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GCSE

Applications of Mathematics

Scheme of work

Edexcel GCSE in Applications of Mathematics (2AM01)

For first teaching from September 2010

A PEARSON COMPANY

Contents

Introduction

This scheme of work is based upon a five term model over two years for both Foundation and Higher tier students.
It can be used directly as a scheme of work for the GCSE Applications of Mathematics (2AM01).

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
- Content, referenced back to the specification
- Objectives for students at the end of the module
- Ideas for differentiation and extension activities
- Notes for general mathematical teaching points and common misconceptions

Updates will be available via a link from the Edexcel pilot mathematics website (www.edexcel.com/linkedpairpilot).

This scheme of work can be used in conjunction with the scheme of work for GCSE Methods in Mathematics (2MM01). Where a module appears in both schemes of work, it is labelled with (**COMMON**).

Notes in *italics* are Applications only.

GCSE in Applications of Mathematics (2AM01) Foundation Tier

Scheme of Work

Foundation course overview

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

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

Unit	Module	Title	Estimated teaching hours
1	1	Integers and decimals	4
1	2	Factors and multiples	2.5
1	3	Laws of indices	2.5
1	4	Fractions	6
1	5	Fractions, decimals and percentages	5
1	6	Algebraic manipulation	5
1	7	Financial and business applications	5
1	8	Solving linear equations	5
1	9	Linear graphs and $y = mx + c$	4
1	10	Angle facts and geometric shapes	6
1	11	Line and rotational symmetry	3.5
1	12	Circles	1.5
1	13	Area and perimeter	4
1	14	Reading scales and converting units	3
1	15	Similarity and congruence	3
1	16	Collecting data	4
1	17	Charts and graphs	4
1	18	Pie charts	3.5
1	19	Averages and range	6
1	20	Scatter graphs, correlation and time series	4.5
2	1	Integers, decimals and fractions	4
2	2	Real-life graphs	4
2	3	Trial and improvement	3.5
2	4	Ratio and proportion	4.5
2	5	Solving linear inequalities	5
2	6	Substitution and formulae	4.5
2	7	Using graphs to solve equations	4
2	8	Angle facts and polygons	4
2	9	Similarity and congruence	3.5
2	10	Pythagoras' theorem	6.5
2	11	Circles	4.5
2	12	Surface area and volume	4.5
2	13	2-D representation of 3-D shapes	3
2	14	Bearings and accurate drawings	4
2	15	Constructions	4
2	16	Probability	8
		TOTAL	**152.5**

Unit 1: Applications 1 – Foundation

Centres may wish to teach this unit alongside Unit 2 if they prefer to deliver their curriculum in a holistic manner.
They would enter students for both papers at the same time.
However, some centres may prefer to concentrate on Unit 1 first and enter their students in either June 2011 or in November 2011. The benefit of this model is that it allows a full analysis of the paper using ResultsPlus before students are prepared for a possible resit (one resit per unit is permitted).
In addition, some centres that traditionally organise their mock examinations in November or December may use this opportunity for an external body to mark and analyse their papers. It may also flag up any students who would benefit from a change of tier for either their resit examination or Unit 2 assessment.

Module 1 APPLICATIONS **Time: 3 – 5 hours**

Tier: Foundation – Unit 1

Content: Integers and decimals **COMMON**

AN a, d	Understand place value and round to the nearest integer and to a given power of 10
AN b	Understand and use negative integers both as positions and translations on a number line
AN b	Order integers
AN a	Multiply and divide by negative numbers
AN a	Multiply or divide any number by powers of 10, and any number by a number between 0 and 1
AN d	Check and estimate answers to problems using integers
AN b	Write decimal numbers in order of size
AN d	Round to a given number of significant figures and decimal places
AN a	Add and subtract decimal numbers
AN a	Divide by a decimal
AN a, d	Check and estimate answers to problems, by using approximations or inverse operations
AN a	Use brackets and the hierarchy of operations
AN a	Use one calculation to find the answer to another

PRIOR KNOWLEDGE

The ability to order numbers
Place value
Experience of the four operations using whole numbers
Knowledge of integer complements to 10 and to 100
Knowledge of multiplication facts to 10×10
Knowledge of strategies for multiplying and dividing whole numbers by 10
The concepts of a fraction and a decimal

OBJECTIVES

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

- Understand and order integers
- Add, subtract, multiply and divide integers (BIDMAS)
- Round whole numbers to the nearest 10, 100, 1000, …
- Multiply and divide whole numbers by a given multiple of 10
- Check their calculations by rounding, eg $29 \times 31 \approx 30 \times 30$
- Put digits in the correct place in a decimal number
- Write decimals in ascending order of size
- Approximate decimals to a given number of decimal places or significant figures
- Multiply and divide decimal numbers by whole numbers and decimal numbers, eg $266.22 \div 0.34$
- Know that, eg $13.5 \div 0.5 = 135 \div 5$

DIFFERENTIATION & EXTENSION

More work on long multiplication and division without using a calculator
Estimate answers to calculations involving the four operations
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
Use decimals in real-life problems as much as possible, eg Best Buys
Use functional examples such as entry into theme parks, cost of holidays, sharing the cost of a meal
Money calculations that require rounding answers to the nearest penny

NOTES

Present all working clearly with decimal points in line
Emphasise that all working is shown
For non-calculator methods make sure that remainders and carrying are shown
It is essential to ensure students are absolutely clear about the difference between significant figures and
decimal places
Extend to multiplication of decimals or long division of integers
Try different methods from the traditional ones, eg Russian or Chinese methods for multiplication
Directed number work with multi-step calculations
Encourage effective use of a calculator
Try investigations with digits 3, 7, 5 and 2 and challenge students to find the biggest number, smallest odd number, the largest sum or product etc
For non-calculator methods, ensure that remainders are shown as evidence of working
Encourage students to show what is entered into the calculator, not just the answer
Incorporate Functional Elements whenever and wherever possible and always round measures to an appropriate degree of accuracy
Advise students not to round decimals, used in calculations, until stating in the final answer
Link decimals to Statistics and Probability, eg the mean should not be rounded, the probability of all events occurring is equal to 1
Link decimals to reading scales and converting units and compound measures

