GCSE

Mathematics A (1MA0)

Scheme of work

Edexcel GCSE in Mathematics A (1MA0)

For first teaching from September 2010

Issue 2 September 2010

GCSE Mathematics A (1MA0)

Higher
Tier

Linear
Scheme of Work

Higher course overview

The table below shows an overview of modules in the Higher tier scheme of work.

Teachers should be aware that the estimated teaching hours are approximate and should be used as a guideline only.

Module number	Title	Estimated teaching hours
1	Integers and decimals	5
2	Coordinates	3
3	Fractions	5
4	Algebra	7
5	Shape and angles	6
6	Collecting data	4
7	Displaying data	7
8	Construction and loci	5
9	Types of number	7
10	Patterns and sequences	4
11	2-D and 3-D shapes	4
12	Perimeter and area	7
13	Fractions, decimals and percentages	8
14	Formulae and linear equations	7
15	Linear graphs	5
16	Simultaneous equations	4
17	Probability	7
18	Ratio and scale	7
19	Averages and range	8
20	Pythagoras and trigonometry	8
21	Trial and Improvement	4
22	Surface area and volume	7
23	Compound measures	7
24	Transformations	6
25	Similarity and Congruence	5
26	Quadratic functions, equations and graphs	7
27	Index notation and surds	6
28	Circle theorems	4
29	Sine and cosine rules	5
30	Vectors	5
31	Further graphs and functions	5
32	Transformations of functions	4
	Total	**183 HOURS**

Module **1** **Time: 4 – 6 hours**

GCSE Tier: **Higher**

Contents: **Integers and decimals**

N a	Add, subtract, multiply and divide whole numbers, integers and decimals
N b	Order integers and decimals
N j	Use decimal notation
N q	Understand and use number operations and the relationships between them, including inverse operations and hierarchy of operations
N u	Round to specified or appropriate degrees of accuracy including a given power of ten, number of decimal places and significant figures

PRIOR KNOWLEDGE:

The ability to order numbers
Appreciation of place value
Experience of the four 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
The concept of a decimal

OBJECTIVES

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

- Understand and order integers and decimals **(assumed, 4.1)**
- Use brackets and the hierarchy of operations (BIDMAS) **(1.3)**
- Understand and use positive numbers and negative integers, both as positions and translations on a number line **(assumed)**
- Add, subtract, multiply and divide integers, negative numbers and decimals **(assumed, 4.2)**
- Round whole numbers to the nearest, 10, 100, 1000, … **(assumed)**
- Round decimals to appropriate numbers of decimal places or significant figures **(4.3, 4.4)**
- Multiply and divide by any number between 0 and 1 **(4.2)**
- Check their calculations by rounding, eg $29 \times 31 \approx 30 \times 30$ **(4.5, 4.6)**
- Check answers to a division sum using multiplication, eg use inverse operations **(assumed)**
- Multiply and divide whole numbers by a given multiple of 10 **(assumed)**
- Put digits in the correct place in a decimal number **(assumed)**
- Multiply and divide decimal numbers by whole numbers and decimal numbers (up to 2 d.p.), eg $266.22 \div 0.34$ **(4.2)**
- Know that, eg $13.5 \div 0.5 = 135 \div 5$ **(4.7)**

DIFFERENTIATION & EXTENSION

Teachers may just want to check that students have the appropriate skills by investigative means, eg Give students five digits say 2, 5, 7, 8 and 1. They then need to find

1) the largest even number
2) the smallest number in the 5 times table
3) the largest answer $\square\square\square + \square\square$
4) the smallest answer to $\square\square\square - \square\square$

Practice long multiplication and division without using a calculator
Estimate answers to calculations involving the four rules
Work with 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
Use decimals in real-life problems
Introduce standard form for very large and small numbers
Money calculations that require rounding answers to the nearest penny
Multiply and divide decimals by decimals (more than 2 d.p.)

NOTES

The expectation for most students doing Higher tier is that some of this material can be delivered or reinforced during other topics. For example, rounding with significant figures could be done with trigonometry
Present all working clearly with decimal points in line; emphasise 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
Extend to multiplication of decimals and/or long division of integers
Try different methods from the traditional ones, eg Russian or Chinese methods for multiplication etc
Give lots of Functional Elements examples

Module **2** **Time: 2 – 4 hours**

GCSE Tier: **Higher**

Contents: **Coordinates**

A k Use the conventions for coordinates in the plane and plot points in all four quadrants, including using geometric information

PRIOR KNOWLEDGE:

Directed numbers

OBJECTIVES

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

- Use axes and coordinates to specify points in all four quadrants in 2-D and 3-D **(15.1, 23.10)**
- Identify points with given coordinates **(15.1)**
- Identify coordinates of given points (NB: Points may be in the first quadrant or all four quadrants) **(15.1)**
- Find the coordinates of points identified by geometrical information in 2-D and 3-D **(15.1, 23.10)**
- Find the coordinates of the midpoint of a line segment, *AB*, given the coordinates of *A* and *B* **(15.2)**

DIFFERENTIATION & EXTENSION

There are some excellent interactive 3-D resources which aid student understanding

NOTES

This topic can be delivered simultaneously with the properties of simple 2-D and 3-D shapes

Module **3** **Time: 4 – 6 hours**

GCSE Tier: **Higher**

Contents: **Fractions**

N h	Understand equivalent fractions
N h	Simplify a fraction by cancelling all common factors
N i, a	Add, subtract, multiply and divide fractions
N b	Order rational numbers
N a	Multiply and divide fractions
N v	Use a calculator effectively and efficiently
N o	Use fractions as operators

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

OBJECTIVES

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

- Find equivalent fractions **(3.1, 4.1)**
- Compare the sizes of fractions **(assumed)**
- Write a fraction in its simplest form **(assumed)**
- Find fractions of an amount **(3.2)**
- Convert between mixed numbers and improper fractions **(assumed)**
- Add, subtract, multiply and divide fractions **(3.1)**
- Multiply and divide fractions including mixed numbers **(3.2–3.3)**

DIFFERENTIATION & EXTENSION

Could introduce 'hundredths' at this stage
Solve word problems involving fractions
Improper fractions can be introduced by using real-world examples, eg dividing 5 pizzas equally amongst 3 people
Careful differentiation is essential for this topic dependent upon the student's ability
Use a calculator to change fractions into decimals and look for patterns
Work with improper fractions and mixed numbers
Multiplication and division of fractions to link with probability
Recognising that every terminating decimal has its fraction with 2 and/or 5 as a common factor in the denominator
Introduce algebraic fractions

NOTES

Constant revision of this topic is needed
Use fraction button on the calculator to check solutions
Link with Probability calculations using AND and OR Laws
Use fractions for calculations involving compound units
Use Functional Elements questions and examples using fractions, eg $\frac{1}{4}$ off the list price when comparing different sale prices

Module **4** **Time: 6 – 8 hours**

GCSE Tier: **Higher**

Contents: **Algebra**

A a Distinguish the different roles played by letter symbols in algebra, using the correct notation
A b Distinguish in meaning between the words 'equation', 'formula', 'identity' and 'expression'
A c Manipulate algebraic expressions by collecting like terms, by multiplying a single term over a bracket, and by taking out common factors, multiplying two linear expressions, factorise quadratic expressions including the difference of two squares and simplify rational expressions

PRIOR KNOWLEDGE:

Experience of using a letter to represent a number
Ability to use negative numbers with the four operations
Recall and use BIDMAS

OBJECTIVES

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

- Use notation and symbols correctly **(2.1)**
- Write an expression **(2.1)**
- Select an expression/identity/equation/formula from a list **(13.6)**
- Manipulate algebraic expressions by collecting like terms **(2.1)**
- Multiply a single term over a bracket **(9.1)**
- Factorise algebraic expressions by taking out common factors **(9.2)**
- Expand the product of two linear expressions **(9.3)**
- Factorise quadratic expressions including using the difference of two squares **(9.4)**
- Simplify rational expressions by cancelling, adding, subtracting, and multiplying **(32.1–32.3)**

DIFFERENTIATION & EXTENSION

This topic can be used as a reminder of the KS3 curriculum and could be introduced via investigative material, eg frogs, handshakes, patterns in real life, formulae
Use examples where generalisation skills are required
Extend the above ideas to the 'equation' of the straight line, $y = mx + c$
Look at word formulae written in symbolic form, eg $F = 2C + 30$ to convert temperature (roughly) and compare with $F = \frac{9}{5}C + 32$
Practise factorisation where the factor may involve more than one variable

NOTES

There are plenty of old exam papers with matching tables testing knowledge of the 'Vocabulary of Algebra' (See Emporium website)

Module **5** **Time: 5 – 7 hours**

GCSE Tier: **Higher**

Contents: **Shape and angles**

GM a	Recall and use properties of angles at a point, angles on a straight line (including right angles), perpendicular lines, and opposite angles at a vertex
GM b	Understand and use the angle properties of parallel lines, triangles and quadrilaterals
GM c	Calculate and use the sums of the interior and exterior angles of polygons
GM d	Recall the properties and definitions of special types of quadrilateral, including square, rectangle, parallelogram, trapezium, kite and rhombus
Gm r	Understand and use bearings

