Higher course overview 2009-2011

The table below shows an overview of modules in the Higher tier scheme of work.
Text Book and Homework references are for the **Edexcel GCSE Maths Higher Tier Books**
To see details of each module click on the topic title while holding Ctrl

	Chap	Topic		Hrs approx	Grade	Workbook Page (h/w)
		FINA EXAM JUNE 2010				
		End of Year 9 and Autumn Term Year 10		37		
1	1	Number 1: Whole numbers, Factors and Multiples		3	D	2,3,4
2	4	Fractions 1: Addition and Subtraction, Multiplication and Division		2	D	7,8
3	5	Algebra 1: Expressions and sequences		5	C	120
4	9	2D Shapes: Perimeter and Area, Properties		5	D	
5	12 F	Coordinates		2	E/D	78
6	2	Angles: Properties of triangles, quadrilaterals and polygons		6	D	
7	11	Collecting and recording data		4	D/C/B/A	114
8	21	Displaying data 1: Processing, representing and interpreting data		4	D/C/B	104
		END OF TERM TEST				
9	7	Number 2: Decimals and Fractions		3	D/C	5,6
10	16	Estimating and accuracy		2	C	18, 19
		Spring Term Year 10		33		
11	27	Drawing and construction 1: 2-D shapes		3	C/B/A	
12	12	Percentages		4	B	12,13
13	10	Linear equations		6	C/B	
14	22	3D shapes: Construction, Surface Area and Volume		4	C/B/A	42,43
15	8	Algebra 2: Brackets		3	C/B	
16	30	Quadratic Equations $y=ax^2 + bx + c$		4	B	132
		END OF TERM TEST				
17	3 + U1	Displaying data 2: Time Series and Scatter graphs		4	D/B	108, 115
18	18	Formulae		3	D/C/B/A	128
		Summer Term Year 10		30		
19	29	Circle Geometry		4	A	50
20	13	Graphs 1 (Linear functions) $y = mx + c$		4	C	83
21	23	Graphs 2 (Quadratic functions) $y=ax^2 + bx + c$		2	C/B	ICT
22	17	Statistical Measures 1: Averages and Spread		2	B	
23	19	Trigonometry and Pythagoras's Theorem 1 (sine, cosine, tangent)		3	B	
24	33	Similar Shapes		2	B	
25	20	Fractions 2: Ratio and Proportion		3	D	
26	34	Direct and Inverse Proportion		4	A	
27	26	Number 3: Indices, Standard Form and Surds		5	A	
		END OF YEAR EXAM (Exam paper)				
		Autumn Term Year 11		37		
28	15	Inequalities		3	C/B	
29	28	Further Quadratic Equations		3	A	
30	6	Measure		3		
31	24	Probability		3		
32	25	Trial and Improvement and Further Graphs		5	C/B	
33	14	Transformations 1		5	D	
34	31	Trigonometry and Pythagoras's Theorem 2 (non-right angled triangles and applications in 3D)		4	A	
		END OF TERM TEST				
35	32	Loci, Further simultaneous linear and quadratic equations		5	A	
36	35	Vectors		5	A	
37	36	Transformations 2 (transformations of functions)		5	A	
		Spring Term Year 11		20		
		MOCKS				
		Complete syllabus then revision until exam in June 2011				

GCSE

Edexcel GCSE in
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First examination in 2009

The Archbishop Lanfranc Scheme of Work

Higher tier
Scheme of work

Last Updated: 8th April 2009

Introduction

This scheme of work is based upon a five-term model over two years for both Foundation and Higher students.

It can be used directly as a scheme of work for the GCSE Mathematics (A) (Linear) specification, and a mapping guide to a variety of models for the GCSE Mathematics (B) (Modular) specification can be found on pages **Error! Bookmark not defined.–Error! Bookmark not defined.Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.Error! Reference source not found.**.

The scheme of work is structured so each topic contains:

- Module Number
- Recommended teaching time, though of course this is adaptable according to individual teaching needs
- Tier
- Contents, referenced back to the National Curriculum Programme of Study
- Objectives for students at the end of the module
- Ideas for differentiation and extension activities
- Endorsed Publishers' resources, referenced to textbook chapters and sections
- Issues regarding assessment of the module
- Ideas for homework tasks
- Notes for general mathematical teaching points and common misconceptions.

Schemes of work giving more specific detail of each endorsed textbook will be available via a link from the Edexcel mathematics website (www.edexcel.org.uk).

Module 1 **Chapter 1** **Time: 5–7 hours**

GCSE tier: **Higher**

Contents: **Number 1** **Whole numbers, Factors and Multiples**

Objectives

By the end of the module the student should be able to:

- **understand and order integers**
- **add, subtract, multiply and divide integers**
- **multiply and divide whole numbers by a given multiple of 10**
- **find: squares; cubes; square roots; cube roots of numbers, with and without a calculator (including the use of trial and improvement)**
- **understand odd and even numbers, and prime numbers**
- **find the HCF and the LCM of numbers**
- **write a number as a product of its prime factors, eg 108 = $2^2 \times 3^3$**

Prior knowledge

- The ability to order numbers.
- Appreciation of place value.
- Experience of the 4 operations using whole numbers.
- Knowledge of integer complements to 10 and 100
- Knowledge of multiplication facts to 10 × 10
- Knowledge of strategies for multiplying and dividing whole numbers by 10
- Number complements to 10 and multiplication/division facts.
- Use a number line to show how numbers relate to each other.
- Recognise basic number patterns.
- Experience of classifying integers.

Differentiation and extension

- More work on long multiplication and division without using a calculator.
- Estimating answers to calculations involving the four rules.
- Consideration of mental maths problems with negative powers of 10: 2.5 × 0.01, 0.001
- Directed number work with two or more operations, or with decimals.

- Calculator exercise to check factors of larger numbers.
- Further work on indices to include negative and/or fractional indices.
- Use prime factors to find LCM.
- Use a number square to find primes (sieve of Eratosthenes).
- Calculator exercise to find squares, cubes and square roots of larger numbers (using trial and improvement).

Publisher	Textbook	Chapter
Edexcel	Higher	1: Number
Harper Collins	Higher	1: Number
Heinemann (Harcourt)	Higher	1: Exploring numbers 1
Hodder Murray	Higher	1: Working with whole numbers, 4: Powers, roots and reciprocals
Oxford University Press	Higher	N1: Integers and decimals
	Higher Plus	N1: Integers, powers and roots

Resources

Assessment issues

- Written testing to assess knowledge of content.
- Regular oral work — eg a five-minute assessment at the beginning or end of a lesson.
- Mental test to check knowledge of squares and cubes/odd and even numbers.
- Test on performance using a calculator to find squares, cubes and square roots.
- Test without a calculator on knowledge of squares, cubes and square numbers (keeping the numbers small).

Homework

- Consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.
- Investigational tasks leading to number patterns involving powers of numbers.
- GCSE past paper questions.

Notes

- Present all working clearly with numbers in line; emphasising that all working is to be shown.
- For non-calculator methods make sure that remainders and carrying are shown.
- All of the work in this unit is easily reinforced by starter and end activities.
- Oral discussion should be used to ensure understanding
- Recognition of odd and even numbers.
- Calculators are only used when appropriate.

Module 2 **Chapter 4** **Time: 3 hours**

GCSE tier: **Higher**

Contents: **Fractions 1:** **Addition and Subtraction, Multiplication and Division**

Objectives

By the end of the module the student should be able to:

- **write a fraction in its simplest form and recognise equivalent fractions**
- **compare the sizes of fractions using a common denominator**
- **add and subtract fractions by using a common denominator**
- **write an improper fraction as a mixed number, and visa versa**
- **add and subtract mixed numbers.**
- **find the reciprocal of whole numbers, fractions, and decimals**
- **multiply and divide a fraction by an integer, by a unit fraction and by a general fraction (expressing the answer in its simplest form)**

Prior knowledge

- Multiplication facts.
- Ability to find common factors.
- A basic understanding of fractions as being 'parts of a whole unit'.
- Use of a calculator with fractions.

Differentiation and extension

Careful differentiation is essential for this topic dependent upon the student's ability:

- relating simple fractions to remembered percentages and vice-versa
- using a calculator to change fractions into decimals and looking for patterns
- working with improper fractions and mixed numbers
- solve word problems involving fractions (and in real-life problems eg find perimeter using fractional values).
- use a calculator to find fractions of given quantities.
- use combinations of the four operations with fractions (and in real-life problems eg to find areas using fractional values).
- for very able students algebraic fractions could be considered.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	4: Fractions
Heinemann (Harcourt)	Higher	4: Fractions and decimals
Hodder Murray	Higher	2: Fractions and decimals
Oxford University Press	Higher	N3: Fractions, decimals and percentages
	Higher Plus	N3: Fractions, decimals and percentages

Assessment issues

- Written testing to assess knowledge of content.
- Testing the ability to perform calculations, using simple fractions, without a calculator.
- Mental arithmetic test involving simple fractions such as ½, ¼, ...

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.
- An equivalent fractions worksheet as a preliminary, following on from the initial lesson.
- Use the worksheet for comparing fractions, ordering fractions, and adding and subtracting fractions.
- Extra examples on a regular basis for revision purposes.
- Other work given could have fractional answers as a part of the process.

Notes

- Understanding of equivalent fractions is the key issue in order to be able to tackle the other content
- Calculators should only be used when appropriate.
- Constant revision of this aspect is needed.
- All work needs to be presented clearly with the relevant stages of working shown.
- Non-calculator work with fractions is generally poorly attempted at GCSE. Students may have difficulty with the concept of dividing by a fraction.