Module 2 APPLICATIONS **Time: 1 – 3 hours**

Tier: Foundation – Unit 1

Content: Factors and multiples **COMMON**

AN c Understand even, odd and prime numbers
AN c Find factors and multiples of numbers
AN b Find squares and cubes of numbers and find square roots and cube roots of numbers
AN c Find common factors and common multiples
AN c Understand index notation for powers of 10, squares and cubes

PRIOR KNOWLEDGE

Number complements to 10 and multiplication or 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:

- Find squares, cubes, square roots, and cube roots, with and without a calculator (including the use of trial and improvement)
- Understand odd and even numbers, and prime numbers
- Find common factors and common multiples

DIFFERENTIATION & EXTENSION

Calculator exercise to check factors of larger numbers
Further work on indices to include negative and/or fractional indices (introduction to Higher tier)
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)

NOTES

All of the work in this unit is easily reinforced through starters and plenaries
Calculators should only be used when appropriate
Encourage student to learn square, cube, prime and common roots
Functional Elements – problems incorporating need to find common factors and/or common multiples

Module 3 APPLICATIONS **Time: 1 – 4 hours**

Tier: Foundation – Unit 1

Content: Laws of indices **COMMON**

AN b Use index notation and index laws for multiplication and division of integer powers and powers of powers

AN b Use index laws to simplify and calculate the value of numerical expressions involving multiplication and division of integers

PRIOR KNOWLEDGE

Knowledge of squares, square roots, cubes and cube roots

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 $(2^3 \times 2^5) \div 2^4$

DIFFERENTIATION & EXTENSION

Use index rules to simplify algebraic expressions

Treat index rules like formulae (state which rule is being used at each stage in a calculation)

Extend to questions like $2x^2 \times 4x^3$

NOTES

When a question asks for the answer as a power then leave the answer in index form

Module 4 APPLICATIONS Time: 5 – 7 hours

Tier: Foundation – Unit 1

Content: Fractions COMMON

AN a Understand and use number operations and the relationship between them, including inverse operations and hierarchy of operations (fractions)
AN b Order fractions
AN b Compare fractions (and decimals)
AN a Use the four operations with fractions
AN b Find equivalent fractions, cancel fractions, and use mixed numbers
AN b Convert between mixed numbers and improper fractions

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:

- Visualise a fraction diagrammatically
- Understand a fraction as part of a whole
- Recognise and write fractions in everyday situations
- Find fractions of amounts
- 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
- Multiple and divide fractions
- Write an improper fraction as a mixed fraction

DIFFERENTIATION & EXTENSION

Careful differentiation is essential as this topic is dependent on the student's ability
Relate simple fractions to percentages and vice versa
Work with improper fractions and mixed numbers, eg divide 5 pizzas between 3 people
Solve word problems involving fractions and real life problems, eg finding the perimeter of a shape with sides with fractional measurements
Link fractions with probability questions

NOTES

Regular revision of fractions is essential
Demonstrate how to use the fraction button on a calculator, in order to be able to check solutions
Use real-life examples whenever possible
Functional Elements – include practice of fraction arithmetic in problems in context

Module 5 APPLICATIONS **Time: 4 – 6 hours**

Tier: Foundation – Unit 1

Content: Fractions, decimals and percentages

AN f	Convert between fractions, decimals and percentages
AN f	Use fractions, decimals and percentages to compare proportions
AN h	Find a fraction of a quantity
AN h	Express a number as a fraction of another number
AN g, h	Use percentages
AN h	Express a given number as a percentage of another
AN h	Interpret fractions, decimals and percentages as operators
AN h	Find a percentage of a quantity
AN m	Use calculators effectively and efficiently

PRIOR KNOWLEDGE

Four operations of number
The concepts of a fraction and a decimal
Number complements to 10 and multiplication tables
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
- Convert between fractions decimals and percentages
- Write one number as a percentage of another number
- Calculate the percentage of a given amount
- Find a fraction of a quantity
- Write one number as a fraction of another number
- Use percentages to solve problems
- Convert between fractions, decimals and percentages to find percentage change
- Find a percentage of a quantity in order to increase or decrease
- Use percentages in real-life situations
    - price after VAT
    - profit or loss
    - simple interest
    - income tax calculations
    - annual rate of inflation

DIFFERENTIATION & EXTENSION

Consider fractional percentages of amounts, eg 12.5% = 0.125 = $\frac{1}{8}$

Consider percentages which convert to recurring decimals (eg $33\frac{1}{3}\%$), and situations which lead to percentages of more than 100%

Use fraction, decimal and percentage dominos or follow me cards
Investigate the many uses made of percentages, particularly in the media
Practise the ability to convert between different forms
Use a mixture of calculator and non-calculator methods
Use functional skills questions to look at questions in context
Combine multipliers to simplify a series of percentage changes
Use problems which lead to the necessity of rounding to the nearest penny, eg real-life contexts
Investigate comparisons between simple and compound interest calculations

NOTES

Use Functional Elements questions using fractions, eg $\frac{1}{4}$ off the list price when comparing different sale prices

Keep using non-calculator methods, eg start with 10%, then 1% in order to required percentages

Use plenty of practical examples that can be linked to Functional Elements, eg VAT calculations

Module 6 APPLICATIONS **Time: 4 – 6 hours**

Tier: Foundation – Unit 1

Content: Algebraic manipulation **COMMON**

AA a Simplify terms, products and sums
AA a Multiply a single term over a bracket
AA a Take out common factors
AA a Substitute into given expressions and formulae
AA a Use squares and cubes to write expressions
AA a Use index laws to simplify expressions