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

OBJECTIVES

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

- Recall and use properties of angles **(assumed)**
  - – angles at a point
  - – angles at a point on a straight line
  - – perpendicular lines
  - – vertically opposite angles
- Understand and use the angle properties of parallel lines **(5.1)**
- Understand, draw and measure bearings **(5.5)**
- Calculate bearings and solve bearings problems **(5.5)**
- Distinguish between scalene, isosceles, equilateral, and right-angled triangles **(assumed)**
- Understand and use the angle properties of triangles **(assumed)**
- Use the angle sum of a triangle is 180º **(assumed)**
- Understand and use the angle properties of intersecting lines **(assumed)**
- Mark parallel lines on a diagram **(5.1)**
- Use the properties of corresponding and alternate angles **(5.1, 5.4)**
- Recognise and classify quadrilaterals **(8.3)**
- Understand and use the angle properties of quadrilaterals **(5.3)**
- Give reasons for angle calculations **(Chapter 5)**
- Explain why the angle sum of a quadrilateral is 360º **(5.2)**
- Understand the proof that the angle sum of a triangle is 180º **(5.2)**
- Understand a proof that the exterior angle of a triangle is equal to the sum of the interior angles of the other two vertices **(5.2)**
- Use the size/angle properties of isosceles and equilateral triangles **(5.3, 5.6)**
- Recall and use these properties of angles in more complex problems **(5.3, 5.6)**
- Calculate and use the sums of the interior angles of polygons **(5.7)**
- Use geometric language appropriately and recognise and name pentagons, hexagons, heptagons, octagons and decagons **(5.7)**
- Use the angle sums of irregular polygons **(5.7)**
- Calculate and use the angles of regular polygons **(5.7)**
- Use the sum of the interior angles of an *n* sided polygon **(5.7)**
- Use the sum of the exterior angles of any polygon is 360º **(5.7)**
- Use the sum of the interior angle and the exterior angle is 180º **(5.7)**
- Find the size of each interior angle or the size of each exterior angle or the number of sides of a regular polygon **(5.7)**
- Understand tessellations of regular and irregular polygons and combinations of polygons **(5.7)**
- Explain why some shapes tessellate when other shapes do not **(5.7)**

DIFFERENTIATION & EXTENSION

Use triangles to find the angle sums of polygons
Use the angle properties of triangles to find missing angles in combinations of triangles
Harder problems involving multi-step calculations
Link with symmetry and tessellations

NOTES

Most of this is KS3, so can be treated as an opportunity for groups of students to present parts of the module to the rest of the class. They could be encouraged to make resources, eg follow me cards, puzzles etc for the others to do
Angles in polygons could be investigated algebraically as an investigation
The tessellation can be done as a cross curricular project with Art (Escher) and is good for wall display
Use lots of practical drawing examples to help illustrate properties of various shapes – Group/Displays
Diagrams used in examinations are seldom drawn accurately
Use tracing paper to show which angles in parallel lines are equal
Encourage students to always give their reasons in problems and 'quote' the angle fact/theorem used

Module **6** **Time: 3 – 5 hours**

GCSE Tier: **Higher**

Contents: **Collecting data**

SP a Understand and use statistical problem solving process (handling data cycle)
SP b Identify possible sources of bias
SP c Design an experiment or survey
SP d Design data-collection sheets distinguishing between different types of data
SP e Extract data from printed tables and lists
SP f Design and use two-way tables for discrete and grouped 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:

- Specify the problem and plan **(6.1)**
- Decide what data to collect and what statistical analysis is needed **(6.2)**
- Collect data from a variety of suitable primary and secondary sources **(6.4, 6.8)**
- Use suitable data collection techniques **(6.4)**
- Process and represent the data **(6.4, 6.6)**
- Interpret and discuss the data **(6.7)**
- Discuss how data relates to a problem, identify possible sources of bias and plan to minimise it **(6.7)**
- Understand how different sample sizes may affect the reliability of conclusions drawn **(6.7)**
- Identify which primary data they need to collect and in what format, including grouped data **(6.4)**
- Consider fairness **(6.5, 6.7)**
- Understand sample and population **(6.2)**
- Design a question for a questionnaire **(6.5)**
- Criticise questions for a questionnaire **(6.5)**
- Design an experiment or survey **(6.2, 6.3, 6.5)**
- Select and justify a sampling scheme and a method to investigate a population, including random and stratified sampling **(6.2, 6.3)**
- Use stratified sampling **(6.3)**
- Design and use data-collection sheets for grouped, discrete and continuous data **(6.4)**
- Collect data using various methods **(6.4, 6.5)**
- Sort, classify and tabulate data and discrete or continuous quantitative data **(6.1, 6.4, 6.6)**
- Group discrete and continuous data into class intervals of equal width **(6.4)**
- Extract data from lists and tables **(6.6, 6.8)**
- Design and use two-way tables for discrete and grouped data **(6.6)**
- Use information provided to complete a two way table **(6.6)**

DIFFERENTIATION & EXTENSION

Carry out a statistical investigation of their own, including designing an appropriate means of gathering the data
Some guidance needs to be given to stop students from choosing limited investigations, eg favourite football team
Get data from holiday brochures to compare resorts for temp, rainfall and type of visitor
Carry out a statistical investigation of their own including, designing an appropriate means of gathering the data
Investigation into other sampling schemes, such as cluster, systematic and quota sampling

NOTES

Students may need reminding about the correct use of tallies
Emphasise the differences between primary and secondary data
Discuss sample size and mention that a census is the whole population
In the UK the census takes place every year that ends in a '1' (2011 is the next census)
If students are collecting data as a group, they should all use the same procedure
Emphasise that continuous data is data that is measured, eg temperature
Mayfield High data from coursework task can be used to collect samples and can be used to make comparisons in following sections
Use year group data, eg Mayfield High data to introduce stratified sampling techniques
Use investigations to link with future statistics modules

Module **7** **Time: 6 – 8 hours**

GCSE Tier: **Higher**

Contents: **Displaying data**

SP g	Produce charts and diagrams for various data types
SP i	Interpret a wide range of graphs and diagrams and draw conclusions
SP j	Present findings from databases, tables and charts
SP k	Recognise correlation and draw and/or use lines of best fit by eye, understanding what these represent
SP l	Compare distributions

PRIOR KNOWLEDGE:

An understanding of the different types of data: continuous; discrete;
Experience of inequality notation
Ability to multiply a number by a fraction
Use a protractor to measure and draw angles

OBJECTIVES

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

- Produce: composite bar charts, comparative and dual bar charts, pie charts, histograms with equal or unequal class intervals and frequency diagrams for grouped discrete data, scatter graphs, line graphs, frequency polygons for grouped data, grouped frequency tables for continuous data **(18.1, 18.4–18.7, 24.1–24.2)**
- Interpret: composite bar charts, comparative and dual bar charts, pie charts, scatter graphs, frequency polygons and histograms **(18.2, 18.4–18.7, 24.2)**
- Recognise simple patterns, characteristics and relationships in line graphs and frequency polygons **(18.6, 24.1)**
- Find the median from a histogram or any other information from a histogram, such as the number of people in a given interval **(18.5)**
- From line graphs, frequency polygons and frequency diagrams: read off frequency values, calculate total population, find greatest and least values **(18.5–18.6, 24.1)**
- From pie charts: find the total frequency and find the frequency represented by each sector **(18.2)**
- From histograms: complete a grouped frequency table and understand and define frequency density **(18.7)**
- Present findings from databases, tables and charts **(Chapters 18, 24)**
- Look at data to find patterns and exceptions, explain an isolated point on a scatter graph **(Chapter 18, 24.4)**
- Draw lines of best fit by eye, understanding what these represent **(24.4)**
- Use a line of best fit, or otherwise, to predict values of one variable given values of the other variable **(24.5)**
- Distinguish between positive, negative and zero correlation using lines of best fit **(24.3)**
- Understand that correlation does not imply causality **(24.3)**
- Appreciate that correlation is a measure of the strength of the association between two variables and that zero correlation does not necessarily imply 'no relationship' **(24.3)**

DIFFERENTIATION & EXTENSION

Carry out a statistical investigation of their own and use an appropriate means of displaying the results
Use a spreadsheet/ICT to draw different types of graphs

NOTES

Collect examples of charts and graphs in the media which have been misused, and discuss the implications
Clearly label all axes on graphs and use a ruler to draw straight lines
Many students enjoy drawing statistical graphs for classroom displays. Include the Functional Elements in this topic with regard to holiday data, energy charts etc
Stem and leaf diagrams must have a key and show how to find the median and mode from a stem and leaf diagram.
Angles for pie charts should be accurate to within 2°. Ask students to check each others' charts
Make comparisons between previously collected data, eg Mayfield boys vs girls or Yr 7 vs Yr 8
Encourage students to work in groups and present their charts – display work in classroom/corridors
Use Excel Graph wizard

Module **8** **Time: 4 – 6 hours**

GCSE Tier: **Higher**

Contents: **Constructions and loci**

GM v Use straight edge and a pair of compasses to carry out constructions
GM w Construct loci

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

OBJECTIVES

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

- Use straight edge and a pair of compasses to do standard constructions **(12.2, 12.3)**
- Construct triangles including an equilateral triangle **(12.1, 12.3)**
- Understand, from the experience of constructing them, that triangles satisfying SSS, SAS, ASA and RHS are unique, but SSA triangles are not **(12.1)**
- Construct the perpendicular bisector of a given line **(12.2)**
- Construct the perpendicular from a point to a line **(12.2)**
- Construct the perpendicular from a point on a line **(12.2)**
- Construct the bisector of a given angle **(12.3)**
- Construct angles of 60º, 90º , 30º, 45º **(12.3)**
- Draw parallel lines **(assumed)**
- Draw circles and arcs to a given radius **(assumed)**
- Construct a regular hexagon inside a circle **(12.3)**
- Construct diagrams of everyday 2-D situations involving rectangles, triangles, perpendicular and parallel lines **(Ch.12)**
- Draw and construct diagrams from given information **(Ch.12)**
- Construct: a region bounded by a circle and an intersecting line **(12.5)**
  - a given distance from a point and a given distance from a line **(12.4)**
  - equal distances from 2 points or 2 line segments **(12.4)**
  - regions which may be defined by ‘nearer to’ or ‘greater than’ **(12.5)**
- Find and describe regions satisfying a combination of loci **(12.5)**

