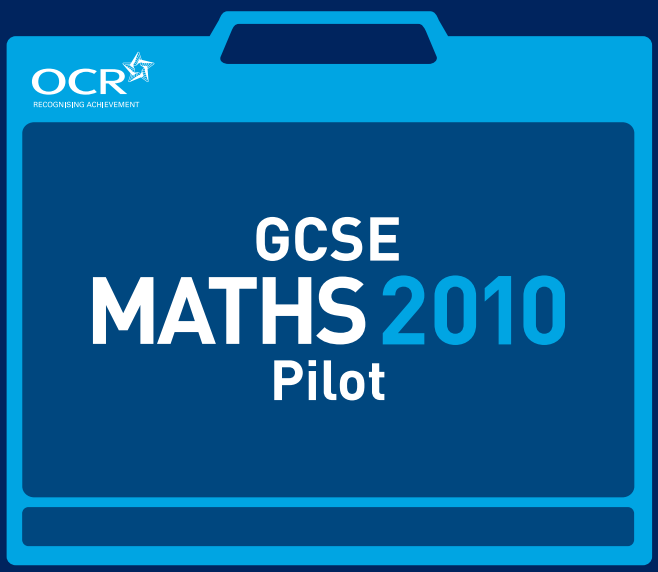
OCR
RECOGNISING ACHIEVEMENT

OCR GCSE in Applications of Mathematics J925 (Pilot)

specification

July 2010



Why choose OCR GCSE Applications of Mathematics?

This exciting OCR pilot GCSE Applications of Mathematics is designed to be inspiring, motivating and challenging. In this pilot, the two qualifications – GCSE Applications of Mathematics and GCSE Methods in Mathematics – cover, between them, the entire Key Stage 4 programme of study for mathematics. Each GCSE is distinctive and contains some additional content.

Helping you bring mathematics to life

The specification aims to encourage learners to develop problem solving skills in mathematics.

With this pilot GCSE specification, we also want to promote the teaching and learning of mathematics at Key Stage 4 in schools and to provide a suitable one-year post-16 course. It has been designed to provide opportunities to access a Grade C in mathematics for all learners.

A carefully planned specification

Its aim is to encourage candidates to develop knowledge, skills and understanding of mathematical and statistical methods, techniques and concepts. It is designed to help them acquire and use strategies for problem solving and modelling in context, understanding that models may need refining and that there may be more than one way to solve a problem.

It also looks to help candidates use mathematics to represent, analyse and interpret financial information, to select and apply appropriate mathematics and statistics in everyday situations and contexts from the real world, and to understand and use the statistical problem solving cycle.

It has been planned to help learners reason mathematically, make deductions and inferences and draw conclusions, as well as interpret mathematical results and draw and justify conclusions that are relevant to the context, and communicate mathematical information in a variety of forms.

A firm foundation

Learners who successfully complete courses based on this specification will have a suitable basis for progression to further study in mathematics or related subjects or directly into employment.

Contents

1. Introduction to GCSE Applications of Mathematics

1.1 Overview of OCR GCSE Applications of Mathematics

Unit A381/01 *Applications of Mathematics 1 (Foundation)*

Written paper
1 hour
60 marks
40% of the qualification

Calculator permitted

or

Unit A381/02 *Applications of Mathematics 1 (Higher)*

Written paper
1 hour 15 minutes
60 marks
40% of the qualification

Calculator permitted

AND

Unit A382/01 *Applications of Mathematics 2 (Foundation)*

Written paper
1 hour 30 minutes
90 marks
60% of the qualification

Calculator permitted

or

Unit A382/02 *Applications of Mathematics 2 (Higher)*

Written paper
2 hours
90 marks
60% of the qualification

Calculator permitted

1.2 Key aspects of GCSE Applications of Mathematics

The broad objectives in designing the scheme have been to:

- Provide opportunities to access a Grade C in mathematics for all candidates.
- Encourage an awareness of the links between different areas within mathematics.
- Foster the development of the ability to reason logically and develop mathematical arguments.
- Provide, together with GCSE Methods in Mathematics, the best possible mathematics qualification offer currently available in the UK.

1.3 Aims and learning outcomes

The aims of this specification are to:

- Develop knowledge, skills and understanding of mathematical and statistical methods, techniques and concepts.
- Select and apply appropriate mathematics and statistics in everyday situations and contexts from the real-world.
- Use mathematics to represent, analyse and interpret financial information.
- Understand and use the statistical problem solving cycle.
- Acquire and use strategies for problem solving and modelling in context, understanding that models may need refining and that there may be more than one way to solve a problem.
- Interpret mathematical results and draw and justify conclusions that are relevant to the context.
- Communicate mathematical information in a variety of forms.

1.4 Guided learning hours

GCSE Applications of Mathematics requires 120-140 guided learning hours in total.

2. Content of GCSE Applications of Mathematics

2.1 Summary of GCSE Applications of Mathematics

This specification comprises 2 mandatory units, Unit A381 and Unit A382, available at Foundation Tier and Higher Tier.

The content of Foundation Tier – Unit A381/01 and Unit A382/01 – is detailed in Sections 2.2 and 2.3. The content of Higher Tier – Unit A381/02 and Unit A38202 – is detailed in Sections 2.4 and 2.5.

The content of GCSE Applications of Mathematics and Methods in Mathematics **together** cover the Key Stage 4 programme of study plus some additional content.

There is some overlap in content between GCSE Applications of Mathematics and GCSE Methods in Mathematics. There is some content that is additional to the programme of study that is unique to GCSE Applications of Mathematics.

This is indicated in the content (Sections 2.2 to 2.5) as follows:

- the content from the programme of study that is found in **both** GCSE Applications of Mathematics and Methods in Mathematics is shaded in grey;
- the content from the programme of study that is found only in GCSE Applications of Mathematics is in plain text;
- the content that is additional to the programme of study and is unique to GCSE Applications of Mathematics is in *italics.*

At both Foundation Tier and Higher Tier, the content listed for Unit A381 will **not** be the focus of a question for Unit A382. However, knowledge of it is assumed and may form part of the assessment for Unit A382.

The content for the Foundation Tier is subsumed in the content for the Higher Tier.

2.2 Content – Foundation Tier – Unit A381/01

F1A General problem solving skills		Notes and Examples
These skills should underpin and influence the learning experiences of all candidates in mathematics. They are assessed within this specification.		
1. Solve problems using mathematical skills	Candidates should be able to:	
	a. select and use suitable problem solving strategies and efficient techniques to solve numerical problems;	
	b. identify what further information may be required in order to pursue a particular line of enquiry and give reasons for following or rejecting particular approaches;	
	c. break down a complex calculation into simpler steps before attempting to solve it and justify their choice of methods;	
	d. use notation and symbols correctly and consistently within a problem;	
	e. use a range of strategies to create numerical representations of a problem and its solution; move from one form of representation to another in order to get different perspectives on the problem;	
	f. interpret and discuss numerical information presented in a variety of forms;	
	g. present and interpret solutions in the context of the original problem;	
	h. review and justify their choice of mathematical presentation;	
	i. identify exceptional cases when solving problems;	
	j. show deduction in solving a problem;	
	k. recognise the importance of assumptions when deducing results; recognise the limitations of any assumptions that are made and the effect that varying those assumptions may have on the solution to a problem.	

F1B Number		Notes and Examples
1. Add, subtract, multiply and divide any number	Candidates should be able to:	
	a. understand and use positive numbers and negative integers, both as positions and translations on a number line;	
	b. add, subtract, multiply and divide integers and then any number;	
	c. multiply or divide any number by powers of 10;	
	d. multiply or divide any positive number by a number between 0 and 1;	
	e. multiply and divide by a negative number;	
	f. derive positive integer complements to 100;	
	g. recall all multiplication facts to 10 × 10, and use them to derive quickly the corresponding division facts;	
	h. derive unknown facts from those they know;	
	i. add and subtract numbers with up to **two** decimal places;	
	j. multiply and divide numbers with no more than **one** decimal place, using place value adjustments, factorisation and the commutative, associative, and distributive laws, where possible;	
	k. add and subtract integers and decimals understanding where to position the decimal point;	
	l. perform a calculation involving division by a decimal (up to **two** decimal places).	

F1B Number		Notes and Examples
2. Approximate to a specified or appropriate degree of accuracy	Candidates should be able to:	(1) Write 13 066 using words and to the nearest 100. (2) Round 345·46 to the nearest integer, 1 decimal place and 2 significant figures. (3) Know that 3·5 on a calculator means 3·50 in money context and that 3·66666667 on a calculator is a recurring decimal.
	a. use their previous understanding of integers and place value to deal with arbitrarily large positive numbers;	
	b. estimate answers to problems involving decimals;	
	c. use a variety of checking procedures, including working the problem backwards, and considering whether a result is of the right order of magnitude;	
	d. round to the nearest integer, to a given power of 10(1), to any number of decimal places, specified or appropriate, and to any number of significant figures(2);	
	e. give solutions in the context of the problem to an appropriate degree of accuracy, interpreting the solution shown on a calculator display(3), and recognising limitations on the accuracy of data and measurements;	
	f. understand the calculator display, knowing when to interpret the display(3), when the display has been rounded by the calculator, and not to round during the intermediate steps of a calculation.	
3. Use calculators effectively and efficiently	Candidates should be able to:	(1) $\sqrt{7 \cdot 29}$, $1 \cdot 6^3$ (2) $\frac{2 \cdot 6 - 0 \cdot 8}{0 \cdot 2}$, $\sqrt[3]{6 \cdot 1^2 - 0 \cdot 81}$ (3) When using money interpret a calculator display of 2·6 as £2·60
	a. use calculators effectively and efficiently(1);	
	b. know how to enter complex calculations and use function keys for reciprocals, squares and powers(2);	
	c. enter a range of calculations, including those involving measures(3).	