Module 3 **Chapter 5** **Time: 4 -6 hours**

GCSE tier: **Higher**

Contents: **Algebra 1** **Expressions and Sequences**

NA5a	Simplifying expressions with one or more variables
NA5a	Performing simple algebraic multiplication and division
NA5d	Using index laws for simple integer powers; simple instances of index laws
NA6a	Generating common integer sequences (including: sequences of odd or even integers; squared integers; powers of 2; powers of 10; triangle numbers)
NA6a	Generating terms of a sequence using term-to-term and position-to-term definitions of the sequence
NA6a	Using linear expressions to describe the *n*th term of an arithmetic sequence

Objectives

By the end of the module the student should be able to:

- **simplify algebraic expressions in one or more like terms by addition and subtraction**
- **multiply and divide with letters and numbers**
- **multiply and divide powers of the same letter**
- **understand and use the index rules to simplify algebraic expressions**
- **use brackets to expand and simplify simple algebraic expressions.**
- **find the missing numbers in a number pattern or sequence**
- **find the *n*th term of a number sequence as an algebraic expression**
- **explain why a number is, or is not, a member of a given sequence**
- **use a calculator to produce a sequence of numbers.**

Prior knowledge

- Experience of using a letter to represent a number.
- Ability to use negative numbers with the four operations.
- Know about odd and even numbers.
- Recognise simple number patterns eg 1, 3, 5, ...
- Writing simple rules algebraically.
- Raise numbers to positive whole number powers.

Differentiation and extension

- Examples where all the skills above are required.
- Factorising where the factor may involve more than one variable.
- Use index rules with negative numbers (and fractions).
- Match-stick problems.
- Sequences of triangle numbers, Fibonacci numbers, etc.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	5: Expressions and sequences
Harper Collins	Higher	5: Algebra 1
Heinemann (Harcourt)	Higher	1: Exploring numbers 1 2: Essential algebra
Hodder Murray	Higher	5: Working with algebra
Oxford University Press	Higher	A1: Expressions
	Higher Plus	A1: Expressions

Assessment issues

- Written testing to assess knowledge of content.
- Simple investigation of a sequence, using diagrams and number patterns.

- Use of mental maths in the substitution of simple numbers into expressions.

Homework

- Fibonacci sequence, Pascal's triangle.
- Uses of algebra to describe real situation eg n quadrilaterals have $4n$ sides.

Notes

- Emphasise correct use of symbolic notation (eg $3x$ rather than $3 \times x$).
- Present all work neatly, writing out the questions with the answers to aid revision at a later stage.
- When investigating linear sequences, students should be clear on the description of the pattern in words, the difference between the terms and the algebraic description of the nth term.
- The cube (and cube root) function on a calculator may not be the same for other makes.

Module 4 **Chapter 9** **Time: 4 hours**

GCSE tier: **Higher**

Contents: **2D Shapes** **Perimeter and area , Properties**

SSM2f	Understand and use Pythagoras' theorem in 2-D
SSM4d	Calculating perimeters and areas of shapes made from triangles and rectangles
NA3q	Using calculators, or written methods, to calculate the upper and lower bounds of calculations, particularly when working with measurements
SSM4a	Recognising that measurements given to the nearest whole unit may be inaccurate by up to one half in either direction
SSM4d	Converting between area measures, including square centimetres and square metres
SSM4d	Finding circumferences of circles and areas enclosed by circles, recalling relevant formulae
SSM4d	Calculating the lengths of arcs and sectors of circles
NA3n	Using surds and pi in exact calculations, without a calculator

Objectives

By the end of the module the student should be able to:

- **use Pythagoras' theorem to find unknown lengths, eg the height of an isosceles triangle given the lengths of all three sides**
- **find the perimeter and area of shapes made up from triangles and rectangles**
- **find when numbers are given to a specific degree of accuracy, the upper and lower bounds of perimeters and areas**
- **convert between units of area**
- **find the perimeter and area of shapes made up from triangles, rectangles and parts of circles**
- **use and recall formulae to calculate perimeters and areas of circles, and parts of circles.**

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Prior knowledge

- Names of triangles, quadrilaterals and polygons.
- Concept of perimeter and area.
- Units of measurement.
- Substitute numbers into formulae.
- Ability to give answers to a degree of accuracy.

Differentiation and extension

- Calculating areas and volumes using formulae.
- Using compound shape methods to investigate areas of other standard shapes such as parallelograms, trapeziums and kites.
- Practical investigation to find an approximate value for pi, eg wrapping string around a bottle.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	9: Two-dimensional shapes
Harper Collins	Higher	6: Pythagoras and trigonometry 23: Number and limits of accuracy
Heinemann (Harcourt)	Higher	11: Estimation and approximation 13: Measure and mensuration 15: Pythagoras' theorem 23: Exploring numbers 2
Oxford University Press	Higher	S1: Length, area and volume
	Higher Plus	

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.
- Find the perimeter and area of the floor of a room at home.
- A fencing problem — find the smallest/largest area with a fixed perimeter.

Notes

- Discuss the correct use of language and units.
- Ensure that students can distinguish between perimeter, area and volume.
- Many students have little real understanding of perimeter, area and volume. Practical experience is essential to clarify these concepts.
- Need to constantly revise the expressions for area of shapes.

Module 9 **Chapter 7** **Time: 3–5 hours**

GCSE tier: **Higher**

Contents: **Number 2** **Decimals and Fractions**

NA2d	Writing decimal numbers in order of size
Na2d	Recognising that each terminating decimal is a fraction
NA3c	Converting a recurring decimal to a fraction
NA3c	Performing short division to convert a fraction to a decimal
NA3i	Adding and subtracting decimal numbers
NA3k	Dividing by a decimal (up to 2 dp) by transforming it to a problem involving division using by an integer
NA3k	Understanding where to position the decimal point by considering what happens if they multiply/divide equivalent fractions

Objectives

By the end of the module the student should be able to:

- **put digits in the correct place in a decimal number**
- **write decimals in ascending order of size**
- **multiply and divide decimal numbers by whole numbers and decimal numbers (up to 2 dp), eg 266.22 ÷ 0.34 by transforming the problem into one involving intergers and then considering the position of the decimal point.**
- **know that e.g. 13.5 ÷ 0.5 = 135 ÷ 5**
- **use fractions in contextualised problems.**
- **convert between fractions and decimals**
- **convert recurring decimals to fractions (and vice versa)**

Prior knowledge

- The concepts of a fraction and a decimal.

Differentiation and extension

- Use decimals in real-life problems.
- Use standard form for vary large/small numbers.
- Money calculations that require rounding answers to the nearest penny.
- Multiply and divide decimals by decimals (more than 2 dp).

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	7: Decimals
Harper Collins	Higher	1: Number
Heinemann (Harcourt)	Higher	4: Fractions and decimals, 11: Estimation and approximation
Hodder Murray	Higher	2: Fractions and decimals
Oxford University Press	Higher	N2: Decimal calculations, N3: Fractions, decimals and percentages
	Higher Plus	N3: Fractions, decimals and percentages

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Present all working clearly with decimal points in line; emphasising that all working is to be shown.
- For non-calculator methods make sure that remainders and carrying are shown.
- Amounts of money should always be rounded to the nearest penny where necessary.
- It is essential to ensure the students are absolutely clear about the difference between significant figures and decimal places.

Module 4 **Chapter 16** **Time: 3–5 hours**

GCSE tier: **Higher**

Contents: **Estimating and Accuracy**

NA3h	Rounding to a given number of significant figures (and decimal places)
NA4b	Checking and estimating answers to problems

Objectives

By the end of the module the student should be able to:

- **round whole numbers to the nearest, 10, 100, 1000, …**
- **write a number to a given number of decimal places or significant figures**
- **check their calculations by rounding.**
- **estimate the value of an expression by writing all the numbers correct to 1 significant figure**
- **write down the lower and upper bounds of a value written to a given degree of accuracy**
- **work out the lower and upper bounds of an expression**

Prior knowledge

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Differentiation and extension

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Resources

Publisher	Textbook	Chapter
Edexcel	Higher	16: Estimating and Accuracy
Harper Collins	Higher	
Heinemann (Harcourt)	Higher	
Hodder Murray	Higher	
Oxford University Press	Higher	
	Higher Plus	

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Amounts of money should always be rounded to the nearest penny where necessary.
- It is essential to ensure the students are absolutely clear about the difference between significant figures and decimal places.
- Whether zero's are significant or not can cause confusion.

Module 6 **Chapter 12 Foundation Book** **Time: 2-3 hours**

GCSE tier: **Higher**

Contents: **Coordinates**

SSM3e	Understanding that one coordinate identifies a point on a line, two coordinates identify a point in a plane and three coordinates identify a point in space, using the terms '1-D', '2-D' and '3-D'
SSM3e	Using axes and coordinates to specify points in all four quadrants
SSM3e	Locating points with given coordinates
SSM3e	Finding the coordinates of points identified by geometrical information
SSM3e	Finding the coordinates of the midpoint of the a line segment; given the points *A* and *B*, calculate the length *AB*

Objectives

By the end of the module the student should be able to:

- **plot and reading coordinates on a coordinate grid (in all four quadrants)**
- **understand that one coordinate identifies a point on a line, two coordinates identify a point in a plane and three coordinates identify a point in space, and use the terms '1-D', '2-D' and '3-D'**
- **find the coordinates of the fourth vertex of a parallelogram**
- **identify the coordinates of the vertex of a cuboid on a 3-D grid**
- **writing down the coordinates of the midpoint of the line connecting two points**
- **calculate the length of the line segment joining to point in the plane (all four quadrants).**

Prior knowledge

- Directed numbers.
- Parallel and perpendicular lines.

Differentiation and extension

- Find the coordinates of the point if intersection of the medians of a triangle, and explore further.
- Identify the coordinates of the mid-point of a line segment in 3-D.

Resources

Publisher	Textbook	Chapter	Section
Edexcel	Higher		
Heinemann (Harcourt)	Higher	9: Functions, lines, simultaneous equations and regions 13: Measure and mensuration	9.7 13.6
Oxford University Press	Higher		
	Higher Plus		

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Students should use a ruler to draw coordinate axes.
- Coordinate axes should be labelled.
- Students often have difficulty visualising 3-D coordinates.