DIFFERENTIATION & EXTENSION

Solve loci problems that require a combination of loci
Relate to real life examples including horses tethered in fields or mobile phone masts and signal coverage

NOTES

All working should be presented clearly, and accurately
A sturdy pair of compasses is essential
Construction lines should not be erased as they carry method marks
Could use construction to link to similarity and congruence

Module **9** **Time: 5 – 7 hours**

GCSE Tier: **Higher**

Contents: **Types of number**

N c	Use the concepts and vocabulary of factor (divisor), multiple, common factor, Highest Common Factor, Lowest Common Multiple, prime number and prime factor decomposition
N d	Use the terms square, positive and negative square root, cube and cube root
N e	Use index notation for squares, cubes and powers of 10
N f	Use index laws for multiplication and division of integer, negative and fractional powers
N g	Interpret, order and calculate with numbers written in standard form
N v	Use a calculator effectively and efficiently

PRIOR KNOWLEDGE:

Number complements to 10 and multiplication and division facts
Use a number line to show how numbers relate to each other
Recognise basic number patterns
Experience of classifying integers

OBJECTIVES

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

- Identify factors, multiples and prime numbers **(1.1)**
- Find the prime factor decomposition of positive integers **(1.1)**
- Find the common factors and common multiples of two numbers **(1.1)**
- Find the Highest Common Factor (HCF) and the Lowest Common Multiple (LCM) of two numbers **(1.1)**
- Recall integer squares from 2×2 to 15×15 and the corresponding square roots **(1.2)**
- Recall the cubes of 2, 3, 4, 5 and 10 and cube roots **(1.2)**
- Use index notation for squares and cubes **(1.2)**
- Use index notation for integer powers of 10 **(25.2)**
- Use standard form, expressed in conventional notation **(25.2)**
- Be able to write very large and very small numbers presented in a context in standard form **(25.2)**
- Convert between ordinary and standard form representations **(25.2)**
- Interpret a calculator display using standard form (**25.2)**
- Calculate with standard form **(25.2)**
- Use index laws to simplify and calculate the value of numerical expressions involving multiplication and division of integer negative and fractional powers, and powers of a power **(1.5, 25.1, 25.3)**

DIFFERENTIATION & EXTENSION

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 and square roots
Plenty of investigative work for squares like ‘half time’ scores
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)

NOTES

All of the work in this unit is easily reinforced by starters and plenaries
Calculators are used only when appropriate
Encourage student to learn square, cube, prime and common roots for the non-calculator examination

Module **10** **Time: 3 – 5 hours**

GCSE Tier: **Higher**

Contents: **Patterns and sequences**

A i Generate terms of a sequence using term-to-term and position to-term definitions of the sequence
A j Use linear expressions to describe the *n*th term of an arithmetic sequence

PRIOR KNOWLEDGE:

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

OBJECTIVES

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

- Recognise sequences of odd and even numbers **(2.5)**
- Generate simple sequences of numbers, squared integers and sequences derived from diagrams **(2.5)**
- Describe the term-to-term definition of a sequence in words **(2.5)**
- Identify which terms cannot be in a sequence **(2.6)**
- Generate specific terms in a sequence using the position-to-term and term-to-term rules **(2.5)**
- Find the *n*th term of an arithmetic sequence **(2.6)**
- Use the *n*th term of an arithmetic sequence **(2.6)**

DIFFERENTIATION & EXTENSION

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 *n*th term
Match-stick problems
Sequences and *n*th term formula for triangle numbers, Fibonacci numbers etc
Prove a sequence cannot have odd numbers for all values of *n*
Extend to quadratic sequences whose *n*th term is $an^2 + bn + c$

NOTES

Emphasis on good use of notation $3n$ means $3 \times n$
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 *n*th term

Module **11** **Time: 3 – 5 hours**

GCSE Tier: **Higher**

Contents: **2-D and 3-D shapes**

GM k Use 2-D representations of 3-D shapes

PRIOR KNOWLEDGE:

Construction and loci
Names of 3-D shapes

OBJECTIVES

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

- Use 2-D representations of 3-D shapes **(10.4–10.7)**
- Use isometric grids **(10.4)**
- Draw nets and show how they fold to make a 3-D solid **(10.4)**
- Understand and draw front and side elevations and plans of shapes made from simple solids **(10.5)**
- Given the front and side elevations and the plan of a solid, draw a sketch of the 3-D solid **(10.5)**

DIFFERENTIATION & EXTENSION

Make solids using equipment such as clixi or multi-link with different coloured cubes.
Draw on isometric paper shapes made from multi-link
Construct combinations of 2-D shapes to make nets of 2-D shapes
Build shapes from cubes that are represented in 2-D using cubes
An excellent topic for wall display
Extend to Planes of Symmetry for 3-D solids
Discover Euler's Formula for solids
Investigate how many small boxes can be packed into a larger box, as a Functional-type example

This result is known as **Euler's formula**. An illustration of the formula on some below.

Name	Image	Vertices *V*	Edges *E*	Faces *F*	Euler characteristic: *V* − *E* + *F*
Tetrahedron		4	6	4	**2**
Hexahedron or cube		8	12	6	**2**
Octahedron		6	12	8	**2**
Dodecahedron		20	30	12	**2**
Icosahedron		12	30	20	**2**

NOTES

All working should be presented clearly, and accurately
A sturdy pair of compasses are essential
Accurate drawing skills need to be reinforced
Some students find visualising 3-D objects difficult; simple models will assist

Module **12** **Time: 6 – 8 hours**

GCSE Tier: **Higher**

Contents: **Perimeter and area**

GM x	Calculate perimeters and areas of shapes made from triangles and rectangles or other shapes
GM z	Find circumferences and areas of circles
N r	Use π in an exact calculation
GM bb	Solve mensuration problems involving more complex shapes and solids
GM p	Convert measurements from one unit to another

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 an appropriate degree of accuracy

OBJECTIVES

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

- Measure sides of a shape to work out perimeter or area **(assumed)**
- Find the perimeter of rectangles and triangles **(assumed)**
- Recall and use the formulae for the area of a triangle, rectangle and a parallelogram **(10.1)**
- Find the area of a trapezium **(10.1)**
- Calculate perimeter and area of compound shapes made from triangles, rectangles and other shapes **(10.1, 10.2)**
- Find the surface area of simple shapes (prisms) using the formulae for triangles and rectangles, and other shapes **(23.8)**
- Find circumferences of circles and areas enclosed by circles **(10.3)**
- Recall and use the formulae for the circumference of a circle and the area enclosed by a circle **(10.3, 23.1–23.2)**
- Use $\pi \approx 3.142$ or use the π button on a calculator **(10.3)**
- Give an exact answer to a question involving the area or a circumference of a circle **(23.2)**
- Find the perimeters and areas of semicircles and quarter circles **(10.3)**
- Calculate the lengths of arcs and the areas of sectors of circles **(23.1)**
- Find the surface area of a cylinder **(23.9)**
- Find the area of a segment of a circle given the radius and length of the chord **(Chapter 23)**
- Convert between metric units of area **(23.3)**

DIFFERENTIATION & EXTENSION

Calculate areas and volumes using formulae
Using compound shape methods to investigate areas of other standard shapes such as parallelograms, trapeziums and kites
Emphasise the Functional Elements here with carpets for rooms, tiles for walls, turf for gardens as well as wall paper and skirting board problems
Further problems involving combinations of shapes
Practical activities, eg using estimation and accurate measuring to calculate perimeters and areas of classroom/corridor floors

NOTES

Discuss the correct use of language and units
Ensure that students can distinguish between perimeter, area and volume
Practical experience is essential to clarify these concepts
There are many Functional Elements questions which can be applied to this topic area, eg floor tiles, optimization type questions, which pack of tiles give the best value?