F1C Hierarchy of operations		
1. Hierarchy of operations	Candidates should be able to:	
	a. use brackets and the hierarchy of operations.	• Calculate $\frac{(6 + 8)^2}{2 \cdot 5^2 - 1 \cdot 5^2}$

F1D Factors, multiples and primes		
1. Factors, multiples and primes	Candidates should be able to:	
	a. use the concepts and vocabulary of factor (divisor), multiple, common factor, common multiple and prime number.	• Write down a number between 25 and 30 that is (i) a multiple of 7, (ii) a prime number and (iii) a factor of 104.

F1E Fractions, decimals and percentages		Notes and Examples
1. Calculate with fractions	Candidates should be able to:	(1) Multiplication by $\frac{1}{5}$ is equivalent to division by 5.
	a. calculate a given fraction of a given quantity, expressing the answer as a fraction;	
	b. express a given number as a fraction of another;	
	c. add and subtract fractions by writing them with a common denominator;	
	d. convert a simple fraction to a decimal;	
	e. multiply and divide a fraction by an integer and by a unit fraction;	
	f. understand and use unit fractions as multiplicative inverses(1).	
2. Order rational numbers	Candidates should be able to:	
	a. order integers;	
	b. order fractions;	
	c. order decimals.	
3. Understand equivalent fractions	Candidates should be able to:	
	a. understand equivalent fractions and simplify a fraction.	
4. Understand percentage	Candidates should be able to:	
	a. understand that 'percentage' means 'number of parts per 100' and use this to compare proportions;	
	b. know the fraction-to-percentage (or decimal) conversion of familiar simple fractions.	

F1E Fractions, decimals and percentages		Notes and Examples
5. Interpret fractions, decimals and percentages as operators	Candidates should be able to:	(1) A 15% decrease in *Y* is calculated as 0·85 × *Y*.
	a. interpret percentage as the operator 'so many hundredths of';	
	b. convert between fractions, decimals and percentages;	
	c. understand the multiplicative nature of percentages as operators(1).	
6. Proportional change	Candidates should be able to:	
	a. find proportional change using fractions, decimals and percentages;	
	b. understand and use direct proportion.	

F1F Indices and surds		Notes and Examples
1. Indices in common use	Candidates should be able to:	
	a. use the terms 'square', 'positive square root', 'negative square root', 'cube' and 'cube root';	
	b. recall integer squares from 11 × 11 to 15 × 15 and the corresponding square roots;	
	c. recall the cubes of 2, 3, 4, 5 and 10.	
2. Use index notation	Candidates should be able to:	
	a. use index notation for squares, cubes and powers of 10;	
	b. use index notation for simple positive integer powers;	
	c. use index laws for multiplication and division of integer powers.	

F1G Measures		Notes and Examples
1. Solve real-life problems involving measures	Candidates should be able to:	(1) Given a picture of a building and an adult man, estimate the height of the building in metres. (2) How far do you go travelling at 40 mph for 3 hours? (3) Use bearings to specify direction.
	a. interpret scales on a range of measuring instruments, and recognise the inaccuracy of measurements;	
	b. convert measurements from one unit to another;	
	c. make sensible estimates of a range of measures in everyday settings(1);	
	d. understand and use compound measures (including speed(2) and density) in familiar contexts;	
	e. understand and use bearings(3);	
	f. measure and draw lines correct to the nearest millimetre and angles correct to the nearest degree.	

F1H Coordinates		Notes and Examples
1. Use the conventions for coordinates in the plane	Candidates should be able to:	(1) Plot (3, 6) and (2, -4) on a grid.
	a. use the conventions for coordinates in the plane; plot points in all four quadrants;	
	b. understand that **one** coordinate identifies a point on a number line and **two** coordinates identify a point in a plane, using the terms '1D' and '2D';	
	c. use axes and coordinates to specify points in all four quadrants;	
	d. locate points with given coordinates(1).	

F1I Formulae		Notes and Examples
1. Derive a formula, substitute numbers into a formula	Candidates should be able to:	• Formulae for area of a parallelogram, area enclosed by a circle, volume of a prism. • Wage earned = hours worked × rate per hour.
	a. use formulae from mathematics and other subjects expressed initially in words and then using letters and symbols;	
	b. substitute numbers into a formula;	
	c. derive a formula.	

F1J Linear equations		Notes and Examples
1. Manipulate algebraic expressions	Candidates should be able to:	(1) $a(b + c) = ab + ac$ (2) $x + 5 – 2x – 1 = 4 – x$ (3) $9x – 3 = 3(3x – 1)$ or $x^2 – 3x = x(x – 3)$
	a. understand that the transformation of algebraic expressions obeys and generalises the rules of arithmetic[(1)];	
	b. manipulate algebraic expressions by collecting like terms[(2)], by multiplying a single term over a bracket, and by taking out common factors[(3)].	
2. Set up and solve simple equations	Candidates should be able to:	(1) Richard is x years, Julie is twice as old and their combined age is 24 years. Write an equation to show this information. (2) $11 – 4x = 2$; $3(2x + 1) = 8$; $2(1 – x) = 6(2 + x)$.
	a. set up simple equations[(1)];	
	b. solve simple equations[(2)] by transforming both sides in the same way;	
	c. solve linear equations, with integer coefficients, in which the unknown appears on either side or on both sides of the equation.	
3. Plot graphs of simple equations	Candidates should be able to:	
	a. recognise and plot equations that correspond to straight line graphs in the coordinate plane.	

F1K Angles and properties of shapes		Notes and Examples
1. Lines and angles	Candidates should be able to:	
	a. recall and use properties of angles at a point, angles at a point on a straight line (including right angles), perpendicular lines, and opposite angles at a vertex;	
	b. distinguish between acute, obtuse, reflex and right angles; estimate the size of an angle in degrees;	
	c. distinguish between lines and line segments;	
	d. use parallel lines, alternate angles and corresponding angles;	
	e. understand the consequent properties of parallel and intersecting lines, triangles (including a proof that the angle sum of a triangle is 180°) and parallelograms.	
2. Properties of shapes	Candidates should be able to:	
	a. use angle properties of equilateral, isosceles and right-angled triangles;	
	b. recall the essential properties and definitions of special types of quadrilateral, including square, rectangle, parallelogram, trapezium, kite and rhombus;	
	c. classify quadrilaterals by their geometric properties;	
	d. distinguish between centre, radius, chord, diameter, circumference, tangent, arc, sector and segment;	
	e. understand that inscribed regular polygons can be constructed by equal division of a circle;	
	f. recognise reflection and rotation symmetry of 2D shapes.	
3. Congruence and similarity	Candidates should be able to:	
	a. understand congruence;	
	b. understand similarity and the relationship between lengths and angles in similar figures.	

F1L Area and volume		Notes and Examples
1. Perimeter, area and volume	Candidates should be able to:	Could involve inverse calculations - find the length of a side given the area and the other side.
	a. find areas of rectangles, recalling the formula, understanding the connection to counting squares and how it extends this approach;	
	b. find the area of a parallelogram and a triangle;	
	c. calculate perimeters and areas of shapes made from triangles and rectangles.	

Content – Foundation Tier – Unit A382/01

F2A General problem solving skills		Notes and Examples
These skills should underpin and influence the learning experiences of all candidates in mathematics. They are assessed within this specification.		
1. Solve problems using mathematical skills	Candidates should be able to:	
	a. select and use suitable problem solving strategies and efficient techniques to solve numerical problems;	
	b. identify what further information may be required in order to pursue a particular line of enquiry and give reasons for following or rejecting particular approaches;	
	c. break down a complex calculation into simpler steps before attempting to solve it and justify their choice of methods;	
	d. use notation and symbols correctly and consistently within a problem;	
	e. use a range of strategies to create numerical representations of a problem and its solution; move from one form of representation to another in order to get different perspectives on the problem;	
	f. interpret and discuss numerical information presented in a variety of forms;	
	g. present and interpret solutions in the context of the original problem;	
	h. review and justify their choice of mathematical presentation;	
	i. identify exceptional cases when solving problems;	
	j. show deduction in solving a problem;	
	k. recognise the importance of assumptions when deducing results; recognise the limitations of any assumptions that are made and the effect that varying those assumptions may have on the solution to a problem.	