PRIOR KNOWLEDGE

Know that a letter can be used to represent a number
Ability to use negative numbers with the four operations
Experience of using BIDMAS in calculations without a calculator

OBJECTIVES

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

- Simplify expressions with like terms, eg $x^2 + 3x^2$; $3ab + 5ab + 2c^2$
- Expand and factorise expressions with one pair of brackets, eg expand $x(2x + 3y)$; factorise $3xy^2 - 6x^2y$
- Expand and simplify expressions involving more than one pair of brackets, eg $3(x + 4) - 2(x - 3)$
- Substitute positive and negative numbers into expressions such as $3x^2 + 4$ and $2x^3$
- Substitute into simple formulae
- Use index laws to simplify expressions

DIFFERENTIATION & EXTENSION

Expand algebraic expressions involving a pair of brackets
Use formulae from science and mathematics, eg $F = 2C + 30$
Look at patterns in games like 'frogs', eg Total moves = $R \times G + R + G$
Look at methods to understand expressions, eg there are 'b' boys and 'g' girls in a class, what is the total 't' number of students in the class
Further work, such as collecting like terms involving negative terms, collecting terms where each term may consist of more than one letter, eg $3ab + 4ab$

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 7 APPLICATIONS Time: 4 – 6 hours

Tier: Foundation – Unit 1

Content: Financial and business applications

AF a	Carry out calculations relating to enterprise, saving and borrowing, appreciation and depreciation
AF b	Use mathematics in the context of personal and domestic finance including loan repayments, budgeting, RPI and CPI, loan rates and commission
AN g	Use multipliers for percentage change, including simple and compound interest
AN i	Find proportional change
AN m	Use calculators effectively and efficiently
AF c	Use spreadsheets to model financial situations
AF d	Construct and use flow charts (financial)

PRIOR KNOWLEDGE

Four operations of number
The concepts of a fraction and a decimal
Number complements to 10 and multiplication tables
Awareness that percentages are used in everyday life

OBJECTIVES

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

- Use percentages to solve problems
- Convert between fractions, decimals and percentages to find percentage change
- Find a percentage of a quantity in order to increase or decrease
- Use percentages in real-life situations
  - price after VAT
  - profit or loss
  - simple and compound interest
  - income tax calculations
  - annual rate of inflation
- Use percentages and multipliers for savings, borrowing, exchange rates
- Use simple index numbers (RPI and CPI)
- Use spreadsheets to model a financial problem or budget
- Construct a flow chart
- Use a flow chart

DIFFERENTIATION & EXTENSION

Use a mixture of calculator and non-calculator methods
Use functional skills questions to look at questions in context
Combine multipliers to simplify a series of percentage changes
Use problems which lead to the necessity of rounding to the nearest penny, eg real-life contexts

NOTES

Use plenty of practical examples that can be linked to Functional Elements, eg VAT calculations
Newspapers and the internet can be a source of financial information for comparison and discussion
Investigate comparisons between simple and compound interest calculations

Module 8 APPLICATIONS Time: 4 – 6 hours

Tier: Foundation – Unit 1

Content: Linear equations and inequalities COMMON

AA b Set up simple equations
AA b Solve equations by using inverse operations or by transforming both sides in the same way
AA b Solve linear equations with integer or fractional coefficients, in which the unknown appears on either side or on both sides of the equation
AA b Solve 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
AA b *Set up and solve simple inequalities in one variable*

PRIOR KNOWLEDGE:

Experience of finding missing numbers in calculations
The idea that some operations are the reverse of each other
Experience of using letters to represent quantities
Be able to draw a number line
An understanding of fractions and negative numbers

OBJECTIVES

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

- Set up simple equations
- Rearrange simple equations
- Solve simple equations
- Solve linear equations with integer coefficients, in which the unknown appears on either side or on both sides of the equation
- Solve linear equations which include brackets, those that have negative signs occurring anywhere in the equation, and those with a negative solution
- Solve linear equations in one unknown, with integer or fractional coefficients
- *Use linear equations to solve word problems*
- *Set up and solve simple linear inequalities in one variable*

DIFFERENTIATION & EXTENSION

Derive equations from practical situations (such as finding unknown angles in polygons or perimeter problems)

Solve equations where manipulation of fractions (including negative fractions) is required

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

Remind students of the need to set their work out clearly, keeping the equal signs in line

Module 9 APPLICATIONS Time: 3 – 5 hours

Tier: Foundation – Unit 1

Content: Linear graphs and $y = mx + c$ COMMON

AA d Use the conventions for coordinates in the plane
AA d Plot points in all four quadrants
AA d Find the midpoint of a line segment
AA e Draw, label and scale axes
AA e Recognise (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
AA e 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
AA e Plot graphs of functions in which y is given explicitly in terms of x, or implicitly
AA j Find the gradient of a straight line from a graph
AA j Find gradients of linear functions
AA j Interpret gradients in context

PRIOR KNOWLEDGE

Substitute positive and negative numbers into algebraic expressions
Plot coordinates in the first quadrant
Calculate the mean of two numbers
Identify properties of basic shapes
Rearrange to change the subject of a formula

OBJECTIVES

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

- Add a point to a coordinate grid to complete a given shape (parallelogram, rhombus, trapezium, square)
- Find the coordinates of the midpoint of a line segment
- Understand how to represent points in 2-D
- 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
- Understand linear functions in practical problems, eg conversion graphs
- Find the gradient of a straight line graph

DIFFERENTIATION & EXTENSION

Find the equation of the line through two given points
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
Cover horizontal and vertical lines ($x = c$ and $y = c$) [Students often forget these]

NOTES

Careful annotation should be encouraged
Students should label the coordinate axes 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, ie science, geography etc