Module **13** **Time: 7 – 9 hours**

GCSE Tier: **Higher**

Contents: **Fractions, decimals and percentages**

N j	Use decimal notation and recognise that each terminating decimal is a fraction
N k	Recognise that recurring decimals are exact fractions, and that some exact fractions are recurring decimals
N l	Understand that 'percentage' means 'number of parts per 100' and use this to compare proportions
N m	Use percentage and repeated proportional change
N o	Interpret fractions, decimals and percentages as operators
N v	Use calculators effectively and efficiently
N q	Use percentages

PRIOR KNOWLEDGE:

Four operations of number
The concepts of a fraction and a decimal
Awareness that percentages are used in everyday life

OBJECTIVES

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

- Understand that a percentage is a fraction in hundredths **(14.1)**
- Convert between fractions, decimals and percentages **(14.1)**
- Convert between recurring decimals and exact fractions and use proof **(4.8)**
- Write one number as a percentage of another number **(14.3)**
- Calculate the percentage of a given amount **(14.1, 14.2)**
- Find a percentage increase/decrease of an amount **(14.3)**
- Reverse percentage, eg find the original cost of an item given the cost after a 10% deduction **(14.5)**
- Use a multiplier to increase by a given percent over a given time , eg $1.1^8 \times 64$ increases 64 by 10% over 8 years **(14.4)**
- Calculate simple and compound interest **(14.2, 14.4)**

DIFFERENTIATION & EXTENSION

Find fractional percentages of amounts, without using a calculator, eg 0.825%
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

NOTES

Emphasise the Functional Elements in this topic, use real-world problems involving fractions, decimals and percentages
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
Link with probability calculations using AND and OR Laws

Module **14** **Time: 6 – 8 hours**

GCSE Tier: **Higher**

Contents: **Formulae and linear equations**

A f Derive a formula, substitute numbers into a formula and change the subject of a formula
A d Set up and solve simple equations
A g Solve linear inequalities in one variable, and represent the solution set on a number line

PRIOR KNOWLEDGE:

Experience of finding missing numbers in calculations
The idea that some operations are the reverse of each other
An understanding of balancing
Experience of using letters to represent quantities
Understand and recall BIDMAS

OBJECTIVES

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

- Derive a formula **(19.6)**
- Use formulae from mathematics and other subjects **(19.5)**
- Substitute numbers into a formula **(19.5, 2.2)**
- Substitute positive and negative numbers into expressions such as $3x^2 + 4$ and $2x^3$ **(19.5, 2.2)**
- Set up linear equations from word problems **(13.5, 19.6)**
- Solve simple linear equations **(13.1, 13.2)**
- Solve linear equations, with integer coefficients, in which the unknown appears on either side or on both sides of the equation **(13.2, 13.3)**
- Solve linear equations that include brackets, those that have negative signs occurring anywhere in the equation, and those with a negative solution **(13.2–13.4)**
- Solve linear equations in one unknown, with integer or fractional coefficients **(13.4, 13.5)**
- Solve simple linear inequalities in one variable, and represent the solution set on a number line **(19.1–19.3)**
- Use the correct notation to show inclusive and exclusive inequalities **(19.1–19.4)**
- Change the subject of a formula including cases where the subject is on both sides of the original formula, or where a power of the subject appears **(19.7, 19.8)**

DIFFERENTIATION & EXTENSION

Use negative numbers in formulae involving indices
Use investigations to lead to generalisations
Apply changing the subject to $y = mx + c$
Derive equations from practical situations (such as finding unknown angles in polygons or perimeter problems)

NOTES

Emphasise 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
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 important
Students can leave their answers in fractional form where appropriate

Module **15** **Time: 4 – 6 hours**

GCSE Tier: **Higher**

Contents: **Linear graphs**

A l	Recognise and plot equations that correspond to straight-line graphs in the coordinate plane, including finding gradients
A m	Understand that the form $y = mx + c$ represents a straight line and that m is the gradient of the line and c is the value of the y-intercept
A n	Understand the gradients of parallel lines
A g	Solve linear inequalities in two variables, and represent the solution set on a coordinate grid
A r	Construct linear functions from real-life problems and plot their corresponding graphs
A s	Interpret graphs of linear functions

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

OBJECTIVES

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

- Draw, label and scale axes **(assumed)**
- Recognise that equations of the form $y = mx + c$ correspond to straight-line graphs in the coordinate plane **(15.4)**
- Draw and interpret straight line graphs for real-life situations **(15.3, 15.6)**
  - ready reckoner graphs
  - conversion graphs
  - fuel bills, eg gas and electric
  - fixed charge (standing charge) and cost per unit
- Plot and draw graphs of straight lines with equations of the form $y = mx + c$ **(15.4)**
- Find the gradient of a straight line from a graph **(15.3)**
- Analyse problems and use gradients to interpret how one variable changes in relation to another **(15.3)**
- Interpret and analyse a straight-line graph **(15.4)**
- Understand that the form $y = mx + c$ represents a straight line **(15.4)**
- Find the gradient of a straight line from its equation **(15.4)**
- Explore the gradients of parallel lines and lines perpendicular to each other **(15.5)**
- Write down the equation of a line parallel or perpendicular to a given line **(15.5)**
- Use the fact that when $y = mx + c$ is the equation of a straight line then the gradient of a line parallel to it will have a gradient of m and a line perpendicular to this line will have a gradient of $-\frac{1}{m}$ **(15.5)**
- Interpret and analyse a straight line graph and generate equations of lines parallel and perpendicular to the given line **(15.5)**
- Show the solution set of several inequalities in two variables on a graph **(19.4)**

DIFFERENTIATION & EXTENSION

Find the equation of the line through two given points
Find the equation of the perpendicular bisector of the line segment joining two given points
Use Functional Elements in terms of mobile phone bills
Use a spreadsheet to generate straight-line graphs, posing questions about the gradient of lines
Use a graphical calculator or graphical ICT package to draw straight-line graphs
Link to scatter graphs and correlation
Cover horizontal and vertical lines ($x = c$ and $y = c$), as students often forget these

NOTES

Careful annotation should be encouraged. Label the coordinate axes and origin and write the equation of the line
Recognise linear graphs and hence when data may be incorrect
Link to graphs and relationships in other subject areas, i.e. science, geography etc
Link conversion graphs to converting metric and imperial units
A-Level C1 text books can be a good source of extension questions on this topic

Module **16** **Time: 3 – 5 hours**

GCSE Tier: **Higher**

Contents: **Simultaneous equations (go back and do formula and rearranging first!)**

A d Set up and solve simultaneous equations in two unknowns

PRIOR KNOWLEDGE:

Introduction to algebra
Linear functions
Solving equations

OBJECTIVES

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

- Find the exact solutions of two simultaneous equations in two unknowns **(22.1)**
- Use elimination or substitution to solve simultaneous equations **(22.1)**
- Interpret a pair of simultaneous equations as a pair of straight lines and their solution as the point of intersection **(22.3)**
- Set up and solve a pair of simultaneous equations in two variables **(22.2)**

DIFFERENTIATION & EXTENSION

Inaccurate graphs could lead to incorrect solutions
Clear presentation of workings is essential
Use open ended questions that test student awareness of what intersections mean for mobile phone bills
Solve two simultaneous equations with fractional coefficients
Solve two simultaneous equations with second order terms, eg equations in x and y^2

NOTES

Build up the algebraic techniques slowly
Link the graphical solutions with linear graphs and changing the subject
Inaccurate graphs could lead to incorrect solutions, encourage substitution of answers to check they are correct
Clear presentation of working is essential

Module **17** **Time: 6 – 8 hours**

GCSE Tier: **Higher**

Contents: **Probability**

SP m	Understand and use the vocabulary of probability and the probability scale
SP n	Understand and use estimates or measures of probability from theoretical models (including equally likely outcomes), or from relative frequency
SP o	List all outcomes for single events, and for two successive events, in a systematic way and derive relative probabilities
SP p	Identify different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1
SP q	Know when to add or multiply two probabilities: when A and B are mutually exclusive, then the probability of A or B occurring is $P(A) + P(B)$, whereas when A and B are independent events, the probability of A and B occurring is $P(A) \times P(B)$
SP r	Use tree diagrams to represent outcomes of compound events, recognising when events are independent
SP s	Compare experimental data and theoretical probabilities
SP t	Understand that if they repeat an experiment, they may, and usually will, get different outcomes, and that increasing sample size generally leads to better estimates of probability and population characteristics

PRIOR KNOWLEDGE:

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

OBJECTIVES

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

- Write probabilities using fractions, percentages or decimals **(28.1)**
- Understand and use estimates or measures of probability, including relative frequency **(28.1, 28.3)**
- Use theoretical models to include outcomes using dice, spinners, coins etc **(28.1, 28.4)**
- Find the probability of successive events, such as several throws of a single dice **(28.1)**
- Estimate the number of times an event will occur, given the probability and the number of trials **(28.4)**
- List all outcomes for single events, and for two successive events, systematically **(28.1)**
- Use and draw sample space diagrams **(28.1)**
- Add simple probabilities, eg from sample space diagrams **(28.2)**
- Identify different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1 **(28.2)**
- Use $1 - p$ as the probability of an event not occurring where p is the probability of the event occurring **(28.2)**
- Find a missing probability from a list or table **(28.2)**
- Understand conditional probabilities **(28.7)**
- Understand selection with or without replacement **(28.5, 28.7)**
- Draw a probability tree diagram based on given information **(28.6)**
- Use a tree diagram to calculate conditional probability **(28.7)**
- Compare experimental data and theoretical probabilities **(28.3)**
- Compare relative frequencies from samples of different sizes **(28.3)**

DIFFERENTIATION & EXTENSION

An opportunity for practical examples, eg P(pin up) for a drawing pin, the 'horse' race, the national lottery
Show that each cluster of branches on a tree diagram adds up to 1
Explain that if two objects are chosen, then this is the same as one event followed by another event without replacement
Show that it is often easier to solve a problem involving multiple outcomes, by considering the *opposite* event and subtracting from 1, eg 'at least' two reds, 'at least' two beads of a different colour etc)
Experiments with dice and spinners
Show sample space for outcomes of throwing 2 dice
Stress that there are 36 outcomes (they will initially guess it's 12 outcomes for 2 dice)
Binomial probabilities (H or T)

Do a question ‘with’ and then repeat it ‘without’ replacement. Good idea to show the contents of the bag and physically remove the object to illustrate the change of probability fraction for the second selection

NOTES

Students should express probabilities as fractions, percentages or decimals
Fractions do not need to be cancelled to their lowest terms. This makes it easier to calculate tree diagram probabilities, eg easier to add like denominators