F2B Number		Notes and Examples
1. Add, subtract, multiply and divide any number	Candidates should be able to:	
	a. understand and use positive numbers and negative integers, both as positions and translations on a number line;	
	b. add, subtract, multiply and divide integers and then any number;	
	c. multiply or divide any number by powers of 10;	
	d. multiply or divide any positive number by a number between 0 and 1;	
	e. multiply and divide by a negative number;	
	f. recall all positive integer complements to 100;	
	g. recall all multiplication facts to 10 × 10, and use them to derive quickly the corresponding division facts;	
	h. derive unknown facts from those they know;	
	i. add and subtract numbers with up to **two** decimal places;	
	j. multiply and divide numbers with no more than one decimal place, using place value adjustments, factorisation and the commutative, associative, and distributive laws, where possible;	
	k. add and subtract integers and decimals understanding where to position the decimal point;	
	l. perform a calculation involving division by a decimal (up to **two** decimal places) by transforming it to a calculation involving division by an integer.	
2. Use calculators effectively and efficiently	Candidates should be able to:	(1) $\sqrt{7 \cdot 29}$, $1 \cdot 6^3$ (2) $\frac{2 \cdot 6 - 0 \cdot 8}{0 \cdot 2}$, $\sqrt[3]{6 \cdot 1^2 - 0 \cdot 81}$
	a. use calculators effectively and efficiently(1);	
	b. know how to enter complex calculations and use function keys for reciprocals, squares and powers(2);	
	c. enter a range of calculations, including those involving statistics.	

F2C Hierarchy of operations		Notes and Examples
1. Hierarchy of operations	Candidates should be able to:	• Calculate $\frac{(6+8)^2}{2\cdot5^2-1\cdot5^2}$
	a. understand and use number operations and the relationships between them, including inverse operations.	

F2D Ratio		Notes and Examples
1. Divide a quantity in a given ratio	Candidates should be able to:	(1) Divide £120 in the ratio 3:7. (2) 8 calculators cost £59·52. How much do 3 calculators cost?
	a. divide a quantity in a given ratio(1);	
	b. determine the original quantity by knowing the size of one part of the divided quantity;	
	c. solve word problems about ratio, including using informal strategies and the unitary method of solution(2).	

F2E Financial and business applications		Notes and Examples
1. Financial and business applications	Candidates should be able to:	
	a. carry out calculations relating to enterprise, saving and borrowing, appreciation and depreciation;	
	b. use mathematics in the context of personal and domestic finance including loan repayments, budgeting, exchange rates and commissions;	
	c. use spreadsheets to model financial, statistical and other numerical situations;	
	d. construct and use flow charts.	

F2F Coordinates		Notes and Examples
1. Use the conventions for coordinates in the plane	Candidates should be able to:	
	a. given the coordinates of the points A and B, find coordinate of the midpoint of the line segment AB;	
	b. given the coordinates of the points A and B, find the length of AB.	

F2G Linear inequalities		Notes and Examples
1. Set up and solve simple inequalities	Candidates should be able to:	
	a. set up linear inequalities in **one** variable;	
	b. solve simple inequalities by transforming both sides in the same way;	
	c. solve simple linear inequalities in **one** variable and represent the solution on a number line.	

F2H Functions and graphs		Notes and Examples
1. Functions from real life	Candidates should be able to:	
	a. find and interpret gradients and intercepts of straight line graphs in practical contexts;	(1) Linear functions only required. (2) These may intersect.
	b. construct linear functions from real life problems and plot their corresponding graphs(1);	
	c. discuss, plot and interpret graphs (which may be non-linear) modelling real situations, including journeys/travel graphs(2);	
	d. recognise and use graphs that illustrate direct proportion.	

F2I Algebraic manipulation		Notes and Examples
1. Use trial and improvement to solve equations	Candidates should be able to:	(1) $x^3 = x - 900$; $1/x = x^2 - 5$
	a. find approximate solutions of equations using graphical methods and systematic trial and improvement(1).	

F2J Estimate areas		Notes and Examples
1. Estimate areas	Candidates should be able to:	(1) Estimate the area of a leaf drawn on a centimetre grid.
	a. estimate areas of irregular shapes(1);	
	b. estimate areas bounded by straight lines.	

F2K Pythagoras in 2D		Notes and Examples
1. Use Pythagoras' theorem	Candidates should be able to:	
	a. understand, recall and use Pythagoras' theorem to solve simple cases in 2D.	

F2L Area and volume		Notes and Examples
1. Perimeter, area (including circles), and volume	Candidates should be able to:	
	a. find circumferences of circles and areas enclosed by circles, recalling relevant formulae;	
	b. find volumes of cuboids, recalling the formula and understanding the connection to counting cubes and how it extends this approach;	
	c. calculate volumes of right prisms and of shapes made from cubes and cuboids.	
2. Use 2D representations of 3D shapes	Candidates should be able to:	(1) Cube, cuboid and simple pyramids.
	a. explore the geometry of cuboids (including cubes) and objects made from cuboids;	
	b. use 2D representations of 3D objects; analyse 3D objects through 2D projections (including plan and elevation) and cross-sections;	
	c. draw nets of 3D objects(1);	
	d. construct nets of cubes, regular tetrahedra, square-based pyramids and other 3D shapes from given information.	

F2M Constructions		Notes and Examples
1. Draw triangles and other 2D shapes using a ruler and protractor	Candidates should be able to:	
	a. draw triangles and other 2D shapes using a ruler and protractor, given information about their side lengths and angles(1).	(1) Use ruler and protractor to construct triangle ABC with AB = 5cm, BC = 6cm and angle ABC = 30°.
2. Use straight edge and a pair of compasses to do constructions	Candidates should be able to:	
	a. use straight edge and a pair of compasses to do standard constructions(1), including: i. an equilateral triangle with a given side; ii. the midpoint and perpendicular bisector of a line segment(2); iii. the perpendicular from a point to a line, the perpendicular from a point on a line; iv. the bisector of an angle(3).	(1) Use ruler and a pair of compasses to construct a triangle with sides 4cm, 8cm and 9cm. (2) Construct the locus of points equidistant from P and Q. (3) Construct the locus of points equidistant from AB and BC.
3. Construct loci	Candidates should be able to:	
	a. find loci, by reasoning to produce shapes and paths.	A region bounded by a circle and an intersecting line.

F2N Maps		Notes and Examples
1. Maps and scale drawings	Candidates should be able to:	
	a. use and interpret maps and scale drawings.	

F2O Statistics and probability		Notes and Examples
1. Understand and use statistical problem solving process/ handling data cycle	Candidates should be able to:	
	a. carry out each of the **four** aspects of the handling data cycle to solve problems: i. specify the problem and plan: formulate questions in terms of the data needed, and consider what inferences can be drawn from the data; decide what data to collect (including sample size and data format) and what statistical analysis is needed; ii. collect data from a variety of suitable sources, including experiments and surveys, and primary and secondary sources; iii. process and represent the data: turn the raw data into usable information that gives insight into the problem; iv. interpret and discuss the data: answer the initial question by drawing conclusions from the data.	
2. Experimenting	Candidates should be able to:	
	a. understand that when a statistical experiment or survey is repeated there will usually be different outcomes, and that increasing sample size generally leads to better estimates of probability and population characteristics.	
3. Collecting	Candidates should be able to:	
	a. design an experiment or survey, identifying possible sources of bias;	
	b. design data-collection sheets distinguishing between different types of data;	
	c. extract data from publications, charts, tables and lists;	
	d. design, use and interpret two-way tables for discrete and grouped data.	

F2O Statistics and probability		Notes and Examples
4. Processing	Candidates should be able to:	
	a. draw and interpret charts and diagrams for categorical data including bar charts, pie charts and pictograms;	
	b. produce and interpret diagrams for ungrouped discrete numerical data, including vertical line charts and stem and leaf diagrams;	
	c. calculate median, mean, range, mode and modal class;	
	d. find the median for large, ungrouped, data sets.	
5. Interpreting	Candidates should be able to:	
	a. look at data to find patterns and exceptions;	
	b. interpret a wide range of graphs and diagrams and draw conclusions;	
	c. interpret social statistics including index numbers and survey data;	
	d. compare distributions and make inferences;	
	e. use the shapes of distributions and measures of average and range.	
6. Use charts and correlation	Candidates should be able to:	
	a. draw and interpret scatter graphs;	
	b. recognise correlation and draw and/or use lines of best fit by eye, understanding and interpreting what these represent, and appreciating that correlation does not imply causality;	
	c. work with time series including their graphical representation.	

F2O Statistics and probability		Notes and Examples
7. Probability and risk	Candidates should be able to:	(1) Use impossible, certain, evens, likely, unlikely. (2) Associate 0, 0·5, 1 with impossible, evens and certain and position events on a probability scale. (3) Consider insurance protection for washing machine breakdown.
	a. understand and use the vocabulary of probability(1) and the probability scale(2);	
	b. understand and use theoretical models for probabilities including the model of equally likely outcomes;	
	c. understand and use estimates of probability from relative frequency;	
	d. use probability to estimate risk and make a decision about a course of action(3).	