Module 10 APPLICATIONS Time: 5 – 7 hours

Tier: Foundation – Unit 1

Content: Angle facts and geometric shapes COMMON

AG a Basic angle facts on a straight line, at a point, on a straight line, vertically opposite angles
AG b, c Properties of triangles and quadrilaterals
AG b Understand and use the sum of angles in a triangle is 180°
AG b Give reasons for angle calculations
AG b Angles associated with intersecting lines

PRIOR KNOWLEDGE

The concept of parallel lines
The concept of vertical and horizontal
The concept of an angle between two lines
Experience in drawing triangles, quadrilaterals and circles

OBJECTIVES

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

- Recall and use properties of angles
  – angles at a point
  – angles at a point on a straight line
  – perpendicular lines
  – vertically opposite angles
- Find the size of missing angles
- Use two letter notation for a line and three letter notation for an angle
- Identify triangles by their properties (scalene, isosceles, equilateral, right-angled, obtuse, and acute)
- Prove the angle sum in a triangle is 180°
- Use the angle properties of triangle to find missing angles
- Prove the exterior angle of a triangle is equal to the sum of the two opposite interior angles
- Identify quadrilaterals by their properties (trapezium, parallelogram, rhombus, rectangle, square, kite)

DIFFERENTIATION & EXTENSION

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

NOTES

Use lots of practical drawing examples to help illustrate properties of various shapes

Module 11 APPLICATIONS **Time: 3 – 4 hours**

Tier: Foundation – Unit 1

Content: Line and rotational symmetry **COMMON**

AG d Recognise and visualise reflection and rotational symmetry of 2-D shapes
AG d Be able to identify and draw lines of reflection
AG d Start the line of reflective symmetry as a simple algebraic equation
AG d Be able to identify the order of rotational symmetry of a 2-D shape

PRIOR KNOWLEDGE

Knowledge and properties of 2-D shapes

OBJECTIVES

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

- Recognise line and rotational symmetry in 2-D shapes
- Draw in the line of symmetry (or state its equation if the shape is on a coordinate grid)
- State the order of rotational symmetry

DIFFERENTIATION & EXTENSION

Extend to planes of symmetry for 3-D solids
Ask students to find their own examples of symmetry in real life

NOTES

Accurate drawing skills need to be reinforced
Some students find visualising 3-D objects difficult and simple models will help with this
Use tracing paper or mirrors to help with symmetry questions

Module 12 APPLICATIONS **Time: 1 – 2 hours**

Tier: Foundation – Unit 1

Content: Circles **COMMON**

AG h Recall names and definitions of parts of a circle
AG h Draw circles accurately
AG h Understand related circle terms such as semi circle and quarter circle

PRIOR KNOWLEDGE

Properties of shapes
Ability to draw a circle with compasses
Measuring a length in cm or mm

OBJECTIVES

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

- Identify and name the various parts of a circle (centre, radius, diameter, circumference, sector, segment, arc and chord)
- Draw circles, using a pair of compasses given the radius or diameter

DIFFERENTIATION & EXTENSION

Measure circumference, radius and diameter to discover relationships in preparation for Unit 2 (introduction to π)

NOTES

Students should present working clearly and accurately
Draw lines and circles using an HB pencil
A sturdy pair of compasses is essential and spare equipment is advisable

Module 13 APPLICATIONS **Time: 3 – 5 hours**

Tier: Foundation – Unit 1

Content: Area and perimeter **COMMON**

AG o Recall and use formulae to find the area of triangles, rectangles, parallelograms
AG o Find the area of a trapezium
AG o Find the perimeter and area of shapes made from triangles and rectangles
AG o *Find the surface area using rectangles and triangles*

PRIOR KNOWLEDGE

The names of quadrilaterals
Ability to substitute numbers into a formula
Some notion of the difference between length and area
Properties of cubes, cuboids and other common 3-D objects

OBJECTIVES

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

- Use the area formulae for triangles, rectangles, parallelograms and trapeziums
- Be able to find the perimeter and area of a compound shape
- *Be able to find the surface area of shapes using rectangles and triangles*

DIFFERENTIATION & EXTENSION

Further problems involving combinations of shapes
Use compound shape methods to investigate the areas of other standard shapes, eg kites
Practical activities, eg using estimation and accurate measuring to calculate perimeters and areas of classroom or corridor floors

NOTES

Discuss the correct use of language and units
Ensure that students can distinguish between perimeter and area
Try to impress upon them that perimeter starts with a 'P' which reminds them to plus the sides
Many students have little real understanding of perimeter and area
Practical experience is essential to clarify these concepts
Functional Elements – ensure that students get plenty of practice in using perimeter and area in solving problems possibly incorporating cost of, for example, carpeting a room, covering parts of a garden with lawn

Module 14 APPLICATIONS Time: 2 – 4 hours

Tier: Foundation – Unit 1

Content: Reading scales and converting units

AM a Interpret scales on a range of measuring instruments, and recognise the inaccuracy of measurements
AM f Measure and draw lines
AM b Convert measurements from one unit to another
AM c Make sensible estimates of a range of measures

PRIOR KNOWLEDGE

An awareness of the imperial system of measures
Strategies for multiplying and dividing by 10 (for converting metric units)

OBJECTIVES

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

- Interpret scales on a range of measuring instruments including mm, cm, m, km, m*l*, c*l*, *l*, mg, g, kg, tonnes, °C
- Indicate given values on a scale
- Know that measurements using real numbers depend upon the choice of unit
- Recognise that measurements given to the nearest whole unit may be inaccurate by up to one half in either direction
- Convert units within one system
- Convert metric units to metric units (Metric equivalents should be known)
- Convert imperial units to imperial units (NB: Conversion between imperial units will be given)
- Convert between metric and imperial measures
- Know rough metric equivalents of pounds, feet, miles, pints and gallons, ie