Module 6 **Chapter 2** **Time: 5–7 hours**

GCSE tier: **Higher**

Contents: **Angles**

SSM2b	Naming angles
SSM2a	Using angles in a straight line and angles at a point
SSM2c	Using parallel lines to identify alternate and corresponding angles
SSM2g	Calculating interior and exterior angles in polygons
SSM4b	Using bearings
SSM2b	Using angle properties of equilateral, isosceles and right-angled triangles
SSM2a	Using parallel lines, alternate angles and corresponding angles
SSM2a	Understanding the consequent properties of a parallelogram and a proof that the angle sum of a triangle is 180 degrees
SSM2a	Understanding a proof that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices
SSM2b	Explain why the angle sum of a quadrilateral is 360 degrees
SSM2c	Recalling definitions of special types of quadrilateral, including square, rectangle, parallelogram, trapezium and rhombus
SSM2d	Calculating and using the sums of the interior angles of quadrilaterals, pentagons and hexagons
SSM2d	Calculating and using the angles of regular polygons
SSM2h	Understanding that inscribed regular polygons can be constructed by equal divisions of a circle

Objectives

By the end of the module the student should be able to:

- **distinguish between acute, obtuse, reflex and right angles**
- **use angle properties on a line and at a point to calculate unknown angles**
- **use angle properties of triangles and quadrilaterals to calculate unknown angles**
- **use parallel lines to identify alternate and corresponding angles**
- **calculate interior and exterior angles in a polygon**
- **understand and use bearings.**
- **mark parallel lines in a diagram**
- **find missing angles using properties of corresponding angles and alternate angles, giving reasons**
- **find the three missing angles in a parallelogram when one of them is missing**
- **identify and list the properties of quadrilaterals (including kites)**
- **name all quadrilaterals that have a pair of opposite sides that are equal.**
- **calculate and use the sums of the interior angles of convex polygons of sides 3, 4, 5, 6, 8, 10**
- **know, or work out, the relationship between the number of sides of a polygon and the sum of its interior angles**
- **know that the sum of the exterior angles of any polygon is 360 degrees**
- **find the size of each exterior/interior angle of a regular polygon.**

Prior knowledge

- An understanding of angle as a measure of turning.
- The ability to use a protractor to measure angles.
- Understanding of the concept of parallel lines.
- Recall the names of special types of triangle, including equilateral, right-angled and isosceles.
- Know that angles on a straight line sum to 180 degrees.
- Know that a right angle = 90 degrees.

Differentiation and extension

- Find the rule for the sum of the interior/exterior angles of an *n* sided polygon.
- Harder problems involving multi-stage calculations.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	2: Angles
Harper Collins	Higher	7: Geometry
Heinemann (Harcourt)	Higher	3: Shapes 7: Transformation and loci
Hodder Murray	Higher	12: Working with shape and space
Oxford University Press	Higher	S2: Angles and circles S5: Constructions and loci
	Higher Plus	

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.
- Regular quick test type homework on angle properties of various shapes.

Notes

- Make sure that all pencils are sharp and drawings are neat and accurate.
- Angles should be within 2 degrees.
- Remind students a protractor should be taken into the exam.
- In solutions ‘alternate angle theorem’ and ‘corresponding angle theorem’ should be stated if used.
- Diagrams used in examinations are seldom drawn accurately.

Module 7 **Chapter 11** **Time: 3–4 hours**

GCSE tier: **Higher**

Contents: **Collecting data**

HD2d	Identifying which primary data they need to collect and in what format, including grouped data, considering appropriate equal class intervals
HD2d	Selecting and justifying a sampling scheme and a method to investigate a population
HD3a	Collecting data using various method, including observation, controlled experiments, data logging, questionnaires and surveys
HD3a	Designing and using data-collection sheets
HD3b	Gathering data from secondary sources
HD3c	Designing and using two-way tables
HD3d	Dealing with practical problems such as non-response or missing data

Prior knowledge

- An understanding of why data needs to be collected.
- Experience of simple tally charts.
- Experience of inequality notation.

Objectives

By the end of the module the student should be able to:

- **design a suitable question for a questionnaire**
- **understand the difference between: primary and secondary data; discrete and continuous data**
- **design suitable data capture sheets for surveys and experiments**
- **understand about bias in sampling**
- **choose and justify an appropriate sampling scheme, including random and systematic sampling**
- **deal with practical problems in data collection, such as non-response, missing and anomalous data.**

Differentiation and extension

- Carry out a statistical investigation of their own including — designing an appropriate means of gathering the data.
- An investigation into other sampling schemes, such as cluster and quota sampling.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	11: Collecting data
Harper Collins	Higher	11: Statistics 1
Heinemann (Harcourt)	Higher	5: Collecting and recording data
Hodder Murray	Higher	20: Collecting data
Oxford University Press	Higher	D1: Collecting data
	Higher Plus	D1: Sampling methods

Assessment issues

- Written testing to assess knowledge of content.
- Their own statistical investigation.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.
- Completion of data collection exercise statistical project.

Notes

- Students may need reminding about the correct use of tallies.
- Emphasis the differences between primary and secondary data.
- If students are collecting data as a group they should all use the same procedure.
- Emphasis that continuous data is data that is measured.

Module 8 **Chapter 21** **Time: 4–5 hours**

GCSE tier: **Higher**

Contents: **Displaying data 1** **Processing, representing and interpreting data**

HD4a	Drawing and producing a wide range of graphs and diagrams
HD5b	Interpreting a wide range of graphs and diagrams and drawing conclusions
HD4a	Drawing and producing stem-and-leaf diagrams
HD4e	Finding the median, quartiles and interquartile range for large data sets
HD4a	Drawing and producing cumulative frequency tables and diagrams
HD4a	Drawing and producing box plots for grouped continuous data
HD5d	Comparing distributions and making inferences, using shapes of distributions and measures of average and spread, including median and quartiles
HD5b	Interpreting cumulative frequency diagrams and box plots and drawing conclusions
HD4a	Drawing and producing histograms for grouped continuous data
HD5b	Interpreting a histogram
HD5d	Understanding frequency density

Objectives

By the end of the module the student should be able to:

- **Represent data as:**
  - **pie charts (for categorical data)**
  - **bar charts and histograms (equal class intervals)**
  - **frequency polygons.**
- **Choose an appropriate way to display discrete, continuous and categorical data.**
- **Understand the difference between a bar chart and a histogram.**
- **Compare distributions shown in charts and graphs.**
- **find the median and quartiles for large sets of ungrouped data**
- **draw a cumulative frequency table for grouped data (using the upper class boundary)**
- **draw a cumulative frequency curve for grouped data**
- **use a cumulative frequency diagram to find estimates for the median and quartiles of a distribution**
- **use a cumulative frequency diagram to solve problems, eg how many greater than a particular value**
- **draw a box plot to summarise information given in cumulative frequency diagrams**
- **compare cumulative frequency diagrams and box lots to make inferences about distributions.**
- **complete a histogram from a frequency table**
- **complete a frequency table from a histogram**
- **use a histogram to work out the frequency in part of a class interval.**

Prior knowledge

- An understanding of the different types of data: continuous; discrete; categorical.
- Experience of inequality notation.
- Ability to multiply a number by a fraction.
- Experience of inequality notation.
- Ability to plot points.
- Understand how to find the median and range for small data sets.
- Use a protractor to measure and draw angles

- **Differentiation and extension**
- Carry out a statistical investigation of their own and use an appropriate means of displaying the results.
- Use a spreadsheet to draw different types of graphs.
- Collect examples of charts and graphs in the media which have been misused, and discuss the implications.
- Understand the distinction between a cumulative frequency curve and a cumulative frequency polygon.
- Compare more than three distributions.
- Use statistical software to produce cumulative frequency diagrams and box plots.
- Identify and represent outliers for box plots.
- Investigate how the choice of class width affects the shape of a distribution.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	21: Processing, representing and interpreting data
Harper Collins	Higher	11: Statistics 1
Heinemann (Harcourt)	Higher	5: Collecting and recording data
Hodder Murray	Higher	21: Working with data
Oxford University Press	Higher	D4: Averages and box plots
	Higher Plus	D4: Representing data

Assessment issues

- Written testing to assess knowledge of content.
- Their own statistical investigation.
- GCSE coursework — data handling project.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.
- Completion of a simple statistical project.

Notes

- Clearly label all axes on graphs and use a ruler to draw straight lines.
- Many students enjoy drawing statistical graphs for classroom displays.
- No distinction is made for cumulative frequency curves and cumulative frequency polygons.
- Students should check that their answers for mean, median and mode lie within the given range of data.
- Label clearly all axes on graphs (frequency density).
- Emphasise the difference between a histogram and bar charts/graphs students have previously encountered.

Module 11 **Chapter 27** **Time:**

GCSE tier: **Higher**

Contents: **Drawing and construction 1** **2-D shapes**

SSM4b	Drawing approximate constructions of triangles and other 2-D shapes, using a ruler and protractor, given information about side lengths and angles
SSM4b	Understand from their experience of constructing them, that triangles satisfying SSS, SAS, ASA and RHS are unique, but SSA are not
SSM4b	Use straight edge and compasses to do standard constructions
SSM4e	Finding loci

Objectives

By the end of the module the student should be able to do a range of standard constructions including:

- an equilateral triangle with a given side
- the mid-point and perpendicular bisector of a line segment
- the perpendicular from a point on a line
- the bisector of an angle
- the angles 60, 30 and 45 degrees
- a regular hexagon inside a circle, etc
- a region bounded by a circle and an intersecting line
- a path equidistant from 2 points or 2 line segments, etc.

Prior knowledge

- An ability to use a pair of compasses.
- The special names of triangles (and angles).
- Understanding of the terms perpendicular, parallel and arc.

Differentiation and extension

- Solve loci problems that require a combination of loci.
- Construct combinations of 2-D shapes to make nets.
- Investigate tessellation.