Module **18** **Time: 6 – 8 hours**

GCSE Tier: **Higher**

Contents: **Ratio and scale**

N p	Use ratio notation, including reduction to its simplest form and its various links to fraction notation
N q	Understand and use number operations and the relationships between them, including inverse operations and hierarchy of operations
N t	Divide a quantity in a given ratio
GM m	Use and interpret maps and scale drawings
N n	Understand and use direct and indirect proportion
A u	Use direct and indirect proportion

PRIOR KNOWLEDGE:

Fractions

OBJECTIVES

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

- Use ratios **(16.1)**
- Write ratios in their simplest form **(16.1)**
- Divide a quantity in a given ratio **(16.3)**
- Solve a ratio problem in a context **(16.2)**
- Use and interpret maps and scale drawings **(12.6)**
- Read and construct scale drawings drawing lines and shapes to scale **(12.6)**
- Estimate lengths using a scale diagram **(12.6)**
- Solve word problems about ratio and proportion **(16.4–16.5)**
- Calculate an unknown quantity from quantities that vary in direct or inverse proportion **(16.4, 16.5)**
- Set up and use equations to solve word and other problems involving direct proportion or inverse proportion and relate algebraic solutions to graphical representation of the equations **(27.1–27.5)**

DIFFERENTIATION & EXTENSION

Harder problems involving multi-stage calculations

Relate ratios to Functional Elements situations, eg investigate the proportions of the different metals in alloys and the new amounts of ingredients for a recipe for different numbers of guests

Harder problems involving multi-stage calculations

NOTES

Students often find ratios with three parts difficult

Link ratios given in different units to metric and imperial units

Module **19** **Time: 7 – 9 hours**

GCSE Tier: **Higher**

Contents: **Averages and range**

SP h	Calculate median, mean, range, quartiles and interquartile range, mode, modal class and interval containing the median
SP g	Produce charts and diagrams for various data types
SP i	Interpret a wide range of graphs and diagrams and draw conclusions
SP l	Compare distributions and make inferences
SP u	Use calculators efficiently and effectively, including statistical functions

PRIOR KNOWLEDGE:

Knowledge of finding the mean for small data sets
Ability to find the midpoint of two numbers

OBJECTIVES

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

- Calculate mean, mode, median and range for small data sets **(11.1, 11.2, 11.4–11.7)**
- Recognise the advantages and disadvantages between measures of average **(11.3)**
- Produce ordered stem and leaf diagrams and use them to find the range and averages **(18.3)**
- Calculate averages and range from frequency tables (Use Σx and Σfx) **(11.4)**
- Estimate the mean for large data sets with grouped data (and understand that it is an estimate) **(11.6)**
- Draw and interpret cumulative frequency tables and graphs **(18.8)**
- Use cumulative frequency graphs to find median, quartiles and interquartile range **(18.9)**
- Draw box plots from a cumulative frequency graph **(18.10)**
- Compare the measures of spread between a pair of box plots/cumulative frequency graphs **(18.10)**
- Interpret box plots to find median, quartiles, range and interquartile range **(18.10)**
- Find the median from a histogram **(18.5)**
- Compare distributions and make inferences, using the shapes of distributions and measures of average and spread, including median and quartiles **(11.7, 18.6)**
- Find quartile and interquartile range from data **(11.7)**
- Find modal class and interval containing the median **(11.5)**

DIFFERENTIATION & 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
Students should understand that finding an *estimate for the mean* of grouped data is not a guess
Opportunity to remind them of Module 6
Pose the question: 'Investigate if the average number of children per family is 2.4.', 'Are the families represented in your class representative of the whole population?'
Discuss occasions when one average is more appropriate, and the limitations of each average
Possibly mention standard deviation (not on course, but good for further comparison of data sets with similar means)

NOTES

Collect data from class – children per family etc. Extend to different classes, year groups or secondary data from the internet. (Previous coursework tasks are a rich source of data to work with, eg *Second-Hand Car Sales*)
Compare distributions and make inferences, using the shapes of distributions and measures of average and spread, eg 'boys are taller on average but there is a much greater spread in heights' (Use date collected from previous investigations or Mayfield High data)
Students tend to select modal class but identify it by the frequency rather than the class itself
Explain that the median of grouped data is not necessarily from the middle class interval

Module **20** **Time: 7 – 9 hours**

GCSE Tier: **Higher**

Contents: **Pythagoras' theorem and Trigonometry**

GM g	Use Pythagoras' theorem in 2-D and 3-D
N r	Use surds in exact calculations
GM h	Use the trigonometric ratios to solve 2-D and 3-D problems
N v	Use calculators effectively and efficiently
N u	Round to specified or appropriate degrees of accuracy including a given, number of decimal places and significant figures
A k	Find the length of a line segment

PRIOR KNOWLEDGE:

Some understanding of similar triangles
Able to use a calculator to divide numbers
Mensuration – perimeter and area 1
Formulae

OBJECTIVES

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

- Understand, recall and use Pythagoras' theorem in 2-D, then in 3-D problems **(20.1–20.2, 29.1)**
- Calculate the length of a line segment in a 2-D plane **(20.3)**
- Give an answer in the use of Pythagoras' Theorem as $\sqrt{13}$ **(25.4)**
- Recall and use the trigonometric ratios to solve 2-D and 3-D problems **(20.4, 20.5, 29.1, 29.2, 29.9)**
- Find angles of elevation and angles of depression **(20.5)**
- Understand the language of planes, and recognise the diagonals of a cuboid **(29.2)**
- Calculate the length of a diagonal of a cuboid **(29.1)**
- Find the angle between a line and a plane (but not the angle between two planes or between two skew lines) **(29.2)**

DIFFERENTIATION & EXTENSION

Look at Functional Elements exemplar material
Harder problems involving multi-stage calculations
Organise a practical surveying lesson to find the heights of buildings/trees around your school grounds. All you need is a set of tape measures (or trundle wheels) and clinometers

NOTES

Students should be encouraged to become familiar with one make of calculator
Calculators should be set to "deg" mode
Emphasise that scale drawings will score no marks for this type of question
A useful mnemonic for remember trig ratios is "Sir Oliver's Horse, Came Ambling Home, To Oliver's Aunt" or 'SOH/CAH/TOA'; but students often enjoy making up their own
Calculated angles should be given to at least 1 decimal place and sides are determined by the units used or accuracy asked for in the question
Students should not forget to state the units for the answers
The angle between two planes or two skew lines is not required

Module **21** **Time: 3 – 5 hours**

GCSE Tier: **Higher**

Contents: **Trial and Improvement**

A h	Use systematic trial and improvement to find approximate solutions of equations where there is no simple analytical method of solving them
N u	Round to specified or appropriate degrees of accuracy including a number of decimal places and significant figures
N v	Use calculators effectively and efficiently

PRIOR KNOWLEDGE:

Substituting numbers into algebraic expressions
Dealing with decimals on a calculator
Ordering decimals

OBJECTIVES

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

- Solve cubic equations by successive substitution of values of x **(21.5)**
- Use systematic trial and improvement to find approximate solutions of equations where there is no simple analytical method of solving them **(21.5)**
- Understand the connections between changes of sign and location of roots **(21.5)**

DIFFERENTIATION & EXTENSION

Solve functions of the form $\frac{1}{x} = x^2 - 5$ (link with changing the subject)

NOTES

Look at 'practical examples'. A room is 2 m longer than it is wide. If its area is 30 m² what is its perimeter?
Students should be encouraged to use their calculators efficiently – by using the "replay" or ANS/EXE functions
The square/cube function on a calculator may not be the same for different makes
Take care when entering negative values to be squared (always use brackets)
Students should write down all the digits on their calculator display and only round the final answer declared to the degree of accuracy

Module **22** **Time: 6 – 8 hours**

GCSE Tier: **Higher**

Contents: **Surface Area and Volume**

GM aa	Calculate volumes of right prisms and shapes made from cubes and cuboids
GM x	Calculate perimeters and areas of shapes made from triangles and rectangles or other shapes
GM z	Find the surface area of a cylinder
GM bb	Solve mensuration problems involving more complex shapes and solids
GM p	Convert measures from one unit to another
GM p	Convert between volume measures, including cubic centimetres and cubic metres
N r	Use π in an exact calculation

PRIOR KNOWLEDGE:

Concept of volume
Knowledge of area module
Ability to give answers to a degree of accuracy
Experience of changing the subject of a formula

OBJECTIVES

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

- Know and use formulae to calculate the surface areas and volumes of cuboids and right-prisms and shapes made from cuboids **(10.6, 10.7, 23.8)**
- Solve a range of problems involving surface area and volume, eg given the volume and length of a cylinder find the radius **(10.6–10.8, 23.4–23.6, 23.8–23.9)**
- Find the volume of a cylinder and surface area of a cylinder **(10.8, 23.9)**
- Convert between volume measures, including cubic centimetres and cubic metres **(23.7)**
- Solve problems involving more complex shapes and solids, including segments of circles and frustums of cones **(23.6)**
- Find the surface area and volumes of compound solids constructed from cubes, cuboids, cones, pyramids, spheres, hemispheres, cylinder, eg solids in everyday use **(23.4–23.6, 23.8–23.9)**
- Convert between units of capacity and volume **(23.7)**

DIFFERENTIATION & EXTENSION

Additional work using algebraic expressions
Find surface area and volume of a sphere and cone (using standard formulae)
Convert between less familiar units, eg cm^3 to mm^3, cm^3 to litres
Look at functional type questions, eg fitting boxes in crates
Look at in conjunction with Module 23 and density/volume/mass questions
Find the volume of a cylinder given its surface area, leaving the answer in terms of l
Find the volume of a right hexagonal pyramid of side x and height h (researching the method for finding the volume of any pyramid)