Metric	Imperial
1 kg	= 2.2 pounds
1.75 pints	= 1 litre
4.5 *l*	= 1 gallon
8 km	= 5 miles
30 cm	= 1 foot

- Estimate measurements

DIFFERENTIATION & EXTENSION

Use a practical activity by collecting assorted everyday items and weighing and measuring to check the estimates of their lengths, weights and volumes
Use the internet to find the weights, volumes and heights of large structures such as buildings, aeroplanes and ships
Take the opportunity to do some real measuring/estimating around school
Use conversions for height and weight of students, cars, bridges. Combine with simple scales such as 1 cm to 1 m for classrooms, playing fields and bedrooms. Ask students to draw a plan of their bedrooms including the furniture

NOTES

Measurement is essentially a practical activity
Use a range of everyday objects to bring reality to lessons
Use Functional Elements as a source of practical activities

Module 15 APPLICATIONS **Time: 2 – 4 hours**

Tier: Foundation – Unit 1

Content: Similarity and congruence **COMMON**

AG e Identify shapes which are similar
AG e Identify shapes which are congruent
AG e Understand what makes two shapes similar or congruent
AG e Recognise that enlargements preserve angle but not length
AG e Understand the relationship between lengths in similar figures

PRIOR KNOWLEDGE

The mathematical names of triangles and angles
Terms 'perpendicular', 'parallel' and 'arc'
Transformations (particularly enlargements)

OBJECTIVES

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

- Identify congruent shapes
- Identify similar shapes
- 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

DIFFERENTIATION & EXTENSION

Link with the information to be able to construct a triangle, eg SSS, ASA, SAS
Link with tessellations and enlargements
Harder problems in congruence

NOTES

All working should be presented clearly and accurately
If a student is not sure how to approach a question, advise them to write 'easy' numbers in pencil on their diagram, use these to approach the problem initially and then repeat the process with the 'real' values in the question

Module 16 APPLICATIONS **Time: 3 – 5 hours**

Tier: Foundation – Unit 1

Content: Collecting data

AS d Understand and use statistical problem solving process (handling data cycle)
AS e Design an experiment or survey, identifying possible sources of bias
AS f Design data-collection sheets distinguishing between different types of data
AS g Extract data from publications, charts, tables and lists
AS h Design, use and interpret two-way tables for discrete and grouped data

PRIOR KNOWLEDGE

An understanding of why data needs to be collected
Experience of simple tally charts
Some idea about different types of graphs
Experience of inequality notation and signs

OBJECTIVES

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

- Specify the problem and plan
- Decide what data to collect and what statistical analysis is needed
- Collect data from a variety of suitable primary and secondary sources
- Use suitable data collection techniques
- Process and represent the data
- Interpret and discuss the data
- Understand how sources of data may be biased
- Identify which primary data they need to collect and in what format, including grouped data
- Consider fairness
- Design a question for a questionnaire
- Criticise questions for a questionnaire
- Design and use data-collection sheets for grouped, discrete and continuous data
- Collect data using various methods
- Sort, classify and tabulate data and discrete or continuous quantitative data
- Group discrete and continuous data into class intervals of equal width
- Extract data from lists and tables
- Design and use two-way tables for discrete and grouped data
- Use information provided to complete a two way table

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 choosing limited investigations, eg favourite football team

NOTES

For Functional Elements activities, it is worth collecting data at different times of the day, eg to compare types of shopper in a centre. Get data from holiday brochures to compare resorts for temperature, rainfall and type of visitor

Emphasise the differences between primary and secondary data. Mayfield High data can be used as an example of secondary data

Discuss sample size and mention that a census is the whole population. In the UK, the census is every year that ends in '1', so the next census is in 2011

If students are collecting data as a group, then they should use the same procedure

Emphasise that continuous data is data that is measured, eg temperature

Module 17 APPLICATIONS Time: 3 – 5 hours

Tier: Foundation – Unit 1

Content: Charts and graphs

AS k Produce charts and diagrams for categorical data including bar chart and pictograms
AS l Produce and interpret diagrams for ungrouped discrete numerical data, including vertical line charts and stem and leaf diagrams
AS m Produce and interpret diagrams for grouped discrete data and continuous data
AS j Compare distributions and make inferences

PRIOR KNOWLEDGE

An understanding of why data needs to be collected and some idea about different types of graphs

OBJECTIVES

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

- Draw:
  - Pictograms
  - Bar charts
  - Frequency diagrams for grouped discrete data,
  - Line (vertical) graphs
  - Frequency polygons for grouped data
  - Composite bar charts
  - Comparative and dual bar charts
- Interpret:
  - composite bar charts
  - stem and leaf diagrams
  - scatter graphs
  - frequency polygons
- From pictograms, bar charts, line graphs and histograms with equal class intervals:
  - read off frequency values
  - calculate total population
  - find greatest and least values
- Recognise simple patterns and characteristic relationships in bar charts, line graphs and frequency polygons
- Use comparative bar charts to compare distributions

DIFFERENTIATION & 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

NOTES

Reiterate that clear presentation with axes correctly labelled is important, and to use a ruler to draw straight lines
Stem and leaf diagrams must have a key
Show how to find the median and the mode from a stem and leaf diagram
Make comparisons between previously collected data
Encourage students to work in groups and present their charts (useful display material for classrooms/corridors)
Use Excel Graph wizard
Consider Functional Elements by comparing rainfall charts, distributions of ages in cinemas etc

Module 18 APPLICATIONS Time: 3 – 4 hours

Tier: Foundation – Unit 1

Content: Pie charts

AS k Produce and interpret charts and diagrams for categorical data (pie charts)

PRIOR KNOWLEDGE

Measuring and drawing angles
Fractions of simple quantities

OBJECTIVES

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

- Represent data in a pie chart
- Interpret data in a pie chart
- Understand that the frequency represented by corresponding sectors in two pie charts is dependent upon the total populations represented by each of the pie charts
- From pie charts
  - work out amounts for each category
  - calculate the total population
  - find greatest and least values