Resources

Publisher	Textbook	Chapter	Section
Edexcel	Higher	27: Constructions, loci and congruence	27.1–27.4, 27.6
Harper Collins	Higher	9: Constructions	
Heinemann (Harcourt)	Higher	7: Transformations and loci	7.3–7.5
Hodder Murray	Higher	14: Constructions and loci	14.1, 14.2, 14.3
Oxford University Press	Higher	S5: Constructions and loci	S5.2–5.5
	Higher Plus		

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- All working should be presented clearly, and accurately.
- Construction lines should not be erased.

Module 12 **Chapter 12** **Time: 4-5 hours**

GCSE tier: **Higher**

Contents: **Percentages**

NA2e	Understanding that 'percentage' means 'number of parts per 100'
NA2e	Interpreting percentage as the operator so many hundredths of'
NA2e	Using percentages in real-life situations
NA3j	Solving percentage problems, including increase and decrease, and reverse percentage
NA3k	Representing repeated proportional change using a multiplier raised to a power
NA3s	Using calculators for reverse percentages calculations by doing an appropriate division
NA3t	Using calculators to explore exponential growth and decay, using a multiplier and power key

Objectives

By the end of the module the student should be able to:

- **understand that a percentage is a fraction in hundredths**
- **write a percentage as a decimal; or as a fraction in its simplest terms**
- **write one number as a percentage of another number**
- **calculate the percentage of a given amount**
- **find a percentage increase/decrease of an amount**
- **find a reverse percentage, eg find the original cost of an item given the cost after a 10% deduction**
- **use a multiplier to increase by a given percent, eg 1.1 × 64 increases 64 by 10%**
- **calculate simple and compound interest for two, or more, periods of time.**

Prior knowledge

- The concepts of a fraction and a decimal.
- Awareness that percentages are used in everyday life.

Differentiation and extension

- Fractional percentages of amounts (non-calculator).
- Combine multipliers to simplify a series of percentage changes.
- Percentages which convert to recurring decimals (eg 33 $\frac{1}{3}$ %), and situations which lead to percentages of more than 100%.
- Problems which lead to the necessity of rounding to the nearest penny (eg real-life contexts).
- Comparisons between simple and compound interest calculations.
- Formulae in simple interest/compound interest methods.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	12: Percentages
Heinemann (Harcourt)	Higher	8: Using basic number skills
Oxford University Press	Higher	N7: Fraction and percentage calculations
	Higher Plus	N3: Fractions, decimals and percentages

Assessment issues

- Reinforce equivalence and the connection between percentage, fraction and decimal.
- Mental methods of calculating common percentages (eg 17.5% using 10%, 5%, 2.5%).

Homework

- Independent research into the many uses made of percentages, particularly in the media.
- The construction of a VAT ready-reckoner table.

Notes

- For non-calculator methods make sure that remainders and carrying are shown.
- Amounts of money should always be rounded to the nearest penny where necessary, except where such rounding is premature (eg in successive calculations like in compound interest).

- In preparation for this unit students should be reminded of basic percentages and recognise their fraction and decimal equivalents.

Module 13 **Chapter 10** **Time: 6–7 hours**

GCSE tier: **Higher**

Contents: **Linear equations**

NA5e	Solving equations by using inverse operations or by transforming both sides in the same way
NA5e	Solving linear equations with integer or fractional coefficients, in which the unknown appears on either side or on both sides of the equation
NA5e	Solving linear equations that require prior simplification of brackets, including those that have negative signs occurring anywhere in the equation, and those with a negative solution
NA5i	Finding the exact solution of two simultaneous equations in two unknowns by eliminating a variable and interpreting the equation as lines and their common solution as the point of intersection

Objectives

By the end of the module the student should be able to:

- **solve linear equations with one, or more, operations (including fractional coefficients)**
- **solve linear equations involving a single pair of brackets.**
- **solve algebraically two simultaneous equations**
- **interpret the solution of two simultaneous equations as the point of intersection the corresponding lines.**

Prior knowledge

- Experience of finding missing numbers in calculations.
- The idea that some operations are 'opposite' to each other.
- An understanding of balancing.
- Experience of using letters to represent quantities.

Differentiation and extension

- Use of inverse operations and rounding to 1 sig. fig. could be applied to more complex calculations.
- Derive equations from practical situations (such as finding unknown angles in polygons).
- Solve second order linear equations.
- Solve two simultaneous equations with fractional coefficients.
- Solve two simultaneous equations with second order terms, eg equations in x and y^2.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	10: Linear equations
Harper Collins	Higher	16: Linear graphs and equations
Heinemann (Harcourt)	Higher	2: Essential algebra 6: Solving equations and inequalities
Hodder Murray	Higher	6: Algebraic equations
Oxford University Press	Higher	A1: Expressions A2: Equations and inequalities
	Higher Plus	A1: Expressions A2: Solving equations

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set or extension work detailed above.

Notes

- Students need to realise that not all linear equations can easily be solved by either observation or trial and improvement, and hence the use of a formal method is vital.
- Students can leave their answers in fractional form where appropriate.
- Interpreting the direction of an inequality is a problem for many.
- Inaccurate graphs could lead to incorrect solutions.
- Clear presentation of workings is essential.

Module 14 **Chapter 22** **Time: 5-6 hours**

GCSE tier: **Higher**

Contents: **3-D shapes** **Construction, Surface Area and Volume**

SSM2i	Using 2-D representations of 3-D shapes and analyse 3-D shapes through 2-D projections and cross-sections, including plan and elevation
SSM3b	Recognising and visualising rotations, reflections and translations including reflection symmetry of 3-D shapes
SMM4b	Constructing specified cubes, regular tetrahedral, square-based pyramids and other 3-D shapes
SSM4d	Finding the surface area of simple shapes made by using the formulae for the areas of triangles, rectangles and circles
SSM4d	Finding volumes of cuboids, recalling and understanding the connection to counting cubes and how it extends this approach
SSM4d	Calculating the volumes of right prisms
SSM2i	Solving problems involving surface areas and volumes of prisms and cylinders
SSM4d	Convert between volume measures, including cubic centimetres and cubic metres
NA3n	Using surds and pi in exact calculations, without a calculator
SSM2i	Solving problems involving surface areas and volumes of cones and pyramids
SSM2i	Solving problems involving more complex shapes, including segments of circles and frustums of cones
NA3n	Using surds and pi in exact calculations, without a calculator
SSM3d	Understanding the difference between formulae for perimeter, area and volume by considering dimensions

Objectives

By the end of the module the student should be able to:

- **count the vertices, faces and edges of 3-D shapes**
- **draw nets of solids and recognise solids from their nets**
- **draw and interpret plans and elevations**
- **draw planes of symmetry in 3-D shapes**
- **recognise and name examples of solids, including prisms, in the real world.**
- **find volumes of shapes by counting cubes**
- **use formulae to calculate the surface areas and volumes of cuboids, right-prisms and cylinders**
- **solve a range of problems involving surface area and volume, eg given the volume and length of a cylinder find the radius**
- **convert between units of volume.**
- **find the surface area and the volume of more complex shapes, eg find the volume of an equilateral triangular prism**
- **solve more complex problems, eg given the surface area of a sphere find the volume**
- **understand formulae for perimeters, areas and volumes by their dimensions, know that eg $4\pi r^2$ cannot represent the volume of a sphere.**

Prior knowledge

- Drawing and construction 1.
- Concept of volume.
- Ability to give answers to a degree of accuracy.
- Experience of changing the subject of a formula.

Differentiation and extension

- Make solids using equipment such as clixi or multi-link.
- Draw shapes made from multi-link on isometric paper.
- Build shapes from cubes that are represented in 2D.
- Work out how many small boxes can be packed into a larger box.
- Additional work using symbolic expressions.
- Find surface area and volume of a sphere or cone (using standard formulae).
- Convert between less familiar units eg cm^3 to mm^3, cm^3 to litres.
- Find the volume of a cylinder given its surface area, leaving the answer in terms of *l*.
- Find the volume of a right hexagonal cone of side *x* and height *h* (researching the method for finding the volume of any cone).

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	22: Three-dimensional shapes
Harper Collins	Higher	4: Shape
Heinemann (Harcourt)	Higher	3: Shapes
Hodder Murray	Higher	18: 2-D and 3-D shapes
Oxford University Press	Higher	S6: Perimeter, area and volume
	Higher Plus	

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, an additional work of a similar nature, or extension work detailed above.
- Sketch a plan view of your bedroom or an elevation of your house.
- Investigate the different nets that can be used to make certain 3-D shapes.
-

Notes

- Accurate drawing skills need to be reinforced.
- Some students find visualising 3-D objects difficult — simple models will assist.
- Answers in terms of pi may be required.
- Need to constantly revise the expressions for area/volume of shapes.

Module 15 **Chapter 8** **Time: 1–3 hours**

GCSE tier: **Higher**

Contents: **Algebra 2** **Brackets**

NA5b	Multiplying a single term over a bracket
NA5b	Taking out common factors
NA5b	Expanding the product of two linear expressions
NA5b	Factorising quadratic expressions

Objectives

By the end of the module the student should be able to:

- **expand or factorise algebraic expressions involving one pair of brackets**
- **expand and simplify expressions involving two pairs of brackets**
- **factorise quadratic expressions (including the difference of two squares).**

Prior knowledge

- Algebra 1.

Differentiation and extension

- Expand algebraic expressions involving three pairs of brackets.
- Further examples in factorising quadratic expression with non-unitary values of a (including fractional values).
- Simplification of algebraic fractions by first factorising and then cancelling common factors.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	8: Expanding brackets and factorising
Harper Collins	Higher	5: Algebra 1
Heinemann (Harcourt)	Higher	2: Essential algebra 14: Simplifying algebraic expressions
Hodder Murray	Higher	5: Working with algebra
Oxford University Press	Higher	A1: Expressions
	Higher Plus	A1: Expressions

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Emphasise correct use of symbolic notation (eg $3x^2$ rather than $3 \times x^2$).
- Present all work neatly, writing out the questions with the answers to aid revision at a later stage.