2.3 Content – Higher Tier – Unit A381/02

H1A General problem solving skills		Notes and Examples
These skills should underpin and influence the learning experiences of all candidates in mathematics. They will be assessed within this specification.		
1. Solve problems using mathematical skills	Candidates should be able to:	
	a. select and use suitable problem solving strategies and efficient techniques to solve numerical problems;	
	b. identify what further information may be required in order to pursue a particular line of enquiry and give reasons for following or rejecting particular approaches;	
	c. break down a complex calculation into simpler steps before attempting to solve it and justify their choice of methods;	
	d. use notation and symbols correctly and consistently within a problem;	
	e. use a range of strategies to create numerical representations of a problem and its solution; move from one form of representation to another in order to get different perspectives on the problem;	
	f. interpret and discuss numerical information presented in a variety of forms;	
	g. present and interpret solutions in the context of the original problem;	
	h. review and justify their choice of mathematical presentation;	
	i. identify exceptional cases when solving problems;	
	j. show deduction in solving a problem;	
	k. recognise the importance of assumptions when deducing results; recognise the limitations of any assumptions that are made and the effect that varying those assumptions may have on the solution to a problem.	

H1B Number		Notes and Examples
1. Add, subtract, multiply and divide any number	Candidates should be able to:	
	a. understand and use positive numbers and negative integers, both as positions and translations on a number line;	
	b. add, subtract, multiply and divide integers and then any number;	
	c. multiply or divide any number by powers of 10;	
	d. multiply or divide any positive number by a number between 0 and 1;	
	e. multiply and divide by a negative number;	
	f. recall all positive integer complements to 100;	
	g. recall all multiplication facts to 10 × 10, and use them to derive quickly the corresponding division facts;	
	h. derive unknown facts from those they know;	
	i. add and subtract numbers with up to **two** decimal places;	
	j. multiply and divide numbers with no more than **one** decimal place, using place value adjustments, factorisation and the commutative, associative, and distributive laws, where possible;	
	k. add and subtract integers and decimals understanding where to position the decimal point;	
	l. perform a calculation involving division by a decimal (up to **two** decimal places).	

H1B Number		Notes and Examples
2. Approximate to a specified or appropriate degree of accuracy	Candidates should be able to:	(1) Round 345·46 to the nearest integer, 1 decimal place, 2 significant figures. (2) Know that 3·5 on a calculator means 3·50 in money context. (3) Know that 3·66666667 on a calculator is a recurring decimal.
	a. use their previous understanding of integers and place value to deal with arbitrarily large positive numbers;	
	b. estimate answers to problems involving decimals;	
	c. use a variety of checking procedures, including working the problem backwards, and considering whether a result is of the right order of magnitude;	
	d. round to the nearest integer, to a given power of 10, to any number of decimal places, specified or appropriate, and to any number of significant figures(1);	
	e. give solutions in the context of the problem to an appropriate degree of accuracy, interpreting the solution shown on a calculator display(2), and recognising limitations on the accuracy of data and measurements(3);	
	f. understand the calculator display, knowing when to interpret the display, when the display has been rounded by the calculator, and not to round during the intermediate steps of a calculation.	
3. Use calculators effectively and efficiently	Candidates should be able to:	(1) $\sqrt{7 \cdot 29}$, $1 \cdot 6^3$ (2) $\frac{2 \cdot 6 - 0 \cdot 8}{0 \cdot 2}$, $\sqrt[3]{6 \cdot 1^2 - 0 \cdot 81}$ (3) $\frac{5 \times \sin 35}{\sin 62}$
	a. use calculators effectively and efficiently(1);	
	b. know how to enter complex calculations and use function keys for reciprocals, squares and powers(2);	
	c. enter a range of calculations, including those involving measures;	
	d. use an extended range of function keys, including trigonometrical(3) functions.	

H1C Hierarchy of operations		Notes and Examples
1. Hierarchy of operations	Candidates should be able to:	
	a. use brackets and the hierarchy of operations.	• Calculate $\frac{(6 + 8)^2}{2 \cdot 5^2 - 1 \cdot 5^2}$

H1D Factors, multiples and primes		Notes and Examples
1. Factors, multiples and primes	Candidates should be able to:	
	a. use the concepts and vocabulary of factor (divisor), multiple, common factor, common multiple and prime number.	• Write down a number between 25 and 30 that is (i) a multiple of 7, (ii) a prime number and (iii) a factor of 104.

H1E Fractions, decimals and percentages		Notes and Examples
1. Calculate with fractions	Candidates should be able to:	(1) Multiplication by $\frac{1}{5}$ is equivalent to division by 5.
	a. calculate a given fraction of a given quantity, expressing the answer as a fraction;	
	b. express a given number as a fraction of another;	
	c. add and subtract fractions by writing them with a common denominator;	
	d. convert a simple fraction to a decimal;	
	e. multiply and divide a fraction by an integer and by a unit fraction;	
	f. understand and use unit fractions as multiplicative inverses(1).	
2. Order rational numbers	Candidates should be able to:	
	a. order integers;	
	b. order fractions;	
	c. order decimals.	
3. Understand equivalent fractions	Candidates should be able to:	
	a. understand equivalent fractions and simplify a fraction.	
4. Understand percentage	Candidates should be able to:	
	a. understand that 'percentage' means 'number of parts per 100' and use this to compare proportions;	
	b. know the fraction-to-percentage (or decimal) conversion of familiar simple fractions.	

H1E Fractions, decimals and percentages		Notes and Examples
5. Interpret fractions, decimals and percentages as operators	Candidates should be able to:	(1) $0{\cdot}137 = \frac{137}{1000}$, convert $0{\cdot}\dot{3}$ to a fraction.
	a. interpret percentage as the operator 'so many hundredths of';	
	b. convert between fractions, decimals and percentages(1);	
	c. understand the multiplicative nature of percentages as operators;	
	d. understand and use repeated percentage change;	
	e. solve reverse percentage problems.	
6. Proportional change	Candidates should be able to:	(1) 5 books cost £23·50, find the cost of 3 books; foreign currency conversion; recipes; best value for money problems.
	a. find proportional change using fractions, decimals and percentages(1);	(2) A tank can be emptied using 6 pumps in 18 hours. How long will it take to empty the tank using 8 pumps? $y \propto x^2$ and $x = 4$ when $y = 8$. Find y when $x = 12$.
	b. understand and use direct and indirect proportion(2);	
	c. use repeated proportional change.	

H1F Indices and surds		Notes and Examples
1. Indices in common use	Candidates should be able to:	
	a. use the terms ‘square’, ‘positive square root’, ‘negative square root’, ‘cube’ and ‘cube root’;	
	b. recall integer squares from 11 × 11 to 15 × 15 and the corresponding square roots;	
	c. recall the cubes of 2, 3, 4, 5 and 10.	
2. Index notation	Candidates should be able to:	
	a. use index notation for squares, cubes and powers of 10;	
	b. use index notation for simple positive integer powers;	
	c. use index laws for multiplication and division of integer powers;	
	d. use index laws to simplify, and calculate the value of, numerical expressions involving multiplication and division of integer, fractional and negative powers;	
	e. know that that $n^0 = 1$; understand that the inverse operation of raising a positive number to power n is raising the result of this operation to power $1/n$;	
	f. know that $n^{-1} = 1/n$ (undefined for $n = 0$), and that $n^{½} = \sqrt{n}$ and $n^{⅓} = \sqrt[3]{n}$ for any positive number n.	

H1G Measures		Notes and Examples
1. Solve real-life problems involving measures	Candidates should be able to:	(1) Given a picture of a building and an adult man, estimate the height of the building in metres. (2) How far do you go travelling at 40 mph for 3 hours? (3) Use bearings to specify direction.
	a. interpret scales on a range of measuring instruments, and recognise the inaccuracy of measurements;	
	b. convert measurements from one unit to another;	
	c. make sensible estimates of a range of measures in everyday settings(1);	
	d. understand and use compound measures (including speed(2) and density) in familiar and unfamiliar contexts;	
	e. understand and use bearings(3).	

H1H Coordinates		Notes and Examples
1. Use the conventions for coordinates in the plane	Candidates should be able to:	(1) Plot (3, 6) and (2, -4) on a grid.
	a. use the conventions for coordinates in the plane; plot points in all four quadrants;	
	b. understand that one coordinate identifies a point on a number line, **two** coordinates identify a point in a plane and **three** coordinates identify a point in space, using the terms '1D', '2D' and '3D';	
	c. use axes and coordinates to specify points in all four quadrants;	
	d. locate points with given coordinates(1).	

H1I Formulae		Notes and Examples
1. Derive a formula, substitute numbers into a formula	Candidates should be able to:	• Formulae for area of a parallelogram, area enclosed by a circle, volume of a prism • Wage earned = hours worked × rate per hour
	a. use formulae from mathematics and other subjects expressed initially in words and then using letters and symbols;	
	b. substitute numbers into a formula;	
	c. derive a formula.	