DIFFERENTIATION & EXTENSION

Use this module to refresh memories on frequency and tally tables
Practise the ability to divide by 20, 30, 40, 60 etc
This can be delivered as a practical module that could lead to wall display. Remind students about bias, eg only asking their friends which band they like
Compare pie charts for, eg boys and girls, to identify similarities and differences
Ask students to combine two pie charts

NOTES

Angles for pie charts should be accurate to within 2°

Module 19 APPLICATIONS Time: 5 – 7 hours

Tier: Foundation – Unit 1

Content: Averages and range

AS p	Calculate median, mean, range, mode and modal class
AN m	Use calculators efficiently and effectively, including statistical functions
AS l	Produce and interpret diagrams for ungrouped discrete numerical data including (ordered) stem and leaf diagrams

PRIOR KNOWLEDGE

Midpoint of a line segment
Addition and subtraction
Different statistical diagrams

OBJECTIVES

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

- Calculate the mean, mode, median and range for discrete data
- Calculate the mean, mode, median and range from an ordered stem and leaf diagram
- Produce an ordered stem and leaf diagram
- Calculate the modal class and interval containing the median for continuous data
- Calculate the mean, median and mode from a frequency table
- Estimate the mean of grouped data using the mid-interval value
- Compare the mean and range of two distributions
- Recognise the advantages and disadvantages between measures of average
- Calculate the mean of a small data set, using the appropriate key on a scientific calculator

DIFFERENTIATION & EXTENSION

Find the mean for grouped continuous data with unequal class intervals
Collect continuous data and decide on appropriate (equal) class intervals, then find measures of average
Use the statistical functions on a calculator or a spreadsheet to calculate the mean for continuous data

NOTES

Ask class to do their own survey with data collection sheets, eg to find the average number of children per family in the class
The internet and old coursework tasks are a rich source of data to work with, eg *Second-Hand Car Sales*, *Mayfield High* data etc

Module 20 APPLICATIONS Time: 4 – 5 hours

Tier: Foundation – Unit 1

Content: Scatter graphs, correlation and time series

AS q Recognise correlation and draw and/or use lines of best fit by eye, understanding and interpreting what these represent, appreciating that correlation does not imply causality
AS o Work with time series including their graphical representation
AS i Look at data to find patterns and exceptions
AF c Use spreadsheets to model statistical situations

PRIOR KNOWLEDGE

Plotting coordinates and scale
The concept of a variable
Recognition that a change in one variable can affect another
Linear graphs

OBJECTIVES

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

- Draw and produce a scatter graph
- Look at data to find patterns and exceptions
- Distinguish between positive, negative and zero correlation using lines of best fit
- Interpret correlation in terms of the problem
- Understand that correlation does not imply causality
- Draw lines of best fit by eye and understand what they represent
- Use a line of best fit to predict values of one variable given values of the other variable
- Be able to work out time series, draw time series graphs
- Use spreadsheets to model a statistical situation

DIFFERENTIATION & EXTENSION

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, eg height and length of arm
Use a spreadsheet, or other software, to produce scatter diagrams/lines of best fit
Investigate how the line of best fit is affected by the choice of scales on the axes, eg use car data with age and price of the same make of car

NOTES

The line of best fit should pass through the coordinate representing the mean of the data
Label all axes clearly and use a ruler to draw all straight lines
Remind student the line of best fit does not necessarily go through the origin of the graph

Unit 2: Applications 2 - Foundation

Centres may wish to teach this unit alongside Unit 1 if they prefer to deliver their curriculum in a holistic manner.
They would enter students for both papers at the same time.
However, some centres may prefer to concentrate on Unit 1 first and enter their students in either June 2011 or in November 2011. The benefit of this model is that it allows a full analysis of the paper using ResultsPlus before students are prepared for a possible resit (one resit per unit is permitted).
In addition, some centres that traditionally organise their mock examinations in November or December may use this opportunity for an external body to mark and analyse their papers. It may also flag up any students who would benefit from a change of tier for either their resit examination or Unit 2 assessment.

Module 1 APPLICATIONS **Time: 3 – 5 hours**

Tier: Foundation – Unit 2

Content: Integers, decimals and fractions **COMMON**

AN a Add, subtract, multiply and divide integers, fractions and decimals with a calculator
AN a Understand and use number operations and the relationships between them, including inverse operations and hierarchy of operations
AN a Solve a problem involving division by a decimal
AN b Recall the fraction to decimal conversion of familiar simple fractions
AN b Convert between fractions and decimals
AN a Find reciprocals

PRIOR KNOWLEDGE

Appreciation of place value
Experience of the four operations using whole numbers
Knowledge of integer complements to 10 and 100
Secure multiplication facts to 10×10
Knowledge of strategies for multiplying and dividing whole numbers by 10
The concept of a fraction and a decimal

OBJECTIVES

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

- Use brackets and the hierarchy of operations (BIDMAS)
- Add, subtract, multiply and divide integers, negative numbers, decimals and fractions **with** a calculator
- Check answers to a division sum using multiplication, eg use inverse operations
- Convert between fractions and decimals

DIFFERENTIATION & EXTENSION

Convert 0.1222222222….. to a fraction

NOTES

Present all working clearly with decimal points in line
Emphasise that all working should be shown
Students should be confident when using their calculator functions
Functional Elements – ensure that students get plenty of practice solving problems in context involving the arithmetic of integers, decimals and fractions

Module 2 APPLICATIONS Time: 3 – 5 hours

Tier: Foundation – Unit 2

Content: Real-life graphs

AA k Construct linear functions from real-life problems and plotting their corresponding graphs
AA n Discuss, plot and interpret graphs (which may be non-linear) modelling real situations including journeys/travel graphs
AM d Understand and use compound measures including speed