Module 16 **Chapter 30** **Time: 1–3 hours**

GCSE tier: **Higher**

Contents: **Quadratic Equations**

Objectives

By the end of the module the student should be able to:

- **Recognise a quadratic equation**
- **Solve quadratic equations by factorising**

Prior knowledge

- Factorising quadratic expressions
- Solving linear equations.

Differentiation and extension

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	
Harper Collins	Higher	
Heinemann (Harcourt)	Higher	
Hodder Murray	Higher	
Oxford University Press	Higher	
	Higher Plus	

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

Module 17 **Chapter 3** **Time: 3–4 hours**

GCSE tier: **Higher**

Contents: **Displaying data 2** **Time series and Scatter Graphs**

HD4a	Drawing and producing a time series
HD5b	Identifying seasonal trends in time series
HD5c	Looking at data to find patterns
HD4f	Calculating an appropriate moving average
HD5j	Interpreting social statistics
HD4a	Drawing and producing a scatter graph
HD5b	Interpreting a scatter graph
HD5h	Appreciating that correlation is a measure of the strength of association between two variables
DH5f	Appreciating that zero correlation does not necessarily imply 'no correlation' but merely 'no linear relationship'
HD5f	Distinguishing between positive, negative and zero correlation and using a line of best fit
HD4i	Drawing a line of best fit by eye, and understanding what these represent

Objectives

By the end of the module the student should be able to:

- **represent data as a time series**
- **identify trends in data over time**
- **calculate a moving average.**
- **draw and produce a scatter graph**
- **appreciate that correlation is a measure of the strength of association between two variables**
- **distinguish between positive, negative and zero correlation using a line of best fit**
- **appreciate that zero correlation does not necessarily imply 'no correlation' but merely 'no linear relationship'**
- **draw a line of best fit by eye and understand what it represents**
- **use a line of best fit to interpolate/extrapolate.**

Prior knowledge

- Ability to work out an average.
- Displaying data 1.
- Plotting coordinates.
- An understanding of the concept of a variable.
- Recognition that a change in one variable can affect another.

Differentiation and extension

- Make predictions by considering trends of line graphs for time series.
- Additional work on making predictions based on current trends, using time series and/or moving averages.
- Collect data from the internet (eg RPI) and analyse it for trend.
- Vary the axes required on a scatter graph to suit the ability of the class.
- Carry out a statistical investigation of their own including; designing an appropriate means of gathering the data, and an appropriate means of displaying the results.
- Use a spreadsheet, or other software, to produce scatter diagrams/lines of best fit. Investigate how the line of best fit is affected (visually) by the choice of scales on the axes.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	3: Scatter graphs
Harper Collins	Higher	11: Statistics 1
Heinemann (Harcourt)	Higher	10. Presenting and analysing data 1
Hodder Murray	Higher	32: Further probability and statistics
Oxford University Press	Higher	D4: Averages and box plots
	Higher Plus	D4: Representing data

Assessment issues

- Written testing to assess knowledge of content.
- Test a given hypothesis either using data provided or by collecting data from the class.
- Their own statistical investigation.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.
- Completion of simple statistical project.

Notes

- Students should realise that lines of best fit should have the same gradient as the correlation of the data.
- Clearly label all axes on graphs and use a ruler to draw straight lines.
- All working should be presented clearly, with descriptions of trends expressed as clearly as possible.

Module 18 **Chapter 18** **Time: 3-5 hours**

GCSE tier: **Higher**

Contents: **Formulae**

NA5g	Substituting numbers into formulae
NA5g	Using formulae from mathematics and other subjects that require prior simplification of brackets, including those that have negative signs occurring anywhere in the equation, and those with a negative solution
NA5g	Changing the subject of a formula including where the subject occurs twice, or where a power of the subject appears
NA5g	Generating a formula

Objectives

By the end of the module the student should be able to:

- **use letters or words to state the relationship between different quantities**
- **substitute positive and negative numbers into simple algebraic formulae**
- **substitute positive and negative numbers into algebraic formulae involving powers**
- **find the solution to a problem by writing an equation and solving it**
- **change the subject of a formula, eg convert the formula for converting Centigrade into Fahrenheit into a formula that converts Fahrenheit into Centigrade**
- **generate a formula from given information, eg find the formula for the perimeter of a rectangle given its area A and the length of one side.**

Prior knowledge

- Understanding of the mathematical meaning of the words expression, simplifying, formulae and equation.
- Experience of using letters to represent quantities.
- Substituting into simple expressions using words.
- Using brackets in numerical calculations and removing brackets in simple algebraic expressions.

Differentiation and extension

- Use negative numbers in formulae involving indices.
- Various investigations leading to generalisations.
- Further problems in generating formulae form given information.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	18: Formulae 5: Expressions and sequences
Harper Collins	Higher	5: Algebra 1
Heinemann (Harcourt)	Higher	2: Essential algebra 12: Sequences and formulae
Hodder Murray	Higher	5: Working with algebra 26: Advanced algebra
Oxford University Press	Higher	A5: Formulae
	Higher Plus	A5: Formulae and proof

Assessment issues

- Written testing to assess knowledge of content.
- Discussion of situations that lead to formulae.
- Spreadsheet tasks such as ‘guess my rule’.

Homework

- Uses of algebra to describe real situation eg n quadrilaterals have $4n$ sides.

Notes

- Emphasis on good use of notation $3ab$ means $3 \times a \times b$.
- Students need to be clear on the meanings of the words expression, equation, formula and identity.

Module 19 **Chapter 29** **Time: 5–7 hours**

GCSE tier: **Higher**

Contents: Circle Geometry

SSM2h	Understanding that the tangent at any point on a circle is perpendicular to the radius at that point
SSM2h	Understanding and using the fact that tangents from an external point are equal in length
SSM2h	Explaining why the perpendicular from the centre to a chord bisect the chord
SSM2h	Proving and using the fact that the angle subtended by an arc at the centre of a circle is twice the angle subtended at any point on the circumference
SSM2h	Proving and using the fact that the angle subtended at the circumference by a semicircle is a right angle
SSM2h	Proving and using the fact that angles in the same segments are equal
SSM2h	Proving and using the fact that opposite angles of a cyclic quadrilateral sum to 180 degrees
SSM2h	Proving and using the alternate segment theorem

Objectives

By the end of the module the student should be able to:

- **understand, prove and use circle theorems (see above)**
- **use circle theorems to find unknown angles and explain their method — quoting the appropriate theorem(s).**

Prior knowledge

- Recall the words centre, radius, diameter and circumference.
- Have practical experience of drawing circles with compasses.

Differentiation and extension

- Harder problems involving multi-stage calculations.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	29: Circle geometry
Harper Collins	Higher	7: Geometry
Heinemann (Harcourt)	Higher	26: Circle theorems
Hodder Murray	Higher	19: Circle theorems
Oxford University Press	Higher	S2: Angles and circles
	Higher Plus	S2: Circle Theorems

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Any proof required will be in relation to a diagram, not purely by reference to a named theorem.

Module 20 **Chapter 13** **Time: 5-7 hours**

GCSE tier: **Higher**

Contents: **Graphs 1** **Linear functions $y = mx + c$**

NA6b	Using the conventions for coordinates in the plane
NA6b	Plotting points in all four quadrants
NA6b	Recognising (when values are given for m and c) that equations of the form $y = mx + c$ correspond to straight-line graphs in the coordinate plane
NA6b	Plotting graphs of functions in which y is given explicitly in terms of x, or implicitly
NA6c	Finding the gradient of lines given by equations of the form $y = mx + c$ (when values are given for m and c)
NA6c	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
NA6c	Exploring the gradients of parallel lines and lines perpendicular to each other
NA6d	Constructing linear functions and plotting the corresponding graphs arising from real-life problems
NA6d	Discussing and interpreting graphs modelling real situations

Objectives

By the end of the module the student should be able to:

- **substitute values of x into linear functions to find corresponding values of y**
- **plot points for linear functions on a coordinate grid and draw the corresponding straight lines**
- **interpret m and c as gradient and y-intercept in linear functions**
- **understand that the graphs of linear functions are parallel if they have the same value of m**
- **know that the line perpendicular to $y = mx + c$ has gradient $-1/m$**
- **understand linear functions in practical problems, eg distance-time graphs.**

Prior knowledge

Being able to:

- substitute positive and negative numbers into algebraic expressions
- plot coordinates in the first quadrant
- rearrange to change the subject of a formula.

Differentiation and extension

- Find the equation of the line through two given point.
- Find the equation of the perpendicular bisector of the line segment joining two given points.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	13: Graphs 1
Harper Collins	Higher	16: Linear graphs and equations
Heinemann (Harcourt)	Higher	9: Functions, lines, simultaneous equations and regions 28: Introducing modelling
Oxford University Press	Higher	A4: Straight line graphs
	Higher Plus	A4: Linear graphs

Assessment issues

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- The values of m and c will be given.
- Careful annotation should be encouraged. Label the coordinate axes and write the equation of the line.

Module 21 **Chapters 30 and 23** **Time: 5 hours**

GCSE tier: **Higher**

Contents: **Quadratic functions**

NA6e	Generating points and plotting graphs of quadratic functions
NA6e	Finding approximate solutions of a quadratic equation from the graph of the corresponding quadratic function
NA5b	Factorising quadratic expressions
NA5k	Solving simple quadratic equations by factorising, completing the square and using the quadratic formula

Objectives

By the end of the module the student should be able to:

- **plot the graphs of quadratic functions for positive and negative values of x**
- **find graphically the solutions of quadratic equations by considering the intercept on the x-axis**
- **solve quadratic equations by factorising (including values of a not equal to 1)**
- **use the quadratic formula to solve quadratic equations giving the answers to 1 dp**
- **use the quadratic formula to solve quadratic equations leaving the answer in surd form**
- **complete the square of a quadratic function (using this to write down the max/min of the function).**

Prior knowledge

- Graphs 1.
- Algebra 2.