H1J Linear equations		Notes and Examples
1. Manipulate algebraic expressions	Candidates should be able to:	(1) $a(b + c) = ab + ac$ (2) $x + 5 – 2x – 1 = 4 – x$ (3) $9x – 3 = 3(3x – 1)$ or $x^2 – 3x = x(x – 3)$
	a. understand that the transformation of algebraic expressions obeys and generalises the rules of arithmetic(1);	
	b. manipulate algebraic expressions by collecting like terms(2), by multiplying a single term over a bracket, and by taking out common factors(3);	
2. Set up and solve simple equations	Candidates should be able to:	(1) Richard is x years, Julie is twice as old and their combined age is 24 years. Write an equation to show this information. (2) $11 – 4x = 2$; $3(2x + 1) = 8$; $2(1 – x) = 6(2 + x)$.
	a. set up simple equations(1);	
	b. solve simple equations by using inverse operations or by transforming both sides in the same way(2);	
	c. solve linear equations in which the unknown appears on either side or on both sides of the equation.	
3. Plot graphs of simple equations	Candidates should be able to:	
	a. recognise and plot equations that correspond to straight line graphs in the coordinate plane.	
4. Simultaneous equations in two unknowns	Candidates should be able to:	
	a. set up and solve linear simultaneous equations in **two** unknowns.	

H1K Angles and properties of shapes		Notes and Examples
1. Lines and angles	Candidates should be able to:	
	a. recall and use properties of angles at a point, angles at a point on a straight line (including right angles), perpendicular lines, and opposite angles at a vertex;	
	b. distinguish between acute, obtuse, reflex and right angles; estimate the size of an angle in degrees;	
	c. distinguish between lines and line segments;	
	d. use parallel lines, alternate angles and corresponding angles;	
	e. understand the consequent properties of parallel and intersecting lines, triangles (including a proof that the angle sum of a triangle is 180º) and parallelograms.	
2. Properties of shapes	Candidates should be able to:	
	a. use angle properties of equilateral, isosceles and right-angled triangles;	
	b. recall the essential properties and definitions of special types of quadrilateral, including square, rectangle, parallelogram, trapezium, kite and rhombus;	
	c. classify quadrilaterals by their geometric properties;	
	d. distinguish between centre, radius, chord, diameter, circumference, tangent, arc, sector and segment;	
	e. understand that inscribed regular polygons can be constructed by equal division of a circle;	
	f. recognise reflection and rotation symmetry of 2D shapes.	
3. Congruence and similarity	Candidates should be able to:	
	a. understand congruence;	
	b. understand similarity and the relationship between lengths, areas and volumes in similar figures.	

H1L Area and volume		Notes and Examples
1. Perimeter, area and volume	Candidates should be able to:	Could involve inverse calculations - find the length of a side given the area and the other side.
	a. find areas of rectangles, recalling the formula, understanding the connection to counting squares and how it extends this approach;	
	b. find the area of a parallelogram and a triangle;	
	c. calculate perimeters and areas of shapes made from triangles and rectangles.	

Content – Higher Tier – Unit A382/02

H2A General problem solving skills		Notes and Examples
These skills should underpin and influence the learning experiences of all candidates in mathematics. They will be assessed within this specification.		
1. Solve problems using mathematical skills	Candidates should be able to:	
	a. select and use suitable problem solving strategies and efficient techniques to solve numerical problems;	
	b. identify what further information may be required in order to pursue a particular line of enquiry and give reasons for following or rejecting particular approaches;	
	c. break down a complex calculation into simpler steps before attempting to solve it and justify their choice of methods;	
	d. use notation and symbols correctly and consistently within a problem;	
	e. use a range of strategies to create numerical representations of a problem and its solution; move from one form of representation to another in order to get different perspectives on the problem;	
	f. interpret and discuss numerical information presented in a variety of forms;	
	g. present and interpret solutions in the context of the original problem;	
	h. review and justify their choice of mathematical presentation;	
	i. identify exceptional cases when solving problems;	
	j. show deduction in solving a problem;	
	k. recognise the importance of assumptions when deducing results; recognise the limitations of any assumptions that are made and the effect that varying those assumptions may have on the solution to a problem.	

H2B Number		Notes and Examples
1. Add, subtract, multiply and divide any number	Candidates should be able to:	
	a. understand and use positive numbers and negative integers, both as positions and translations on a number line;	
	b. add, subtract, multiply and divide integers and then any number;	
	c. multiply or divide any number by powers of 10;	
	d. multiply or divide any positive number by a number between 0 and 1;	
	e. multiply and divide by a negative number;	
	f. recall all positive integer complements to 100;	
	g. recall all multiplication facts to 10 × 10, and use them to derive quickly the corresponding division facts;	
	h. derive unknown facts from those they know;	
	i. add and subtract numbers with up to **two** decimal places;	
	j. multiply and divide numbers with no more than **one** decimal place, using place value adjustments, factorisation and the commutative, associative, and distributive laws, where possible;	
	k. add and subtract integers and decimals understanding where to position the decimal point;	
	l. perform a calculation involving division by a decimal (up to **two** decimal places) by transforming it to a calculation involving division by an integer.	

H2B Number		Notes and Examples
2. Use calculators effectively and efficiently	Candidates should be able to:	(1) $\sqrt{7 \cdot 29}$, $1 \cdot 6^3$ (2) $\frac{2 \cdot 6 - 0 \cdot 8}{0 \cdot 2}$, $\sqrt[3]{6 \cdot 1^2 - 0 \cdot 81}$ (3) $\frac{5 \times \sin 35}{\sin 62}$
	a. use calculators effectively and efficiently(1);	
	b. know how to enter complex calculations and use function keys for reciprocals, squares and powers(2);	
	c. enter a range of calculations, including those involving measures and statistics;	
	d. use an extended range of function keys, including trigonometrical(3) and statistical functions.	

H2C Use upper and lower bounds		Notes and Examples
1. Understand and use upper and lower bounds.	Candidates should be able to:	(1) A book weighs 1·7kg, correct to the nearest 0.1kg. What is the maximum weight of 12 of these books? (2) In money calculations, or when the display has been rounded by the calculator.
	a. use calculators, or written methods, to calculate the upper and lower bounds of calculations.	

H2D Hierarchy of operations		Notes and Examples
1. Hierarchy of operations	Candidates should be able to:	• Calculate $\frac{(6 + 8)^2}{2 \cdot 5^2 - 1 \cdot 5^2}$.
	a. understand and use number operations and the relationships between them, including inverse operations.	

H2E Ratio		Notes and Examples
1. Divide a quantity in a given ratio	Candidates should be able to:	(1) Divide £120 in the ratio 3:7. (2) 8 calculators cost £59·52. How much do 3 calculators cost?
	a. divide a quantity in a given ratio(1);	
	b. determine the original quantity by knowing the size of one part of the divided quantity;	
	c. solve word problems about ratio, including using informal strategies and the unitary method of solution(2).	

H2F Indices and surds		Notes and Examples
1. Exponential growth and decay	Candidates should be able to:	
	a. understand exponential growth and decay, its relationship with repeated proportional change and financial and scientific applications.	

H2G Standard index form		Notes and Examples
1. Standard index form	Candidates should be able to:	(1) $2{\cdot}4 \times 10^7 \times 5 \times 10^3$ $= 1{\cdot}2 \times 10^{11}$ OR $(2{\cdot}4 \times 10^7) \div (5 \times 10^3)$ $= 4{\cdot}8 \times 10^3$ (2) Write 165 000 in standard form; write $6{\cdot}32 \times 10^{-3}$ as an ordinary number.
	a. use and express standard index form expressed in conventional notation and on a calculator display;	
	b. calculate with standard index form(1);	
	c. convert between ordinary and standard index form representations, converting to standard index form to make sensible estimates for calculations involving multiplication and/or division(2).	

H2H Financial and business applications		Notes and Examples
1. *Financial and business applications*	Candidates should be able to:	
	a. carry out calculations relating to enterprise, saving and borrowing, appreciation and depreciation;	
	b. use mathematics in the context of personal and domestic finance including loan repayments, budgeting, exchange rates and commissions;	
	c. use spreadsheets to model financial, statistical and other numerical situations;	
	d. construct and use flowcharts;	
	e. understand AER (annual equivalent rate), RPI (retail prices index) and CPI (consumer price index).	

H2I Coordinates		Notes and Examples
1. Use the conventions for coordinates in the plane	Candidates should be able to:	
	a. given the coordinates of the points A and B, find coordinate of the midpoint of the line segment AB;	
	b. given the coordinates of the points A and B, find the length of AB.	

H2J Linear inequalities		Notes and Examples
1. Set up and solve simple inequalities	Candidates should be able to:	
	a. set up linear inequalities in **one** or **two** variables;	
	b. solve simple inequalities by transforming both sides in the same way;	
	c. represent the solution set on a number line or suitable diagram.	

H2K Linear programming		Notes and Examples
1. Set up and solve problems in linear programming	Candidates should be able to:	
	a. set up and solve problems in linear programming, finding optimal solutions.	