PRIOR KNOWLEDGE

Experience at plotting points in all quadrants
Experience at labelling axes and reading scales
Knowledge of metric units
Know that 1 hour = 60 mins, 1 min = 60 seconds
Know how to find speed
Know how to read scales, draw and interpret graphs

OBJECTIVES

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

- Read bus and train timetables
- Convert between 12-hour and 24-hour clock times
- Draw distance time graphs
- Calculate speed
- Interpret distance time graphs and solve problems
- Draw graphs representing 'real' examples like filling a bath/containers
- Interpret and draw linear graphs, including conversion graphs, fuel bills etc
- Solve problems relating to mobile phone bills with fixed charge and price per unit
- Interpret non-linear graphs like the number of cans in a vending machine at times throughout the day

DIFFERENTIATION & EXTENSION

Use open ended questions that test student awareness of what intersections mean, eg mobile phone bills
Use spreadsheets to generate straight-line graphs and pose questions about gradient of lines
Use ICT packages or graphical calculators to draw straight line graphs and quadratic graphs
Draw and interpret non-linear curves
Make up a graph and supply the commentary for it
Ask students to plan and cost a holiday from a brochure

NOTES

Clear presentation is important with axes clearly labelled
Students need to be able to recognise linear graphs and also be able to recognise when their graph is incorrect
Link graphs and relationships in other subject areas, eg science, geography
Students should have plenty of practice interpreting linear graphs for Functional Elements problems

Module 3 APPLICATIONS Time: 3 – 4 hours

Tier: Foundation – Unit 2

Content: Trial and improvement

AA i Find approximate solutions of equations using systematic trial and improvement
AN m Use calculators effectively and efficiently

PRIOR KNOWLEDGE

Substituting numbers into algebraic expressions
Dealing with decimals on a calculator
Comparing/ordering decimals

OBJECTIVES

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

- Solve algebraic equations involving squares and cubes, eg $x^3 + 3x = 40$
- Solve real life problems on areas and volumes, eg the length of a rectangular room is 2 m longer than the width. If the area is 30 m², find the width

DIFFERENTIATION & EXTENSION

Can look at various calculator functions like 'square root' and 'cube root'
Introduce by trial and improvement
Solve functions of the form $\frac{1}{x} = x^2 - 5$

NOTES

Students should be encouraged to use their calculator efficiently by using the 'replay' or ANS/EXE function keys
Students need to take care when entering negative values to be squared
Students should write down all the digits on their calculator display and only round the final answer to the required degree of accuracy

Module 4 APPLICATIONS **Time: 3 – 6 hours**

Tier: Foundation – Unit 2

Content: Ratio and proportion **COMMON**

AN l Divide a quantity in a given ratio
AN k Solve word problems about proportion and ratio
AN k Understand and use direct proportion
AA m *Recognise and use graphs that illustrate direct proportion*
AA m *Use and interpret maps and scale drawings*

PRIOR KNOWLEDGE

Fractions and decimals

OBJECTIVES

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

- Appreciate that, eg the ratio 1:2 represents $\frac{1}{3}$ and $\frac{2}{3}$ of a quantity
- Divide quantities in a given ratio, eg divide £20 in the ratio 2:3
- Solve word problems involving ratios
- Solve simple direct proportion problems using the unitary method or by proportional change (from a table of values or a word problem)
- *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*

DIFFERENTIATION & EXTENSION

Harder problems involving multi-stage calculations

NOTES

Students often find three-part ratios difficult
Link ratios given in different units to metric and imperial units
Use Functional Elements as a source of practical activities for practising scale drawing and finding 'real life' distances from maps

Module 5 APLICATIONS **Time: 4 – 6 hours**

Tier: Foundation – Unit 2

Content: Solving linear inequalities **COMMON**

AA b Set up linear inequalities in one variable
AA f Solve simple linear inequalities in one variable and represent the solution set on a number line
AA f Use the correct notation to show inclusive and exclusive inequalities

PRIOR KNOWLEDGE

Experience of finding missing numbers in calculations
The idea that some operations are 'opposite' to each other
An understanding of balancing both sides of an equation
Experience of using letters to represent quantities
Be able to draw a number line
Linear equations and inequalities

OBJECTIVES

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

- Set up linear inequalities in one variable
- Solve linear inequalities in one variable and present the solution set on a number line

DIFFERENTIATION & EXTENSION

Use of inverse operations and rounding to 1 sf could be applied to more complex calculations
Derive inequalities from practical situations (such as finding unknown angles in polygons or perimeter problems)
Solve linear inequalities where manipulation of fractions is required

NOTES

Students can leave their answers in fractional form where appropriate
Interpreting the direction of an inequality is a problem for many
Students should use the correct notation when showing inequalities on a number line, eg a solid circle to show inclusion of a point, an empty circle to show exclusion of a point

Module 6 APPLICATIONS **Time: 3 – 6 hours**

Tier: Foundation – Unit 2

Content: Substitution and formulae **COMMON**

AA c Substitute numbers into a formula
AA c Substitute positive and negative numbers into expressions such as $3x^2 + 4$ and $2x^3$
AA c Use formulae from mathematics and other subjects expressed initially in words and then using letters and symbols
AA c Derive a formula, including those with square, cubes and roots

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
Solving linear equations

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
- Simple change of subject of a formula, eg rearrange 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

DIFFERENTIATION & EXTENSION

Use negative numbers in formulae involving indices
Various investigations leading to generalisations
Further problems in generating formulae from given information
Apply changing the subject to physics formulae, eg equations of motion

NOTES

Emphasise good use of notation, eg $3ab$ means $3 \times a \times b$
Students need to be clear on the meanings of the words expression, equation, and formula
Show a linear equation first and follow the same steps to rearrange a similarly structured formula
Link with formulae for area, volume, and surface area