NOTES

'Now! I Know Pi' is a good way to learn the approx value (The number of letters of each word and the ! is the decimal point)
Also 'Cherry Pie Delicious' is $C = \pi D$ and 'Apple Pies are too' is $A = \pi r^2$
Answers in terms of π may be required or final answers rounded to the required degree of accuracy
Need to constantly revise the expressions for area/volume of shapes
Students should be aware of which formulae are on the relevant page on the exam paper and which they need to learn

Module **23** **Time: 6 – 8 hours**

GCSE Tier: **Higher**

Contents: **Compound measures**

GM o	Interpret scales on a range of measuring instruments and recognise the inaccuracy of measurements
GM p	Convert measurements from one unit to another
GM q	Make sensible estimates of a range of measures
GM s	Understand and use compound measures
A r	Draw and interpret distance time graphs
A s	Discuss, plot and interpret graphs (which may be non-linear) modelling real situations
N s	Calculate upper and lower bounds

PRIOR KNOWLEDGE:

Knowledge of metric units, eg 1 m = 100 cm etc
Know that 1 hour = 60 mins, 1 min = 60 seconds
Experience of multiply by powers of 10, e.g $100 \times 100 = 10\,000$

OBJECTIVES

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

- Convert between units of measure in the same system. (NB: Conversion between imperial units will be given. Metric equivalents should be known) **(7.1)**
- Know rough metric equivalents of pounds, feet, miles, pints and gallons: **(7.1)**
  Metric/Imperial
  1 kg= 2.2 pounds
  1 litre=1.75 pints
  4.5l= 1 gallon
  8 km = 5 miles
  30 cm = 1 foot
- Convert between imperial and metric measures **(7.1)**
- Use the relationship between distance, speed and time to solve problems **(7.2, 7.3)**
- Convert between metric units of speed, eg km/h to m/s **(7.3)**
- Construct and interpret distance time graphs **(15.6)**
- Know that density is found by mass ÷ volume **(7.4)**
- Use the relationship between density, mass and volume to solve problems, eg find the mass of an object with a given volume and density **(7.4)**
- Convert between metric units of density, eg kg/m^3 to g/cm^3 **(7.4)**
- Calculate speed **(7.3)**
- Calculate the upper and lower bounds of calculations, particularly when working with measurements **(4.9, 4.10)**
- Find the upper and lower bounds of calculations involving perimeter, areas and volumes of 2-D and 3-D shapes **(4.10)**
- Find the upper and lower bounds in real life situations using measurements given to appropriate degrees of accuracy **(4.10)**
- Give the final answer to an appropriate degree of accuracy following an analysis of the upper and lower bounds of a calculation **(4.10)**

DIFFERENTIATION & EXTENSION

Perform calculations on a calculator by using standard form
Convert imperial units to metric units, eg mph into km/h
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
Mention other units (not on course) like hectares

NOTES

Use a formula triangle to help students see the relationship between the variables for density
Borrow a set of electronic scales and a Eureka Can from Physics for a practical density lesson
Look up densities of different elements from the net
Link converting area & volume units to similar shapes (Module 25)
Draw a large grid made up of 100 by 100 cm squares to show what 1 square metre looks like

Module **24** **Time: 5 – 7 hours**

GCSE Tier: **Higher**

Contents: **Transformations**

GM e Recognise reflection and rotation symmetry of 2-D shapes
GM l Describe and transform 2-D shapes using single or combined rotations, reflections, translations, or enlargements by a positive, fractional or negative scale factor
GM l Distinguish properties that are preserved under particular transformations

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

OBJECTIVES

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

- Recognise rotation and reflection of 2-D shapes **(8.2)**
- Understand translation as a combination of a horizontal and vertical shift including signs for directions **(17.1)**
- Translate a given shape by a vector **(17.1)**
- Understand rotation as a (anti clockwise) turn about a given origin **(17.3)**
- Reflect shapes in a given mirror line; parallel to the coordinate axes and then $y = x$ or $y = -x$ **(17.2)**
- Enlarge shapes by a given scale factor from a given point; using positive, negative and fractional scale factors **(17.4)**
- Find the centre of enlargement **(17.4)**
- Understand that images produced by translation, rotation and reflection are congruent to the object **(17.1–17.3)**
- Describe and transform 2-D shapes using single rotations **(17.3)**
- Understand that rotations are specified by a centre and an (anticlockwise) angle **(17.3)**
- Find the centre of rotation **(17.3)**
- Rotate a shape about the origin, or any other point **(17.3)**
- Describe and transform 2-D shapes using combined rotations, reflections, translations, or enlargements **(17.5)**
- Use congruence to show that translations, rotations and reflections preserve length and angle, so that any figure is congruent to its image under any of these transformations **(17.1–17.3)**
- Distinguish properties that are preserved under particular transformations **(17.1–17.4)**
- Recognise that enlargements preserve angle but not length, linking to similarity **(17.4)**
- Describe a transformation **(Chapter 17)**

DIFFERENTIATION & EXTENSION

The tasks set can be extended to include combinations of transformations
Research glide reflection

NOTES

Emphasise that students describe the given transformation fully
Diagrams should be drawn carefully
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 **25** **Time: 4 – 6 hours**

GCSE Tier: **Higher**

Contents: **Similarity and Congruence**

GM f Understand congruence and similarity
GM n Understand and use the effect of enlargement for perimeter, area and volume of shapes and solids
N q Understand and use number operations and the relationships between them, including inverse operations and hierarchy of operations

PRIOR KNOWLEDGE:

Ratio
Proportion
Area and Volume

OBJECTIVES

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

- Understand and use SSS, SAS, ASA and RHS conditions to prove the congruence of triangles using formal arguments, and to verify standard ruler and a pair of compasses constructions **(8.1)**
- Understand similarity of triangles and of other plane figures, and use this to make geometric inferences **(8.4)**
- Formal geometric proof of similarity of two given triangles **(8.4, 8.5)**
- Recognise that all corresponding angles in similar figures are equal in size when the lengths of sides are not **(8.4)**
- Understand the effect of enlargement for perimeter, area and volume of shapes and solids **(26.1–26.2)**
- Understand that enlargement does not have the same effect on area and volume **(26.2)**
- Use simple examples of the relationship between enlargement and areas and volumes of simple shapes and solids **(26.1–26.2)**
- Use the effect of enlargement on areas and volumes of shapes and solids **(26.1–26.2)**
- Know the relationships between linear, area and volume scale factors of mathematically similar shapes and solids **(26.3)**

DIFFERENTIATION & EXTENSION

This could be introduced practically or by investigating simple shapes such as squares, rectangles, circles (reminder of formula), cuboids, cylinders etc
Solve loci problems that require a combination of loci
Construct combinations of 2-D shapes to make nets
Link with tessellations and enlargements
Link with similar areas and volumes
Harder problems in congruence
Relate this unit to circle theorems

NOTES

All working should be presented clearly, and accurately

Module **26** **Time: 6 – 8 hours**

GCSE Tier: **Higher**

Contents: **Quadratic functions, equations and graphs**

A c	Manipulate algebraic expressions by collecting like terms, by multiplying a single term over a bracket, and by taking out common factors, factorising quadratic expressions, and difference of two squares
A t	Generate points and plot graphs of simple quadratic functions, and use these to find approximate solutions
A r	Construct linear, quadratic and other functions from real-life problems and plot their corresponding graphs
A e	Solve quadratic equations
A o	Find the intersection points of the graphs of a linear and quadratic function, knowing that these are the approximate solutions of the corresponding simultaneous equations representing the linear and quadratic functions

PRIOR KNOWLEDGE:

Graphs and algebra

OBJECTIVES

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

- Generate points and plot graphs of simple quadratic functions, then more general quadratic functions **(21.1)**
- Find approximate solutions of a quadratic equation from the graph of the corresponding quadratic function **(21.1)**
- Find the intersection points of the graphs of a linear and quadratic function, knowing that these are the approximate solutions of the corresponding simultaneous equations representing the linear and quadratic functions **(21.1)**
- Solve simple quadratic equations by factorisation and completing the square **(22.4–22.9)**
- Solve simple quadratic equations by using the quadratic formula **(22.7–22.9)**
- Select and apply algebraic and graphical techniques to solve simultaneous equations where one is linear and one quadratic **(22.11–22.12)**
- Solve equations involving algebraic fractions which lead to quadratic equations **(22.8)**
- Solve quadratic equations by completing the square **(22.6)**

DIFFERENTIATION & EXTENSION

Derive the quadratic equation by completing the square
Use graphical calculators or ICT graph package where appropriate
Show how the value of '$b^2 - 4ac$' can be useful in determining if the quadratic factorises or not (i.e. square number)
Extend to discriminant's properties and roots

NOTES

Lots of practical type examples, eg projectiles
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
There may be a need to remove the HCF (numerical) of a trinomial before factorising to make the factorisation easier

Module **27** **Time: 5 – 7 hours**

GCSE Tier: **Higher**

Contents: **Index notation and surds**

N e	Use index notation for squares, cubes and powers of 10
N q	Understand and use number operations and the relationships between them, including inverse operations and hierarchy of operations
N f	Use index laws for multiplication and division of integer, fractional and negative powers
N v	Use calculators effectively and efficiently
N r	Calculate with surds
A c	Simplify expressions using rules of indices

PRIOR KNOWLEDGE:

Knowledge of squares, square roots, cubes and cube roots
Fractions and algebra

OBJECTIVES

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

- Find the value of calculations using indices **(1.5, 25.1, 25.3)**
- Use index laws to simplify and calculate numerical expressions involving powers, eg $(2^3 \times 2^5) \div 2^4$, 4^0, $8^{-2/3}$ **(1.5, 25.1, 25.3)**
- Know that, eg $x^3 = 64 \Rightarrow x = 8^{2/3}$ **(25.3)**
- Rationalise the denominator, eg $\frac{1}{\sqrt{3}-1} = \left(\frac{\sqrt{3}+1}{2}\right)$, and eg write $(\sqrt{18}+10) \div \sqrt{2}$ in the form $p + q\sqrt{2}$ **(25.4)**
- Use calculators to explore exponential growth and decay **(21.4)**
- Write $\sqrt{8}$ in the form $2\sqrt{2}$ **(25.4)**
- Simplify expressions using index laws **(2.4)**
- Use index laws to write expressions for integer, negative, and fractional powers and powers of a power **(1.5, 25.1, 25.3)**

DIFFERENTIATION & EXTENSION

Use index laws to simplify algebraic expressions
Treat index laws as formulae (state which rule is being at each stage in a calculation)
Explain the difference between rational and irrational numbers as an introduction to surds
Prove that $\sqrt{2}$ is irrational
Revise the difference of two squares to show why we use, for example $(\sqrt{3} - 2)$ as the multiplier to rationalise $(\sqrt{3} + 2)$
Link to work on circle measures (involving π) and Pythagoras calculations in exact form

NOTES

Link simplifying surds to collecting together like terms, eg $3x + 2x = 5x$, so therefore $3\sqrt{5} + 2\sqrt{5} = 5\sqrt{5}$
Stress it is better to write answers in exact form, eg $\frac{1}{3}$ is better than 0.333333…..
A-Level C1 textbooks are a good source of extension questions on surd manipulation, some of which are algebraic
Useful generalisation to learn $\sqrt{x} \times \sqrt{x} = x$

Module **28** **Time: 3 – 5 hours**

GCSE Tier: **Higher**

Contents: **Circle theorems**

GM i Distinguish between centre, radius, chord, diameter, circumference, tangent, arc, sector and segment
GM j Understand and construct geometrical proofs using circle theorems

PRIOR KNOWLEDGE:

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

OBJECTIVES

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

- Recall the definition of a circle and identify (name) and draw the parts of a circle **(assumed)**
- Understand related terms of a circle **(assumed)**
- Draw a circle given the radius or diameter **(assumed)**
- Understand and use the fact that the tangent at any point on a circle is perpendicular to the radius at that point **(31.2)**
- Understand and use the fact that tangents from an external point are equal in length **(31.2)**
- Find missing angles on diagrams **(chapter 31**
- Give reasons for angle calculations involving the use of tangent theorems **(31.2)**
- Prove and use the facts that: **(31.3–31.4)**
  - the angle subtended by an arc at the centre of a circle is twice the angle subtended at any point on the circumference **(31.3)**
  - the angle in a semicircle is a right angle **(31.3)**
  - angles in the same segment are equal **(31.4)**
  - opposite angles of a cyclic quadrilateral sum to 180º **(31.4)**
  - alternate segment theorem **(31.4)**
  - the perpendicular from the centre of a circle to a chord bisect the chord **(31.3)**

DIFFERENTIATION & EXTENSION

Harder problems involving multi-stage angle calculations
Intersecting chord theorem

NOTES

Any proof required will be in relation to a diagram, not purely by reference to a named theorem
Reasoning needs to be carefully constructed as ‘Quality of Written Communication’ marks are likely to be allocated to proofs

Module **29** **Time: 4 – 6 hours**

GCSE Tier: **Higher**

Contents: **Sine and cosine rules**

GM h Use the sine and cosine rules to solve 2-D and 3-D problems

GM y Calculate the area of a triangle using $\frac{1}{2}\ ab\sin C$

PRIOR KNOWLEDGE:

Trigonometry
Formulae

OBJECTIVES

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

- Calculate the unknown lengths, or angles, in non right-angle triangles using the sine and cosine rules **(29.5–29.9)**
- Calculate the area of triangles given two lengths and an included angle **(29.4)**

DIFFERENTIATION & EXTENSION

Use these ratios to solve problems in 3-D and decide if it is easier to extract right-angle triangles to use 'normal' trigonometry

Stress that the cosine rule is only used when we have SAS (and we need to find the side opposite the angle given) or when we are given SSS (then we use the re-arranged version to find any angle) [else we use the Sine Rule]

NOTES

Reminders of simple geometrical facts may be helpful, eg angle sum of a triangle, the shortest side is opposite the smallest angle

Show the form of the cosine rule in the formula page and re-arrange it to show the form which finds missing angles

Module **30** **Time: 4 – 6 hours**

GCSE Tier: **Higher**

Contents: **Vectors**

GM cc Use vectors to solve problems

PRIOR KNOWLEDGE:

Vectors to describe translations
Geometry of triangles and quadrilaterals

OBJECTIVES

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

- Understand that 2**a** is parallel to **a** and twice its length **(33.4)**
- Understand that **a** is parallel to –**a** and in the opposite direction **(33.4)**
- Use and interpret vectors as displacements in the plane (with an associated direction) **(33.1)**
- Use standard vector notation to combine vectors by addition, eg $\overrightarrow{\mathbf{AB}} + \overrightarrow{\mathbf{BC}} = \overrightarrow{\mathbf{AC}}$ and **a** + **b** = **c** **(33.3)**
- Represent vectors, and combinations of vectors, in the plane **(33.1–33.5)**
- Solve geometrical problems in 2-D, eg show that joining the midpoints of the sides of any quadrilateral forms a parallelogram **(33.5)**

DIFFERENTIATION & EXTENSION

Harder geometric proof, eg show that the medians of a triangle intersect at a single point
Illustrate use of vectors by showing 'Crossing the flowing River' example or navigation examples
Vector problems in 3-D (for the most able)
Use **i** and **j** (and **k**) notation

NOTES

Students often find the pictorial representation of vectors more difficult than the manipulation of column vectors
Geometry of a hexagon provides a rich source of parallel, reverse and multiples of vectors
Stress that parallel vectors are equal
Link with like terms and brackets when simplifying
Show there is more than one route round a geometric shape, but the answer simplifies to the same vector
Remind students to underline vectors or they will be regarded as just lengths with no direction
Some extension questions can be found in Mechanics 1 textbooks

Module **31** **Time: 4 – 6 hours**

GCSE Tier: **Higher**

Contents: **Further graphs and functions**

A o Find the intersection points of the graphs of a linear and quadratic function

A p Draw, sketch, recognise graphs of simple cubic functions, the reciprocal function $y = \frac{1}{x}$ with $x \neq 0$,
the function $y = k^x$ for integer values of x and simple positive values of k,
the trigonometric functions $y = \sin x$ and $y = \cos x$

A q Construct the graphs of simple loci

PRIOR KNOWLEDGE:

Linear functions 1
Quadratic functions

OBJECTIVES

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

- Plot and recognise cubic, reciprocal, exponential and circular functions $y = \sin x$ and $y = \cos x$, within the range -360º to +360º (see above) **(21.2–21.4, 22.10, 29.3)**
- Use the graphs of these functions to find approximate solutions to equations, eg given x find y (and vice versa) **(21.2–21.4, 22.10, 29.3)**
- Find the values of p and q in the function $y = pq^x$ given the graph of $y = pq^x$ **(21.4)**
- Match equations with their graphs **(21.2–21.4, 22.10, 29.3)**
- Recognise the characteristic shapes of all these functions **(21.2–21.4, 22.10, 29.3)**
- Construct the graphs of simple loci including the circle $x^2 + y^2 = r^2$ for a circle of radius r centred at the origin of the coordinate plane **(22.10)**
- Find the intersection points of a given straight line with this circle graphically **(22.12)**
- Select and apply construction techniques and understanding of loci to draw graphs based on circles and perpendiculars of lines **(22.10)**
- Solve exactly, by elimination of an unknown, two simultaneous equations in two unknowns, one of which is linear in each unknown, and the other is linear in one unknown and quadratic in the other, or where the second equation is of the form $x^2 + y^2 = r^2$ **(22.11–22.12)**

DIFFERENTIATION & EXTENSION

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)
This work should be enhanced by drawing graphs on graphical calculators and appropriate software
Complete the square for quadratic functions and relate this to transformations of the curve $y = x^2$

NOTES

Make sure the students understand the notation $y = f(x)$, start by comparing $y = x^2$ with $y = x^2 + 2$ before mentioning $y = f(x) + 2$ etc
Graphical calculators and/or graph drawing software will help to underpin the main ideas in this unit
Link with trigonometry and curved graphs

Module **32** **Time: 3 – 5 hours**

GCSE Tier: **Higher**

Contents: **Transformations of functions**

A v Transformation of functions

PRIOR KNOWLEDGE:

Transformations
Using f(x) notation

OBJECTIVES

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

- Apply to the graph of $y = f(x)$ the transformations $y = f(x) + a$, $y = f(ax)$, $y = f(x + a)$, $y = af(x)$ for linear, quadratic, sine and cosine functions **(30.2–30.3)**
- Select and apply the transformations of reflection, rotation, enlargement and translation of functions expressed algebraically **(30.2–30.4)**
- Interpret and analyse transformations of functions and write the functions algebraically **(30.1–30.4)**

DIFFERENTIATION & 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 $\sin(90 - x) = \cos x$