Differentiation and extension

- Solve equations involving algebraic fractions which lead to quadratic equations.
- Solve quadratic equations by completing the square.
- Derive the quadratic equation by completing the square.
- Use graphical calculators where appropriate to enable students to get through examples more rapidly.

Resources

Publisher	Textbook	Chapter	Section
Edexcel	Higher	30: Quadratic Equations 23: Graphs 2	23.1–23.3
Harper Collins	Higher	12: Algebra 2	
Heinemann (Harcourt)	Higher	17: Graphs and equations 19: Quadratic equations	17.1, 17.5 19.1–19.6
Hodder Murray	Higher	25: Quadratic equations 26: Advanced algebra 28: Graphs of curves	25.1–25.4 26.1 28.1, 28.2
Oxford University Press	Higher	A6: Simultaneous and quadratic equations	A6.1–6.2
	Higher Plus	A1: Expressions A3: Sequences and graphs A6: Simultaneous and quadratic equations	A1.3–1.5 A3.4–3.5 A6.1

Assessment issues

- Written testing to assess knowledge of content.

Homework

Notes

- There may be a need to remove the HCF (numerical) of a trinomial before factorising to make the factorisation more obvious.
- Some students may need additional help with factorising.
- Students should be reminded that factorisation should be tried before the formula is used.
- In problem-solving, one of the solutions to a quadratic may not be appropriate.

Module 22 **Chapter 17** **Time: 1–3 hours**

GCSE tier: **Higher**

Contents: **Statistical measures 1** **The mean (large data sets)**

HD4e Finding the mean for large data sets

HD4e Finding the mean for large data sets with grouped data

Objectives

By the end of the module the student should be able to:

- **find the mean of data given in an ungrouped frequency distribution**
- **use the mid interval value to find an estimate for the mean of data given in a grouped frequency distribution**
- **understand and use the sigma notation for the mean of ungrouped, and grouped, data.**

Prior knowledge

- Knowledge of finding the mean for small data sets.
- Ability to find the mid point of two numbers.

Differentiation and extension

- Use statistical functions on calculators and spreadsheets.
- Use statistical software to calculate the mean for grouped data sets.
- Estimate the mean for data sets with ill defined class boundaries.
- Investigate the affect of combining class intervals on estimating the mean for grouped data sets.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	17: Averages and spread
Harper Collins	Higher	18: Statistics 2
Heinemann (Harcourt)	Higher	10: Presenting and analysing data 1
Hodder Murray	Higher	21: Working with data
Oxford University Press	Higher	D4: Averages and box plots
	Higher Plus	D1: Sampling methods

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.
- Completing of data handling coursework.

Notes

- Students should understand that finding an *estimate for the mean* of grouped data is not a guess.
- Some students may find the sigma notation difficult to understand at first.
- The connection between sigma *f* and *n* should be established clearly.

Module 23 **Chapter 19** **Time: 7–9 hours**

GCSE tier: **Higher**

Contents: **Trigonometry and Pythagoras' Theorem 1** **Sine, cosine and tangent**

SSM2g Understanding similarity of triangles and of other plane figures, and using this to make geometrical inferences

SSM2g Understanding, recalling and using trigonometrical relationships in right-angled triangles, and using these to solve problems, including those involving bearings

Objectives

By the end of the module the student should be able to:

- **use trigonometric ratios (sin, cos and tan) to calculate angles in right-angled triangles**
- **use the trigonometric ratios to calculate unknown lengths in right-angled triangles.**

Prior knowledge

- Some understanding of similar triangles.
- Able to use a calculator to divide numbers.
- Mensuration — Perimeter and area 1.
- Formulae.

Differentiation and extension

- Use these ratios to solve problems in 3-D.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	19: Pythagoras' theorem and trigonometry
Harper Collins	Higher	6: Pythagoras and trigonometry
Heinemann (Harcourt)	Higher	16: Basic trigonometry
Hodder Murray	Higher	17: Introducing trigonometry
Oxford University Press	Higher	S8: Pythagoras and trigonometry
	Higher Plus	S4: Pythagoras and trigonometry

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Students should be encouraged to become familiar with one make of calculator.
- Calculators should be set to 'deg' mode.
- For some students this work is found difficult simply because they cannot identify which sides to use or which ratio can be used.
- Emphasise that scale drawings will score 0 marks for this type of question.
- A useful mnemonic for remember trig ratios is 'Silly Old Harry, Caught A Herring, Trawling Off Africa'; but students often enjoy making up their own.
- Calculated angles should be given to at least 1 decimal place.

Module 24 **Chapter 33** **Time: 3 -5 hours**

GCSE tier: **Higher**

Contents: Similar shapes

SSM2g	Understanding similarity of triangles and of other plane figures and use this to make geometric inferences
SSM3d	Recognising that enlargements preserve angle but not length
SSM3d	Identifying the scale factor of an enlargement as a ratio of the lengths of any two corresponding line segments
SSM3d	Understanding the implications of enlargement for perimeter
SSM3d	Understanding and using the effect of enlargement on areas and volumes of shapes and solids
SSM2e	Understanding and using SSS, SAS, ASA and RHS conditions to prove the congruence of triangles using formal arguments, and to verify standard ruler and compass constructions

Objectives

By the end of the module the student should be able to:

- **use integer and non-integer scale factors to find the length of a missing side in each of two similar shapes, given the lengths of a pair of corresponding sides**
- **know the relationship between linear, area and volume scale factors of similar shapes**
- **prove formally geometric properties of triangles, eg that the base angles of an isosceles triangle are equal**
- **prove formally that two triangles are congruent.**

Prior knowledge

- Use ruler and compasses to construct triangles with given dimensions.
- Some concept of enlargement (magnification).

Differentiation and extension

- Find algebraic formulae for the areas and volumes of similar shapes.
- Harder problems in congruence.
- Relate this unit to circle theorems.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	33: Similar shapes 27: Constructions, loci and congruence
Harper Collins	Higher	8: Transformation geometry
Heinemann (Harcourt)	Higher	3: Shapes 22:Advanced mensuration
Hodder Murray	Higher	15: Transformation similarity 30: Mathematical proofs
Oxford University Press	Higher	S7: Enlargement and similarity
	Higher Plus	S3: Congruence and similarity

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Students will need to be reminded of this work on a regular basis.

Module 25 **Chapter 20** **Time: 1–3 hours**

GCSE tier: **Higher**

Contents: **Fractions 3** **Ratio and scale**

NA2f	Using ratio notation, including reduction to its simplest form and it various links to fractions notation
NA3f	Dividing a quantity in a given ratio
NA3n	Solving word problems about ratio, including using informal strategies and the unitary method of solution
SSM3d	Using and interpreting maps and scale drawings

Objectives

By the end of the module the student should be able to:

- **appreciate that eg the ratio 1:2 represents 1/3 and 2/3 of a quantity**
- **divide quantities in a given ratio, eg divide £20 in the ratio 2:3**
- **solve word problems involving ratios, eg Find the cost of 8 pencils given that 6 cost 78p**
- **work out the real distance from a map, eg Find the real distance represented by 4 cm on a map with scale 1:25 000**
- **work out the distance on a map for a given real distance and scale.**

Prior knowledge

- Fractions 1.

Differentiation and extension

- Currency calculations using currency exchange rates.
- Harder problems involving multi-stage calculations.
- Relate ratios to real-life situations, eg Investigate the proportions of the different metals in alloys.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	20: Ratio and proportion
Harper Collins	Higher	3: Ratios and proportion
Heinemann (Harcourt)	Higher	7: Transformation and loci 8: Using basic number skills
Hodder Murray	Higher	3: Ratios and percentages
Oxford University Press	Higher	N8: Ratio and proportion
	Higher Plus	N4: Proportion

Assessment issues

- Written testing to assess knowledge of content.
- Mental testing in terms of in proportion questions, what happens to *y* when *x* is doubled, trebled etc.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Candidates often find three-part ratios difficult.

Module 26 **Chapter 34** **Time: 5 hours**

GCSE tier: **Higher**

Contents: **Direct and inverse proportion**

NA5h	Setting up and using equations to solve word and other problems involving direct proportion or inverse proportion and relating algebraic solutions to graphical representations of the equations
NA3l	Calculating an unknown quantity from quantities that vary in direct or inverse proportion

Objectives

By the end of the module the student should be able to:

- **interpret direct and inverse proportions as algebraic functions, eg $y \propto x^2$ as $y = kx^2$**
- **use given information to find the value of the constant of proportionality**
- **use algebraic functions for direct and inverse proportionality, with their value of k, to find unknown values**
- **recognise and sketch the graphs for direct and inverse proportions ($y \propto x$, $y \propto x^2$, $y \propto x^3$, $y \propto 1/x$, Prior knowledge**

Able to:

- substitute numbers into algebraic formulae
- rearrange the subject of a formula.
- $y \propto 1/x^2$).

Differentiation and extension

- Problems involving other types of proportionality (eg surface area to volume of a sphere).

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	34: Direct and Inverse Proportion
Harper Collins	Higher	3: Ratios and proportion
Heinemann (Harcourt)	Higher	18: Proportion
Hodder Murray	Higher	24: Direct and inverse proportion
Oxford University Press	Higher	N4: Proportionality
	Higher Plus	N4: Proportion

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Students should be encouraged to show all steps in their working.
- Students often forget the ‘square’ in inverse square proportionality.