H2L Functions and graphs		Notes and Examples
1. Functions from real life	Candidates should be able to:	(1) May include distance time graphs, mobile phone charges, electricity bills.
	a. find and interpret gradients and intercepts of straight line graphs in practical contexts;	
	b. construct linear, quadratic and other functions from real life problems and plot their corresponding graphs;	
	c. discuss, plot and interpret graphs (which may be non-linear or periodic) modelling real situations, including journeys/travel graphs(1);	
	d. recognise and use graphs that illustrate direct and inverse proportion;	
	e. interpret the gradient at a point on a curve as a rate of change.	

H2M Algebraic manipulation		Notes and Examples
1. Use trial and improvement to solve equations	Candidates should be able to:	(1) $x^3 = x - 900$; $^1/x = x^2 - 5$
	a. find approximate solutions of equations using graphical methods and systematic trial and improvement(1).	

H2N Estimate areas		Notes and Examples
1. Estimate areas	Candidates should be able to:	(1) Estimate the area of a leaf drawn on a centimetre grid.
	a. estimate areas of irregular shapes(1);	
	b. estimate areas under curves.	

H2O Pythagoras in 2D and 3D		Notes and Examples
1. Use Pythagoras' theorem	Candidates should be able to:	(1) Find the length of the longest diagonal of a cuboid eg 4cm by 5cm by 3cm. (2) Find the angle between the longest diagonal and the base of a cuboid.
	a. understand, recall and use Pythagoras' theorem to solve simple cases in 2D;	
	b. use Pythagoras' theorem to calculate lengths in three dimensions(1);	
	c. use Pythagoras' theorem in 3D contexts(2).	

H2P Angles and properties of shapes		Notes and Examples
1. Congruence and similarity	Candidates should be able to:	• A carton of yoghurt holds 100ml. A similar carton is 1·5 times as tall. How much yoghurt does it hold?
	a. understand similarity and the relationship between lengths, areas and volumes in similar figures.	

H2Q Area and volume		Notes and Examples
1. Perimeter, area (including circles), and volume	Candidates should be able to:	(1) Could involve semicircles, and inverse problems eg find the diameter if the circumference is 60cm. (2) Calculate the arc length of the sector of a circle radius 5cm subtended by an angle of 65°. (3) Calculate the volume of a sphere of radius 1·5cm. (4) A cone is 20cm high and has a base radius of 12cm. The top 15cm of the cone is removed. Find the volume of the remaining frustum.
	a. find circumferences of circles and areas enclosed by circles(1), recalling relevant formulae;	
	b. calculate volumes of right prisms and of shapes made from cubes and cuboids;	
	c. calculate the lengths of arcs and the areas of sectors of circles(2);	
	d. solve problems involving perimeter, surface areas and volumes of prisms, pyramids, cylinders, cones and spheres(3);	
	e. solve mensuration problems involving more complex shapes and solids, including segments of circles and frustums of cones(4).	
2. Use 2D representations of 3D shapes	Candidates should be able to:	(1) Cube, cuboid and simple pyramids.
	a. explore the geometry of cuboids (including cubes) and objects made from cuboids;	
	b. use 2D representations of 3D objects; analyse 3D objects through 2D projections (including plan and elevation) and cross-sections;	
	c. construct nets of cubes, regular tetrahedra, square-based pyramids(1) and other 3D shapes from given information.	

H2R Constructions		Notes and Examples
1. Draw triangles and other 2D shapes using a ruler and protractor	Candidates should be able to: a. draw triangles and other 2D shapes using a ruler and protractor, given information about their side lengths and angles(1).	(1) Use ruler and a protractor to construct triangle ABC with AB = 5cm, BC = 6cm and angle ABC = 30°
2. Use straight edge and a pair of compasses to do constructions	Candidates should be able to: a. use straight edge and a pair of compasses to do standard constructions(1), including: i. an equilateral triangle with a given side; ii. the midpoint and perpendicular bisector of a line segment(2); iii. the perpendicular from a point to a line, the perpendicular from a point on a line; iv. the bisector of an angle(3).	(1) Use ruler and a pair of compasses to construct a triangle with sides 4cm, 8cm and 9cm. (2) Construct the locus of points equidistant from P and Q. (3) Construct the locus of points equidistant from AB and BC.
3. Construct loci	Candidates should be able to: a. find loci, by reasoning, to produce shapes and paths.	A region bounded by a circle and an intersecting line

H2S Maps		Notes and Examples
1. Maps and scale drawings	Candidates should be able to: a. use and interpret maps and scale drawings.	

H2T Trigonometry		Notes and Examples
1. Trigonometry in 2D and 3D	Candidates should be able to: a. use the trigonometrical ratios to solve 2D and 3D problems.	

H2U Statistics and probability		Notes and Examples
1. Understand and use statistical problem solving process/ handling data cycle	Candidates should be able to:	
	a. carry out each of the four aspects of the handling data cycle to solve problems: i. specify the problem and plan: formulate questions in terms of the data needed, and consider what inferences can be drawn from the data; decide what data to collect (including sample size and data format) and what statistical analysis is needed; ii. collect data from a variety of suitable sources, including experiments and surveys, and primary and secondary sources; iii. process and represent the data: turn the raw data into usable information that gives insight into the problem; iv. interpret and discuss the data: answer the initial question by drawing conclusions from the data.	
2. Experimenting	Candidates should be able to:	
	a. understand that when a statistical experiment or survey is repeated there will usually be different outcomes, and that increasing sample size generally leads to better estimates of probability and population characteristics.	
3. Collecting	Candidates should be able to:	
	a. design an experiment or survey, identifying possible sources of bias;	
	b. design data-collection sheets distinguishing between different types of data;	
	c. extract data from publications, charts, tables and lists;	
	d. design, use and interpret two-way tables for discrete and grouped data.	

H2U Statistics and probability		Notes and Examples
4. Processing	Candidates should be able to:	
	a. draw and interpret charts and diagrams for categorical data including bar charts, pie charts and pictograms;	
	b. produce and interpret diagrams for ungrouped discrete numerical data, including vertical line charts and stem and leaf diagrams;	
	c. calculate median, mean, range, quartiles and interquartile range, mode and modal class;	
	d. find the median for large, ungrouped, data sets.	
5. Interpreting	Candidates should be able to:	
	a. look at data to find patterns and exceptions;	
	b. interpret a wide range of graphs and diagrams and draw conclusions;	
	c. interpret social statistics including index numbers and survey data;	
	d. compare distributions and make inferences;	
	e. use the shapes of distributions and measures of average and range.	
6. Data handling	Candidates should be able to:	
	a. for grouped data, find the modal class, estimate mean, median, range, and mode;	
	b. calculate, and for grouped data estimate, the quartiles and interquartile range for large data sets.	

H2U Statistics and probability		Notes and Examples
7. Use charts and correlation	Candidates should be able to:	
	a. draw and interpret scatter graphs;	
	b. recognise correlation and draw and/or use lines of best fit by eye, understanding and interpreting what these represent, and appreciating that correlation does not imply causality;	
	c. work with time series and moving averages, including their graphical representation;	
	d. produce and use cumulative frequency graphs and box-and-whisker plots;	
	e. produce and interpret diagrams for grouped discrete data and continuous data, including histograms with unequal class intervals.	
8. Probability and risk	Candidates should be able to:	(1) Use impossible, certain, evens, likely, unlikely; associate 0, 0·5, 1 with impossible, evens and certain and position events on a probability scale.
	a. understand and use the vocabulary of probability and the probability scale(1);	
	b. understand and use theoretical models for probabilities including the model of equally likely outcomes;	
	c. understand and use estimates of probability from relative frequency;	(2) Consider insurance protection for washing machine breakdown.
	d. use probability to estimate risk and make a decision about a course of action(2).	

3. Assessment of GCSE Applications of Mathematics 3

3.1 Overview of the assessment of GCSE Applications of Mathematics

Unit A381/01 ***Applications of Mathematics 1 (Foundation)*** 40% of the total GCSE marks 1 hour written paper 60 marks	• All units are externally assessed. • Candidates answer **all** questions on each paper. • In some questions candidates have to decide for themselves what mathematics they need to use. • In each question paper, candidates are expected to support their answers with appropriate working. • Quality of written communication (QWC) is assessed in both Units A381 and A382. Questions assessing QWC are indicated by an asterisk (*). • Functional elements of mathematics are assessed in this specification. The weightings are 30% – 40% on Foundation Tier and 20% – 30% on Higher Tier. • Candidates are permitted to use a scientific or graphical calculator for both Unit A381 and A382. All calculators must conform to the rules specified in the document *Instructions for Conducting Examinations,* published annually by the Joint Council for Qualifications (http://www.jcq.org.uk). • All candidates should have the usual geometric instruments available. Tracing paper can be used to aid with transformations etc, whether or not it is specified on the front of the question paper.
Unit A381/02 ***Applications of Mathematics 1 (Higher)*** 40% of the total GCSE marks 1 hour 15 minutes written paper 60 marks	
Unit A382/01 ***Applications of Mathematics 2 (Foundation)*** 60% of the total GCSE marks 1 hour 30 minutes written paper 90 marks	
Unit A382/02 ***Applications of Mathematics 2 (Higher)*** 60% of the total GCSE marks 2 hour written paper 90 marks	

3.2 Tiers

This scheme of assessment consists of **two** tiers: Foundation Tier and Higher Tier. Foundation Tier papers assess Grades c to g and Higher Tier papers assess Grades a* to d (e).