NOTES

Make sure the students understand the notation $y = f(x)$, start by comparing $y = x^2$ with $y = x^2 + 2$ before mentioning $y = f(x) + 2$ etc
Graphical calculators and/or graph drawing software will help to underpin the main ideas in this unit
Link with trigonometry and curved graphs

Higher course objectives (1MA0)

Number

N a	Add, subtract, multiply and divide whole numbers, integers and decimals
N a	Multiply and divide fractions
N b	Order integers and decimals
N b	Order rational numbers
N c	Use the concepts and vocabulary of factor (divisor), multiple, common factor, Highest Common Factor, Lowest Common Multiple, prime number and prime factor decomposition
N d	Use the terms square, positive and negative square root, cube and cube root
N e	Use index notation for squares, cubes and powers of 10
N f	Use index laws for multiplication and division of integer, fractional and negative powers
N g	Interpret, order and calculate with numbers written in standard index form
N h	Understand equivalent fractions
N h	Simplify a fraction by cancelling all common factors
N i, a	Add, subtract, multiply and divide fractions
N j	Use decimal notation
N j	Use decimal notation and recognise that each terminating decimal is a fraction
N k	Recognise that recurring decimals are exact fractions, and that some exact fractions are recurring decimals
N l	Understand that 'percentage' means 'number of parts per 100' and use this to compare proportions
N m	Use percentage and repeated proportional change
N n	Understand and use direct and indirect proportion
N o	Interpret fractions, decimals and percentages as operators
N o	Use fractions as operators
N p	Use ratio notation, including reduction to its simplest form and its various links to fraction notation
N q	Use percentages
N q	Understand and use number operations and the relationships between them, including inverse operations and hierarchy of operations
N r	Use π in an exact calculation
N r	Calculate with surds
N r	Use surds in exact calculations
N s	Calculate upper and lower bounds
N t	Divide a quantity in a given ratio
N u	Round to specified or appropriate degrees of accuracy including a given power of ten, number of decimal places and significant figures
N v	Use a calculator efficiently and effectively

Algebra

A a	Distinguish the different roles played by letter symbols in algebra, using the correct notation
A b	Distinguish in meaning between the words ‘equation’, ‘formula’, ‘identity’ and ‘expression’
A c	Manipulate algebraic expressions by collecting like terms, by multiplying a single term over a bracket, and by taking out common factors, multiplying two linear expressions, factorise quadratic expressions including the difference of two squares and simplify rational expressions
A d	Set up and solve simple equations
A d	Set up and solve simultaneous equations in two unknowns
A e	Solve quadratic equations
A e	Simplify expressions using rules of indices
A f	Derive a formula, substitute numbers into a formula and change the subject of a formula
A g	Solve linear inequalities in one variable, and represent the solution set on a number line
A g	Solve linear inequalities in two variables, and represent the solution set on a coordinate grid
A h	Using systematic trial and improvement to find approximate solutions of equations where there is no simple analytical method of solving them
A i	Generate terms of a sequence using term-to-term and position to-term definitions of the sequence
A j	Use linear expressions to describe the nth term of an arithmetic sequence
A k	Use the conventions for coordinates in the plane and plot points in all four quadrants, including using geometric information
A k	Find the length of a line segment
A l	Recognise and plot equations that correspond to straight-line graphs in the coordinate plane, including finding gradients
A m	Understand that the form $y = mx + c$ represents a straight line and that m is the gradient of the line and c is the value of the y- intercept
A n	Understand the gradients of parallel lines
A o	Find the intersection points of the graphs of a linear and quadratic function
A o	Find the intersection points of the graphs of a linear and quadratic function, knowing that these are the approximate solutions of the corresponding simultaneous equations representing the linear and quadratic functions
A p	Draw, sketch, recognise graphs of simple cubic functions, the reciprocal function $y = \frac{1}{x}$ with $x \neq 0$, the function $y = kx^n$ for integer values of x and simple positive values of k, the trigonometric functions $y = \sin x$ and $y = \cos x$
A q	Construct the graphs of simple loci
A r	Construct linear functions from real-life problems and plot their corresponding graphs
A r	Construct linear, quadratic and other functions from real-life problems and plot their corresponding graphs
A r	Draw and interpret distance time graphs
A s	Interpret graphs of linear functions
A s	Discuss, plot and interpret graphs (which may be non-linear) modelling real situations
A t	Generate points and plot graphs of simple quadratic functions, and use these to find approximate solutions
A u	Use direct and indirect proportion
A v	Transformation of functions

Geometry

GM a	Recall and use properties of angles at a point, angles on a straight line (including right angles), perpendicular lines, and opposite angles at a vertex
GM b	Understand and use the angle properties of parallel lines, triangles and quadrilaterals
GM c	Calculate and use the sums of the interior and exterior angles of polygons
GM d	Recall the properties and definitions of special types of quadrilateral, including square, rectangle, parallelogram, trapezium, kite and rhombus
GM e	Recognise reflection and rotation symmetry of 2-D shapes
GM f	Understand congruence and similarity
GM g	Use Pythagoras' theorem in 2-D and 3-D
GM h	Use the trigonometric ratios and the sine and cosine rules to solve 2-D and 3-D problems
GM h	Use the sine and cosine rules to solve 2-D and 3-D problems
GM i	Distinguish between centre, radius, chord, diameter, circumference, tangent, arc, sector and segment
GM j	Understand and construct geometrical proofs using circle theorems
GM k	Use 2-D representations of 3-D shapes
GM l	Describe and transform 2-D shapes using single or combined rotations, reflections, translations, or enlargements by a positive, fractional or negative scale factor
GM l	Distinguish properties that are preserved under particular transformations
GM m	Use and interpret maps and scale drawings
GM n	Understand and use the effect of enlargement for perimeter, area and volume of shapes and solids
GM o	Interpret scales on a range of measuring instruments and recognise the inaccuracy of measurements
GM p	Convert measurements from one unit to another
GM p	Convert between volume measures, including cubic centimetres and cubic metres
GM q	Make sensible estimates of a range of measures
GM r	Understand and use bearings
GM s	Understand and use compound measures
GM v	Use straight edge and a pair of compasses to carry out constructions
GM w	Construct loci
GM x	Calculate perimeters and areas of shapes made from triangles and rectangles or other shapes
GM y	Calculate the area of a triangle using $\frac{1}{2}\ ab \sin C$
GM z	Find circumferences and areas of circles
GM z	Find surface area of a cylinder
GM aa	Calculate volumes of right prisms and shapes made from cubes and cuboids
GM bb	Solve mensuration problems involving more complex shapes and solids
GM cc	Use vectors to solve problems

Statistics and Probability

SP a	Understand and use statistical problem solving process (handling data cycle)
SP b	Identify possible sources of bias
SP c	Design an experiment or survey
SP d	Design data-collection sheets distinguishing between different types of data
SP e	Extract data from printed tables and lists
SP f	Design and use two-way tables for discrete and grouped data
SP g	Produce charts and diagrams for various data types
SP h	Calculate median, mean, range, quartiles and interquartile range, mode, modal class and interval containing the median
SPi	Interpret a wide range of graphs and diagrams and draw conclusions
SP j	Present findings from databases, tables and charts
SP k	Recognise correlation and drawand/or use lines of best fit by eye, understanding what these represent
SP l	Compare distributions and make inferences
SP m	Understand and use the vocabulary of probability and the probability scale
SP n	Understand and use estimates or measures of probability from theoretical models (including equally likely outcomes), or from relative frequency
SP o	List all outcomes for single events, and for two successive events, in a systematic way and derive relative probabilities
SP p	Identify different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1
SP q	Know when to add or multiply two probabilities: when A and B are mutually exclusive, then the probability of A or B occurring is $P(A) + P(B)$, whereas when A and B are independent events, the probability of A and B occurring is $P(A) \times P(B)$
SP r	Use tree diagrams to represent outcomes of compound events, recognising when events are independent
SP s	Compare experimental data and theoretical probabilities
SP t	Understand that if they repeat an experiment, they may, and usually will, get different outcomes, and that increasing sample size generally leads to better estimates of probability and population characteristics
SP u	Use calculators efficiently and effectively, including statistical functions

Edexcel, a Pearson company, is the UK's largest awarding body, offering academic and vocational qualifications and testing to more than 25,000 schools, colleges, employers and other places of learning in the UK and in over 100 countries worldwide. Qualifications include GCSE, AS and A Level, NVQ and our BTEC suite of vocational qualifications from entry level to BTEC Higher National Diplomas, recognised by employers and higher education institutions worldwide.

We deliver 9.4 million exam scripts each year, with more than 90% of exam papers marked onscreen annually. As part of Pearson, Edexcel continues to invest in cutting-edge technology that has revolutionised the examinations and assessment system. This includes the ability to provide detailed performance data to teachers and students which help to raise attainment.

Acknowledgements

This document has been produced by Edexcel on the basis of consultation with teachers, examiners, consultants and other interested parties. Edexcel would like to thank all those who contributed their time and expertise to its development.

Authorised by Roger Beard
Prepared by Sharon Wood and Ali Melville

Publications code: UG025517

Further copies of this publication are available from
Edexcel Publications, Adamsway, Mansfield, Notts NG18 4FN

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

September 2010
Publications Code: UG025517

For more information on Edexcel and BTEC qualifications please visit our website: www.edexcel.com

Edexcel Limited. Registered in England and Wales No. 4496750
Registered Office: One90 High Holborn, London WC1V 7BH. VAT Reg No 780 0898 07