Module 27	**Chapter 26**	**Time: 5-7 hours**
GCSE tier:	**Higher**	
Contents:	**Numbers 3**	**Indices, Standard Form and Surds**

NA2b	Using index notation and index laws for multiplication and division of integer powers
NA3a	Using index laws to simplify and calculate the value of numerical expressions involving multiplication and division of integers, fractional and negative powers
NA3a	Using inverse operations involving $1/n$
NA3g	Recalling the fact that $n^0 = 1$ and $n^{-1} = 1/n$ for positive integers n, the corresponding rule for negative integers, $n^{1/2}$ = square root n and $n^{1/3}$ = cube root n for any positive number n
NA3n	Rationalising a denominator
NA2b	Using standard index form, expressed in standard notation and on a calculator display
NA3m	Calculating with standard index form
NA3i	Converting between ordinary and standard index form representations
NA3i	Converting to standard index form to make sensible estimates for calculations involving multiplication and/or division
NA3r	Using standard index form display and know how to enter numbers in standard index form

Objectives

By the end of the module the student should be able to:

- **use index rules to simplify and calculate numerical expressions involving powers, eg $(2^3 \times 2^5) \div 2^4$, 4^0, $8^{-2/3}$**
- **know that eg $x^3 = 64 \Rightarrow x = 8^{1/3}$**
- **rationalise the denominator of fractions, eg $1/\sqrt{3} = \sqrt{3}/3$, and eg write $(\sqrt{18} + 10) \div \sqrt{2}$ in the form $p + q\sqrt{2}$.**
- **understand the standard form convention**
- **convert numbers to, and from, standard form**
- **calculate with numbers given in standard form with, and without, a calculator**
- **round numbers given in standard form to a given number of significant figures.**

Prior knowledge

- Knowledge of squares, square roots, cubes and cube roots.
- Fractions 1.
- Algebra 1.
- Rounding decimals to a given number of decimal places or significant figure.
- Multiplying decimal numbers with, and without, a calculator.
- Some experience with powers of 10, eg know that $10^2 = 100$, $10^3 = 1000$, $10^{-1} = 0.1$

Differentiation and extension

- Use index rules to simplify algebraic expressions.
- Treat index rules formulae (state which rule is being at each stage in a calculation).
- Harder problems in rationalising denominators (including algebra).
- Use standard index form in real-life situations, eg Stella distances, sizes of populations, atomic distances.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	26: Indices, standard form and surds
Harper Collins	Higher	10: Powers, standard form and surds
Heinemann (Harcourt)	Higher	14: Simplifying algebraic expression 23: Exploring numbers 2
Hodder Murray	Higher	4: Powers, roots and reciprocals 26: Advanced algebra
Oxford University Press	Higher	N5: Integers, powers and roots
	Higher Plus	N5: index laws

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Encourage students to rationalise fractions wherever possible.
- This work can be enriched by using examples drawn from the sciences.

Module 28 **Chapter 15** **Time: 3–5 hours**

GCSE tier: **Higher**

Contents: **Inequalities**

NA5j Solving linear equations in one variable, and representing the solution set on a number line

NA5j Solving several linear inequalities in two variables and finding the solution set

Objectives

By the end of the module the student should be able to:

- **rearrange and solve linear inequalities in one variable and show the solution set on a number line, or to write down all the integer solutions**
- **draw the graphs of linear inequalities in two variables and interpret the solution sets given by regions in the coordinate plane, or to identify all the integer coordinates with crosses.**

Prior knowledge

- Ability to solve simple linear equations.
- Some experience with inequality notation.
- *Linear functions 1.*

Differentiation and extension

- Find graphical solutions to problems involving linear and quadratic functions.
- Find graphical solution to problems involving lines and circles, parabolas and circles.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	15: Inequalities 13: Graphs 1 23: Graphs 2
Harper Collins	Higher	24: Inequalities and regions
Heinemann (Harcourt)	Higher	6: Solving equations and inequalities 9: Functions, lines, simultaneous equations and regions
Hodder Murray	Higher	9: Inequalities
Oxford University Press	Higher	A2: Equations and inequalities
	Higher Plus	A4: Linear graphs A6: Simultaneous and quadratic equations

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Students should use the correct notation when giving graphical solutions to inequalities, eg a filled in circle to show inclusion of a point, an empty circle to show exclusion of a point.

Module 29 **Chapter 28** **Time: 3–5 hours**

GCSE tier: **Higher**

Contents: **Further Quadratic Equations**

Objectives

By the end of the module the student should be able to:

-

Prior knowledge

Differentiation and extension

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	28: Further Quadratic Equations
Harper Collins	Higher	
Heinemann (Harcourt)	Higher	
Hodder Murray	Higher	
Oxford University Press	Higher	
	Higher Plus	

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, an additional work of a similar nature, or extension work detailed above.

Notes

Module 30 **Chapter 6** **Time: 3–4 hours**

GCSE tier: **Higher**

Contents: Compound measures Speed and density

SSM4a Converting measurements from one unit to another

SSM4a Understanding and using compound measures, speed and density

Objectives

By the end of the module the student should be able to:

- **use the relationship between distance, speed and time to solve problems**
- **convert between metric units of speed eg km/h to m/s**
- **know that density is found by mass ÷ volume**
- **use the relationship between density, mass and volume to solve problems, eg find the mass of an object with a given volume and density**
- **convert between metric units of density eg kg/m to g/cm.**

Prior knowledge

- Knowledge of metric units, eg 1m = 100 cm, etc.
- Know that 1 hour = 60mins, 1min = 60 seconds.
- Experience of multiply by powers of 10, eg 100 × 100 = 10 000

Differentiation and extension

- Perform calculations on a calculator by using standard form.
- Convert imperial units to metric units, eg mph into km/h.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	6: Measures
Harper Collins	Higher	3: Ratios and proportion
Heinemann (Harcourt)	Higher	8: Using basic number skills
Hodder Murray	Higher	11: Travel and other graphs
Oxford University Press	Higher	A8: Using graphs
	Higher Plus	

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, an additional work of a similar nature, or extension work detailed above.

Notes

- Use a distance, speed and time (or mass, density and volume) triangle to help students see the relationship between the variables.
- Help students to recognise the problem they are trying to solve by the unit measurement given eg km/h is a unit of speed as it is a distance divided by a time.

Module 31 **Chapter 24** **Time: 7–9 hours**

GCSE tier: **Higher**

Contents: **Probability**

HD4c	Listing all outcomes for single events, and for successive events, in a systematic way
HD4d	Identifying different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1
HD4g	Knowing when to add or multiply two probabilities
HD4h	Using tree diagrams to represent outcomes of compound events, recognising when events are independent
HD5h	Comparing experimental data and theoretical probabilities
HD4i	Understanding that if they repeat an experiment they may — and usually will — get different outcomes, and that increasing sample size generally leads to better estimates of probability and population parameters

Objectives

By the end of the module the student should be able to:

- **list all the outcomes from mutually exclusive events, eg from two coins, and sample space diagrams**
- **write down the probability associated with equally likely events, eg the probability of drawing an ace from a pack of cards**
- **know that if the probability of an event occurring is p than the probability of it not occurring is $1 - p$**
- **find the missing probability from a list or table**
- **know that the probability of A or B is P(A) + P(B)**
- **know that the probability of A and B is P(A) × P(B)**
- **draw and use tree diagrams to solve probability problems (including examples of non-replacement)**
- **find estimates of probabilities by considering relative frequency in experimental results (including two-way tables)**
- **know that the more an experiment is repeated the better the estimate of probability.**

Prior knowledge

- Understand that a probability is a number between 0 and 1
- Know how to add, and multiplying fractions and decimals.
- Experience of expressing one number as a fraction of another number.
- Recognise the language of statistics, eg words such as likely, certain, impossible, etc.

Differentiation and extension

- Binomial probabilities.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	24: Probability
Harper Collins	Higher	19: Probability
Heinemann (Harcourt)	Higher	24: Probability 29: Conditional probability
Oxford University Press	Higher	D6: Independent events
	Higher Plus	D3: Probability D6: Independent events

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Students should express probabilities as fractions, percentages or decimals.
- Fractions needed not be cancelled to their lowest terms.

Module 32 **Chapter 25** **Time: 1–3 hours**

GCSE tier: **Higher**

Contents: **Trial and improvement and Further Graphs**

NA5m Using systematic trial and improvement to find approximate solutions of equations where there is no simple analytical method of solving them

NA6f Plotting graphs of simple cubic functions, the reciprocal function $y = \frac{1}{x}$ with $x \neq 0$, the exponential function $y = k^x$ for integer values of x and simple positive values of k, the circular functions $y = \sin x$ and $y = \cos x$, using a spreadsheet or graph plotter as well as pencil and paper

NA6f Recognising the characteristic shapes of all these functions

Objectives

- **Solve cubic functions by successive substitution of values of *x*.**
- **plot and recognise cubic, reciprocal, exponential and circular functions (see above)**
- **use the graphs of these functions to find approximate solutions to equations, eg given *x* find *y* (and visa versa)**
- **find the values of p and q in the function $y = pq^x$ given the graph of $y = pq^x$**
- **match equations with their graphs**
- **sketch graphs of given functions.**

Prior knowledge

- Substituting numbers into algebraic expressions.
- Dealing with decimals on a calculator.
- Ordering decimals.
- Linear functions 1.
- Quadratic functions.

Differentiation and extension

- Solve functions of the form $\frac{1}{x} = x^2 - 5$
- Explore the function $y = e^x$ (perhaps relate this to $y = \ln x$).
- Explore the function $y = \tan x$.
- Find solutions to equations of the circular functions $y = \sin x$ and $y = \cos x$ over more than one cycle (and generalise).

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	25: Further graphs and trial and improvement
Harper Collins	Higher	17: More graphs and equations
Heinemann (Harcourt)	Higher	16: Basic trigonometry 17: Graphs and equations 28: Introducing modelling
Hodder Murray	Higher	28: Graphs of curves
Oxford University Press	Higher	
	Higher Plus	A8: Graphical solutions

Assessment issues.

- Test for recognition of function shapes, and the associated name.

Homework

Notes

- Students should be encouraged to use their calculators efficiently — by using the 'replay' function.
- The cube function on a calculator may not be the same for different makes.
- Students should write down all the digits on their calculator display.
- This work should be enhanced by drawing graphs on graphical calculators and appropriate software.

