and giving suggestions for improving the approach to the problem.

PROBLEM SOLVING LEVEL 2

The student must carry through a straightforward activity, which includes tasks for PS2.1, PS2.2 and PS2.3, for each of **two** given problems.:

Students must:	**Evidence must show students can:**	**Examples of evidence -**	**Suggested context:**
PS2.1 Identify a problem, with help from an appropriate person, and identify different ways of tackling it.	provide information to help identify a problem, accurately describing its main features identify how they will know the problem has been solved come up with different ways of tackling the problem.	**Identify problems and options** Descriptions of the two given problems and how the student is going to show they have been solved successfully. Descriptions of ways for solving the two given problems and how these were arrived at. Records of how the student decided which options were most realistic, including the help obtained.	Identify a topic for investigation e.g. the long-run stability of relative frequency and two possible techniques for carrying out the investigation e.g. (a) by experiment (b) by computer simulation.
PS2.2 Plan and try out at least one way of solving the problem.	confirm with an appropriate person how they will try to solve the problem plan what they need to do, identifying the methods and resources they will use use their plan effectively, getting support and revising their plan when needed to help tackle the problem.	**Plan and try out options** Statements on how the options were confirmed and tried out. A plan for trying out each option. Records of what was done, including any changes made to the plan. Notes of the support obtained and how this was used effectively.	Discuss an appropriate plan of action with the class teacher for carrying out the above investigation.
PS2.3 Check if the problem has been solved and identify ways to improve problem solving skills**.**	check if the problem has been solved by accurately using the methods they have been given describe clearly the results, including the strengths and weaknesses of how they tackled the problem identify ways of improving their problem solving skills.	**Check and describe results** Records of the methods used, the results of the checks carried out and explanations of the decisions taken. Descriptions of the strengths and weaknesses of the approach to the problem solving activities, and what would be done differently.	Identify a topic for investigation e.g. the long-run stability of relative frequency and two possible techniques for carrying out the investigation e.g. (a) by experiment (b) by computer simulation. Evaluate the outcomes of the investigation.