Learners are not required to take both units at the same tier. For example, a learner may initially sit a Foundation Tier unit and sit the final unit at Higher Tier.

3.3 Assessment Objectives

Candidates are expected to demonstrate the following in the context of the content described:

	Assessment Objectives	Weighting (%)
AO1	• recall and use their knowledge of the prescribed content	40-50
AO2	• select and apply mathematical methods in a range of contexts	30-40
AO3	• interpret and analyse problems and generate strategies to solve them	15-25

AO weightings – GCSE Applications of Mathematics

The relationship between the units and the assessment objectives in terms of raw marks is shown in the following grid:

Unit	GCSE Raw Marks			Total
	AO1	AO2	AO3	
Unit A381/01: *Applications of Mathematics 1 (Foundation)*	24-30	18-24	9-15	**60**
Unit A381/02: *Applications of Mathematics 1 (Higher)*	24-30	18-24	9-15	**60**
Unit A382/01: *Applications of Mathematics 2 (Foundation)*	36-45	27-36	13-23	**90**
Unit A382/02: *Applications of Mathematics 2 (Higher)*	36-45	27-36	13-23	**90**

3.4 Grading and awarding grades

GCSE results are awarded on the scale A* to G. Units are awarded a* to g, as applicable. Grades are indicated on certificates. However, results for candidates who fail to achieve the minimum grade will be recorded as *unclassified* (U or u) and this is **not** certificated.

This GCSE is a unitised scheme. Candidates can take units across several different series provided the terminal rule is satisfied. They can also re-sit units. When working out candidates' overall grades OCR needs to be able to compare performance on the same unit in different series when different grade boundaries have been set, and between different units. OCR uses a Uniform Mark Scale to enable this to be done.

A candidate's uniform mark for each unit is calculated from the candidate's raw mark on that unit. Raw mark grade boundaries are converted to the equivalent uniform mark grade boundaries. Marks between grade boundaries are converted on a pro rata basis.

When unit results are issued, the candidate's unit grade and uniform mark are given. The uniform mark is shown out of the maximum uniform mark for the unit.

The uniform mark grade boundaries for each of the assessments are shown below:

Unit	Unit Weighting	Maximum Unit Uniform Mark	Unit Grade								
			a*	a	b	c	d	e	f	g	u
A381/01	40%	83				72	60	48	36	24	0
A381/02	40%	120	108	96	84	72	60	54			0
A382/01	60%	125				108	90	72	54	36	0
A382/02	60%	180	162	144	126	108	90	81			0

The written papers will have a total weighting of 100%. For Foundation Tier papers, candidates achieving less than the minimum mark for Grade g will be unclassified. For Higher Tier papers, candidates achieving marginally less than the minimum mark for Grade d will be awarded Grade e, those failing to achieve a Grade e will be unclassified.

A candidate's uniform mark for each unit will be combined to give a total uniform mark for the specification. The candidate's overall grade will be determined by the total uniform mark.

The following table shows the maximum total uniform mark required for each overall grade:

Qualification	Maximum uniform mark	Qualification Grade								
		A*	A	B	C	D	E	F	G	U
J925	300	270	240	210	180	150	120	90	60	0

3.5 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 the assessment may be balanced by better performance in others.

The grade descriptions have been produced by the regulatory authorities in collaboration with the awarding bodies.

Grade F

Candidates use some mathematical techniques, terminology, diagrams and symbols from the foundation tier consistently, appropriately and accurately. Candidates use some different representations effectively and can select information from them. They complete straightforward calculations competently with and without a calculator. They use simple fractions and percentages, simple formulae and some geometric properties, including symmetry.

Candidates work mathematically in everyday and meaningful contexts. They make use of diagrams and symbols to communicate mathematical ideas. Sometimes, they check the accuracy and reasonableness of their results.

Candidates test simple hypotheses and conjectures based on evidence. Candidates are able to use data to look for patterns and relationships. They state a generalisation arising from a set of results and identify counter-examples. They solve simple problems, some of which are non-routine.

Grade C

Candidates use a range of mathematical techniques, terminology, diagrams and symbols consistently, appropriately and accurately. Candidates are able to use different representations effectively and they recognise some equivalent representations eg numerical, graphical and algebraic representations of linear functions; percentages, fractions and decimals. Their numerical skills are sound and they use a calculator accurately. They apply ideas of proportionality to numerical problems and use geometric properties of angles, lines and shapes.

Candidates identify relevant information, select appropriate representations and apply appropriate methods and knowledge. They are able to move from one representation to another, in order to make sense of a situation. Candidates use different methods of mathematical communication.

Candidates tackle problems that bring aspects of mathematics together. They identify evidence that supports or refutes conjectures and hypotheses. They understand the limitations of evidence and sampling, and the difference between a mathematical argument and conclusions based on experimental evidence.

They identify strategies to solve problems involving a limited number of variables. They communicate their chosen strategy, making changes as necessary. They construct a mathematical argument and identify inconsistencies in a given argument or exceptions to a generalisation.

Grade A

Candidates use a wide range of mathematical techniques, terminology, diagrams and symbols consistently, appropriately and accurately. Candidates are able to use different representations effectively and they recognise equivalent representations for example numerical, graphical and algebraic representations. Their numerical skills are sound, they use a calculator effectively and they demonstrate algebraic fluency. They use trigonometry and geometrical properties to solve problems.

Candidates identify and use mathematics accurately in a range of contexts. They evaluate the appropriateness, effectiveness and efficiency of different approaches. Candidates choose methods of mathematical communication appropriate to the context. They are able to state the limitations of an approach or the accuracy of results. They use this information to inform conclusions within a mathematical or statistical problem.

Candidates make and test hypotheses and conjectures. They adopt appropriate strategies to tackle problems (including those that are novel or unfamiliar), adjusting their approach when necessary. They tackle problems that bring together different aspects of mathematics and may involve multiple variables. They can identify some variables and investigate them systematically; the outcomes of which are used in solving the problem.

Candidates communicate their chosen strategy. They can construct a rigorous argument, making inferences and drawing conclusions. They produce simple proofs and can identify errors in reasoning.

3.6 Quality of Written Communication

Quality of written communication (QWC) is assessed in Units A381 and A382.

Candidates are expected to:

- ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
- present information in a form that suits its purpose;
- use a suitable structure and style of writing.

Questions assessing QWC are indicated by an asterisk (*).

4. Support for GCSE Applications of Mathematics

In order to help you implement this GCSE Applications of Mathematics specification effectively, OCR offers a comprehensive package of support. This includes:

4.1 Free resources available from the OCR website

The specification and specimen assessment materials are available to download free of charge from the OCR website.

Mock examination papers are available to download free of charge from OCR Interchange.

4.2 Training

Events are available through our partner, Mill Wharf Training. It offers a range of courses on innovative teaching practice and whole-school issues - www.mill-wharf-training.co.uk.

4.3 OCR support services

Active Results

Active Results is available to all centres offering OCR's GCSE Mathematics specifications.

activeresults

Active Results is a free results analysis service to help teachers review the performance of individual candidates or whole schools.

Devised specifically for the UK market, data can be analysed using filters on several categories such as gender and other demographic information, as well as providing breakdowns of results by question and topic.

Active Results allows you to look in greater detail at your results:

- Richer and more granular data will be made available to centres including question level data available from e-marking
- You can identify the strengths and weaknesses of individual candidates and your centre's cohort as a whole
- Our systems have been developed in close consultation with teachers so that the technology delivers what you need.

Further information on Active Results can be found on the OCR website.

OCR Mathematics support team

A direct number gives access to a dedicated and trained support team handling all queries relating to GCSE Applications of Mathematics and other mathematics qualifications - 0300 456 3142.

OCR Interchange

OCR Interchange has been developed to help you to carry out day-to-day administration functions online, quickly and easily. The site allows you to register and enter candidates online. In addition, you can gain immediate and free access to candidate information at your convenience. Sign up at https://interchange.ocr.org.uk.

5. Access to GCSE Applications of Mathematics

5.1 Disability Discrimination Act Information relating to GCSE Applications of Mathematics

GCSEs often require assessment of a broad range of competences. This is because they are general qualifications and, as such, prepare candidates for a wide range of occupations and higher level courses.

The revised GCSE qualifications and subject criteria were reviewed to identify whether any of the competences required by the subject presented a potential barrier to any disabled candidates. If this was the case, the situation was reviewed again to ensure that such competences were included only where essential to the subject. The findings of this process were discussed with disability groups and with disabled people.

Reasonable adjustments are made for disabled candidates in order to enable them to access the assessments and to demonstrate what they know and can do. For this reason, very few candidates will have a complete barrier to the assessment. Information on reasonable adjustments is found in *Access Arrangements, Reasonable Adjustments and Special Consideration* produced by the Joint Council (www.jcq.org.uk).