Module 33 **Chapter 14** **Time: 5–7 hours**

GCSE tier: **Higher**

Contents: **Transformations 1**

SSM2b	Transforming triangles and other 2-D shapes by translation, rotation and reflection and combinations of these transformations
SSM3a	Understanding that translations are specified by a distance and direction (or a vector), and enlarging by a centre and a scale factor
SSM3a	Rotating a shape about the origin, or any other point
SSM3a	Measuring the angle of rotation using right angles, simple fractions of a turn or degrees
SSM3a	Understanding that rotations are specified by a centre and an (anticlockwise) angle
SSM3a	Understanding that reflections are specified by a mirror line, at first using a line parallel to any axis, then a mirror line such as $y = x$ or $y = -x$
SSM5c	Recognising, visualising and constructing enlargements of objects using positive and negative scale factors greater and less than one
SSM3b	Using congruence to show that translations, rotations and reflections preserve length and angle, so that any figure is congruent to its image under any of these transformations

Objectives

By the end of the module the student should be able to:

- **understand translation as a combination of a horizontal and vertical shift including signs for directions**
- **understand rotation as a (clockwise) turn about a given origin**
- **reflect shapes in a given mirror line; parallel to the coordinate axes and then $y = x$ or $y = -x$**
- **enlarge shapes by a given scale factor from a given point; using positive and negative scale factors greater and less than one**
- **understand that shapes produced by translation, rotation and reflection are congruent to its image.**

Prior knowledge

- Recognition of basic shapes.
- An understanding of the concept of rotation, reflection and enlargement.
- Coordinates in four quadrants.
- Linear equations parallel to the coordinate axes.

Differentiation and extension

- The tasks set can be extended to include combinations of transformations.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	14: Transformations
Harper Collins	Higher	8: Transformation geometry
Heinemann (Harcourt)	Higher	7: Transformations and loci
Hodder Murray	Higher	15: Transformation and similarity
Oxford University Press	Higher	S3: Transformations and congruence
	Higher Plus	S3: Congruence and similarity

Assessment issues

- Written testing to assess knowledge of content.
- Practical poster work.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Emphasis needs to be placed on ensuring that students do describe the given transformation fully.
- The use of tracing paper is allowed in the examination (although students should not have to rely on the use of tracing paper to solve problems).

Module 34 **Chapter 31** **Time: 3–5 hours**

GCSE tier: **Higher**

Contents: **Trigonometry and Pythagoras' Theorem 2** **Non right-angled triangles and applications in 3D**

SSM2g	Using the sine and cosine rules to solve 2-D problems
SSM2g	Calculating the area of a triangle using ½ *ab* sin *C*
SSM2f	Investigating the geometry of cuboids including cubes, and shapes made from cuboids, including the use of Pythagoras' theorem to calculate lengths in three dimensions
SSM2g	Finding the angles between a line and a plane
SSM2g	Use the sine and cosine rules to solve 3-D problems

Prior knowledge

- Trigonometry 1.
- Formulae.

Objectives

By the end of the module the student should be able to:

- **find the unknown lengths, or angles, in non right-angle triangles using the sine and cosine rules**
- **find the area of triangles given two lengths and an included angle.**
- **calculate the length of a diagonal of a rectangle given the lengths of the sides of the rectangle**
- **calculate the diagonal through a cuboid, or across the face of a cuboid**
- **find the angle between the diagonal through a cuboid and the base of the cuboid**
- **find the angle between a sloping edge of a pyramid and the base of the pyramid**
- **identify when to use the sine or cosine rule and adapt the relevant formula to the given triangle.**

Differentiation and extension

- Use these ratios to solve problems in 3-D.
- Harder problems involving multi-stage calculations.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	31: Pythagoras' theorem and trigonometry 2
Harper Collins	Higher	15: Trigonometry
Heinemann (Harcourt)	Higher	21: Advanced trigonometry
Hodder Murray	Higher	27: Further trigonometry
Oxford University Press	Higher	S8: Pythagoras and trigonometry
	Higher Plus	S5: Sine and cosine rule S6: 3-D problems

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Students find the cosine rule more difficult for obtuse angles.
- Reminders of simple geometrical facts may be helpful, eg angle sum of a triangle, the shortest side is opposite the smallest angle.
- The angle between two planes or two skew lines is not required.

Module 35 **Chapter 32** **Time: 5–7 hours**

GCSE tier: **Higher**

Contents: **Loci, Further simultaneous linear and quadratic equations**

NA6e	Finding the intersection points of the graphs of linear and quadratic functions, knowing that these are the approximate solutions of the corresponding simultaneous equation representing the linear and quadratic functions
NA6h	Constructing the graph of $x^2 + y^2 = r^2$ for a circle of radius r centred at the origin of coordinates
NA6l	Finding graphically the intersection points of a given straight line with this circle and knowing that this corresponds to solving the two simultaneous equations representing the line and the circle
NA5l	Solving exactly, by elimination of an unknown, two simultaneous equations in two unknowns, one of which is linear in each unknown, and the other is linear in one unknown and quadratic in the other, of where the second is of the form $x^2 + y^2 = r^2$

Objectives

By the end of the module the student should be able to:

- **find graphically the approximate solutions of linear and quadratic simultaneous equations**
- **find the exact solutions of linear and quadratic simultaneous equations**
- **draw a circle of radius r centred at the origin**
- **find graphically the approximate solutions of linear and circular simultaneous equations**
- **find the exact solutions of linear and circular simultaneous equations.**

Prior knowledge

- Linear functions 2.
- Quadratic functions.

Differentiation and extension

- Find graphically the approximate solutions of quadratic and circular simultaneous equations.
- Find the exact solutions of quadratic and circular simultaneous equations.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	32: Simultaneous linear and quadratic equations and loci
Harper Collins	Higher	20: Algebra 3
Heinemann (Harcourt)	Higher	15: Pythagoras' theorem 19: Quadratic equations
Hodder Murray	Higher	26: Advanced algebra 31: Introducing coordinate geometry
Oxford University Press	Higher	A7: Graphical solutions A8: Using graphs
	Higher Plus	A6: Simultaneous and quadratic equations

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Clear presentation of workings is essential.

Module 36 **Chapter 35** **Time: 5 -7 hours**

GCSE tier: **Higher**

Contents: **Vectors**

SSM3f	Understanding and using vector notation
SSM3f	Calculating, and representing graphically the sum of two vectors, the difference of two vectors and a scalar multiple of a vector
SSM3f	Calculating the resultant of two vectors
SSM3f	Understanding and using the commutative and associative properties of vector addition
SSM3f	Solving simple geometrical problems in 2-D using vector methods

Objectives

By the end of the module the student should be able to:

- **understand that 2a is parallel to a and twice its length**
- **understand that a is parallel to –a and in the opposite direction**
- **use and interpret vectors as displacements in the plane (with an associated direction)**
- **use standard vector notation to combine vectors by addition, eg AB + BC = AC and a + b = c**
- **represent vectors, and combinations of vectors, in the plane**
- **solve geometrical problems in 2-D, eg show that joining the mid-points of the sides of any quadrilateral forms a parallelogram.**

Prior knowledge

- Vectors to describe translations.
- Algebra 1.

Differentiation and extension

- Harder geometric proof, eg Show that the medians of a triangle intersect at a single point.
- Vector problems in 3-D (for the most able).
- Use **i** and **j** (and **k**) notation.

Resources

Publisher	Textbook	Chapter
Edexcel	Higher	35: Vectors
Harper Collins	Higher	25: Vectors
Heinemann (Harcourt)	Higher	27: Vectors
Hodder Murray	Higher	29: Vectors
Oxford University Press	Higher	
	Higher Plus	S7: Vector geometry

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Students often find the pictorial representation of vectors more difficult than the manipulation of column vectors.

Module 37 **Chapter 36** **Time: 5–7 hours**

GCSE tier: **Higher**

Contents: **Transformations 2** Transformations of functions

NA6g applying to the graph of $y = f(x)$ the transformations $y = f(x) + a$, $y = f(ax)$, $y=f(x+ a)$, $y = af(x)$ for linear, quadratic, sine and cosine functions $f(x)$

SMM2g Drawing, sketching and describing the graphs of trigonometric functions for angles of any size, including transformations involving scalings in either or both the x and y directions

Objectives

By the end of the module the student should be able to:

- **represent translations in the x and y direction, reflections in the x-axis and the y-axis, and stretches parallel to the x-axis and the y-axis**
- **sketch the graph of $y = 3 \sin 2x$, given the graph of $y=\sin x$**
- **sketch the graph of $y = f(x + 2)$, $y = f(x) + 2$, $y=2f(x)$, $y = f(2x)$ given the shape of the graph $y = f(x)$**
- **find the coordinates of the minimum of $y = f(x + 3)$, $y = f(x) + 3$ given the coordinates of the minimum of $y=x^2 – 2x$.**

Prior knowledge

- Transformations 1.

Differentiation and extension

Complete the square of quadratic functions and relate this to transformations of the curve $y = x^2$.

- Use a graphical calculator/software to investigate transformations.
- Investigate curves which are unaffected by particular transformations.
- Investigations of the simple relationships such as $\sin(180 – x)=\sin x$, and $\sin(90 – x)=\cos x$.

Resources

Publisher	Textbook	Chapter	Section
Edexcel	Higher	36: Transformations and functions	36.1–31.6
Harper Collins	Higher	26: Transformation of graphs	
Heinemann (Harcourt)	Higher	25: Transformation of graphs	25.1–25.8
Hodder Murray	Higher	28: Graphs of curves	28.4
Oxford University Press	Higher		
	Higher Plus	A10: Transforming graphs S8: Trigonometric graphs	A10.1–10.5 S8.1–8.5

Assessment issues

- Written testing to assess knowledge of content (this should include recognition of trigonometric curves).

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Graphical calculators and/or graph drawing software will help to underpin the main ideas in this unit.