Candidates who are unable to access part of the assessment, even after exploring all possibilities through reasonable adjustments, may still be able to receive an award based on the parts of the assessment they have taken.

The access arrangements permissible for use in this specification are in line with QCDA's GCSE subject criteria equalities review and are as follows:

	Yes/No
Readers	Yes
Scribes	Yes
Practical assistants	Yes
Word processors	Yes
Transcripts	Yes
BSL interpreters	Yes
Oral language modifiers	Yes
MQ papers	Yes
Extra time	Yes

5.2 Arrangements for candidates with particular requirements

Candidates who are not disabled under the terms of the DDA may be eligible for access arrangements to enable them to demonstrate what they know and can do. Candidates who have been fully prepared for the assessment but who are ill at the time of the examination, or are too ill to take part of the assessment, may be eligible for special consideration. Centres should consult the *Access Arrangements, Reasonable Adjustments and Special Consideration* produced by the Joint Council.

6. Administration of GCSE Applications of Mathematics

6.1 Availability of assessment

There are **two** examination series each year, in January and June. First certification of this qualification is in June 2011. Thereafter, certification will be available in January and June of each year for the duration of the qualification.

The availability of units is shown below:

Unit	Unit	Jan 2011	June 2011	Jan 2012	June 2012	Jan 2013	June 2013
Unit A381/01	*Applications of Mathematics 1 (Foundation)*	✓	✓	✓	✓	✓	✓
Unit A381/02	*Applications of Mathematics 1 (Higher)*	✓	✓	✓	✓	✓	✓
Unit A382/01	*Applications of Mathematics 2 (Foundation)*		✓	✓	✓	✓	✓
Unit A382/02	*Applications of Mathematics 2 (Higher)*		✓	✓	✓	✓	✓

The availability in subsequent years is the same as in 2013 subject to continuation of the pilot.

6.2 Making entries

6.2.1 Making unit entries

Centres must be registered with OCR in order to make any entries, including estimated entries. It is essential that centres apply to OCR to become a registered centre well in advance of making their first entries.

It is essential that unit entry codes are quoted in all correspondence with OCR.

Candidates must be entered for either option F or H for each unit. In any examination series centres must enter each candidate for ONE option only. It is not possible for candidates to be entered for both options. Candidates are permitted one re-sit of each unit at the same or a different tier in another series.

Entry code and option	Assessment type	Unit code and title
A381 option F	Written paper	A381/01: *Applications of Mathematics 1 (Foundation)*
A382 option F	Written paper	A382/01: *Applications of Mathematics 2 (Foundation)*
A381 option H	Written paper	A381/02: *Applications of Mathematics 1 (Higher)*
A382 option H	Written paper	A382/02: *Applications of Mathematics 2 (Higher)*

6.2.2 Qualification entries

GCSE candidates must be entered for both units.

Candidates must be entered for certification to claim their overall GCSE qualification grade. All candidates should be entered under the following certification code:

- OCR GCSE in Applications of Mathematics – J925

It is not necessary to stipulate Foundation or Higher as an option.

GCSE certification is available from June 2011.

6.3 Terminal rule

Candidates must take at least 40% of the assessment in the same series they enter for certification of the qualification. All unit entries satisfy the terminal rule.

6.4 Unit and qualification re-sits

Candidates may re-sit each unit once before entering for certification for a GCSE.

Candidates may enter for the qualification an unlimited number of times.

6.5 Enquiries about Results

Under certain circumstances, a centre may wish to query the result issued to one or more candidates. Enquiries about Results for GCSE units must be made immediately following the series in which the relevant unit was taken (by the Enquiries about Results deadline).

Please refer to the *JCQ Post-Results Services* booklet and the *OCR Admin Guide* for further guidance about action on the release of results. Copies of the latest versions of these documents can be obtained from the OCR website.

6.6 Shelf-life of units

Individual unit results, prior to certification of the qualification, have a shelf-life limited only by that of the qualification.

6.7 Prohibited qualifications and classification code

Every specification is assigned a national classification code indicating the subject area to which it belongs. The classification code for this specification is 2210.

In order to meet the statutory requirement of the Key Stage 4 programme of study for Mathematics, candidates must be entered for GCSE Methods in Mathematics **and** GCSE Applications of Mathematics. Alternatively candidates can be entered for GCSE Mathematics:

GCSE Applications of Mathematics will be counted for the purpose of the School and College Performance Tables as part of the 5 A*-C performance indicators, including English and mathematics.

7. Other information about GCSE Applications of Mathematics

7.1 Overlap with other qualifications

There is a small degree of overlap between the content of this specification and those for GCSE Statistics and Free Standing Mathematics Qualifications.

There is a significant overlap with the single GCSE in Mathematics.

7.2 Progression from this qualification

GCSE qualifications are general qualifications which enable candidates to progress either directly to employment, or to proceed to further qualifications.

Progression to further study from GCSE will depend upon the number and nature of the grades achieved. Broadly, candidates who are awarded mainly Grades D to G at GCSE could either strengthen their base through further study of qualifications at Level 1 within the National Qualifications Framework or could proceed to Level 2. Candidates who are awarded mainly Grades A* to C at GCSE would be well prepared for study at Level 3 within the National Qualifications Framework.

This specification provides progression from the Entry Level Certificate in Mathematics specification R448.

7.3 Avoidance of bias

OCR has taken great care in preparation of this specification and the assessment materials to avoid bias of any kind.

7.4 Code of practice/common criteria requirements/subject criteria

This specification complies in all respects with the current *GCSE, GCE and AEA Code of Practice* as available on the QCA website, *The Statutory Regulation of External Qualifications 2004,* and the subject criteria for GCSE Applications of Mathematics.

7.5 Language

This specification and associated assessment materials are in English only.

7.6 Spiritual, moral, ethical, social, legislative, economic and cultural issues

This specification offers opportunities which can contribute to an understanding of these issues in the following topics.

Issue	Opportunities for developing an understanding of the issue during the course
Spiritual issues	Spiritual development: helping candidates obtain an insight into the infinite, and explaining the underlying mathematical principles behind natural forms and patterns.
Moral issues	Moral development: helping candidates recognise how logical reasoning can be used to consider the consequences of particular decisions and choices and helping them learn the value of mathematical truth.
Social issues	Social development: helping candidates work together productively on complex mathematical tasks and helping them see that the result is often better than any of them could achieve separately.
Economic issues	Economic development: helping candidates make informed decisions about the management of money.
Cultural issues	Cultural development: helping candidates appreciate that mathematical thought contributes to the development of our culture and is becoming increasingly central to our highly technological future, and recognising that mathematicians from many cultures have contributed to the development of modern day mathematics.

7.7 Sustainable development, health and safety considerations and European developments, consistent with international agreements

This specification supports these issues, consistent with current EU agreements, through questions set in relevant contexts.

Sustainable development issues could be supported through questions set on carbon emissions or life expectancy, for example.

Health and safety considerations could be supported through questions on maximum safe loads or a nutrition analysis, for example.

European developments could be supported through questions on currency and foreign exchange, for example.

OCR encourages teachers to use appropriate contexts in the delivery of the subject content.

7.8 Key Skills

This specification provides opportunities for the development of the Key Skills of *Communication, Application of Number, Information Technology, Working with Others, Improving Own Learning and Performance and Problem Solving* at Levels 1 and/or 2. However, the extent to which this evidence fulfils the Key Skills criteria at these levels will be totally dependent on the style of teaching and learning adopted.

The following table indicates where opportunities may exist for at least some coverage of the various Key Skills criteria at Levels 1 and/or 2.

	C		AoN		IT		WwO		IoLP		PS	
	1	2	1	2	1	2	1	2	1	2	1	2
J925	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Detailed opportunities for generating Key Skills evidence through this specification are posted on the OCR website (www.ocr.org.uk). A summary document for Key Skills Coordinators showing ways in which opportunities for Key Skills arise within GCSE courses has been published.

7.9 ICT

In order to play a full part in modern society, candidates need to be confident and effective users of ICT. Where appropriate, candidates should be given opportunities to use ICT in order to further their study of mathematics.

The assessment of this course requires candidates to:

- Use calculators effectively and efficiently, knowing how to
  - enter complex calculations;
  - use an extended range of function keys, including trigonometrical and statistical functions relevant to the programme of study.

In addition, the programme of study requires candidates to:

- Become familiar with a range of resources, including ICT such as spreadsheets, dynamic geometry, graphing software and calculators, to develop mathematical ideas.

7.10 Citizenship

Since September 2002, the National Curriculum for England at Key Stage 4 has included a mandatory programme of study for Citizenship. Parts of the programme of study for Citizenship (2007) may be delivered through an appropriate treatment of other subjects.

This Mathematics specification aids candidates in analysing **how information is used in public debate and policy formation, including information from the media and from pressure and interest groups,** through its statistical content.

The key process of **critical thinking and enquiry** can be developed, for example, where candidates have to decide for themselves how to solve a mathematical problem, or decide which information is relevant and redundant.

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www.ocr.org.uk

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