Module 7 APPLICATIONS **Time: 3 – 5 hours**

Tier: Foundation – Unit 2

Content: Using graphs to solve equations **COMMON**

AA i Generate points and plot graphs of quadratic functions
AA i Find approximate solutions of a quadratic equation from the graph of the corresponding quadratic function

PRIOR KNOWLEDGE

Experience at plotting points in all quadrants
Linear sequences and straight-line graphs
Substitution

OBJECTIVES

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

- Draw linear graphs from tabulated data, including real-world examples
- Understand when two straight lines intersect this is the solution to the two simultaneous equations
- Generate points and plotting graphs of quadratic functions
- Plot the graphs of quadratic functions for positive and negative values of x
- Solve a quadratic equation by reading the roots off the x-axis from the graph of that equation

DIFFERENTIATION & EXTENSION

Plot graphs of the form $y = mx + c$ where the student has to generate their own table and draw out their own axes
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 and quadratic graphs
Discuss the shape of quadratic curves and introduce the word ‘parabola’

NOTES

Clear presentation with axes labelled correctly is vital
Recognise linear graphs and identify when data may be incorrect
Link to graphs and relationships in other subject areas, ie science, geography etc

Module 8 APPLICATIONS **Time: 3 – 5 hours**

Tier: Foundation – Unit 2

Content: Angle facts and polygons **COMMON**

AG b Properties of triangles and quadrilaterals
AG b Understand some simple geometric proofs
AG b Mark parallel lines on a diagram
AG b Angles associated with parallel lines
AG b, e Give reasons for angle calculation

PRIOR KNOWLEDGE

The concept of parallel lines
The concept of vertical and horizontal
The concept of an angle between two lines
Experience in drawing triangles, quadrilaterals and circles

OBJECTIVES

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

- Identify triangles by their properties (scalene, isosceles, equilateral, right-angled, obtuse, and acute)
- Prove the angle sum in a triangle is 180° and explain why the angles inside a quadrilateral add up to 360°
- Use the angle properties of a triangle to find missing angles
- Prove the exterior angle of a triangle is equal to the sum of the two opposite interior angles
- Identify quadrilaterals by their properties (trapezium, parallelogram, rhombus, rectangle, square, kite)
- Use alternate, corresponding and co-interior angles in parallel lines to find missing angles

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 tessellations

NOTES

Lots of practical drawing examples to help illustrate properties of various shapes
Diagrams used in examinations are often not drawn accurately
Use tracing paper to show which angles in parallel lines are equal
Useful memory device is ‘the FUZ is the CIA’ (F, U and Z angles’ real names are Corresponding, Interior and Alternate)
Although corresponding, interior and alternate must be used when giving reasons
Encourage students to always put the reasons and ‘quote’ the angle fact/theorem used [important for the new assessment objectives]

Module 9 APPLICATIONS **Time: 2 – 5 hours**

Tier: Foundation – Unit 2

Content: Similarity and congruence **COMMON**

AG e Understand congruence and similarity including the relationship between lengths in similar shapes

PRIOR KNOWLEDGE

The mathematical names of triangles and angles
Understanding of the terms perpendicular, parallel and arc
Transformations (particularly enlargements) (Unit 1)

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
- Use similarity or congruence to solve problems

DIFFERENTIATION & EXTENSION

Link with the information to be able to construct a triangle, eg SSS, ASA, SAS
Harder problems in congruence

NOTES

All working should be presented clearly and accurately
If a student is not sure how to approach a question, advise them to write 'easy' numbers in pencil on their diagram, use these to approach the problem initially and then repeat the process with the 'real' values in the question
Use plastic shapes as templates to draw tessellations (or use a tracing paper template)
Link angles in a polygon to explain why some shapes do or do not tessellate

Module 10 APPLICATIONS **Time: 6 – 7 hours**

Tier: Foundation – Unit 2

Content: Pythagoras' theorem **COMMON**

AG f Understand, recall and use Pythagoras' theorem in 2-D
AA d Calculate the length of a line segment
AN m Use calculators effectively and efficiently

PRIOR KNOWLEDGE

Names of triangles and quadrilaterals and their symmetries
Properties of rectangles, parallelograms and triangles
Indices and roots, substitution, equations and changing the subject

OBJECTIVES

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

- Find missing sides of right-angle triangles by using Pythagoras' theorem
- Find the distance between two coordinates using Pythagoras' theorem
- Give answers as decimals for Pythagoras problems
- Solve problems involving geometric figures (including triangles within circles) in which a right-angle triangle has to be extracted in order to solve it using Pythagoras' theorem

DIFFERENTIATION & EXTENSION

Introduce Pythagoras' theorem in 3-D (not on the tier, but a good extension for the most able)

NOTES

Students should be encouraged to become familiar with one make of calculator
Emphasise that scale drawings will score no marks for this type of question
A useful mnemonic for remembering Pythagoras is 'Square it, Square it, Add or subtract it, Square root it' [This eliminates the need for formal algebra for the less able students]
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

Module 11 APPLICATIONS **Time: 3 – 5 hours**

Tier: Foundation – Unit 2

Content: Circles **COMMON**

AG n Find circumferences of circles and areas enclosed by circles, recalling relevant formulae

AG n Find the perimeter and area of semi circles and quarter circles

AA o *Estimate areas of irregular shapes*

PRIOR KNOWLEDGE

Perimeter and area (Unit 1)
Formulae and substitution

OBJECTIVES

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

- Use the ratio between the circumference and diameter is always constant for a circle (ie π)
- Use the formula for circumference and area of a circle
- Solve problems involving the circumference and area of a circle (and simple fractional parts of a circle)
- *Estimate areas of irregular shapes*

DIFFERENTIATION & EXTENSION

Extend to areas of sectors and length of arc (not on Foundation tier)
Extend to areas on maps

NOTES

'Now! I Know Pi' is a good way to learn the approximate value (The number of letters of each word and the ! is the
decimal point)
Locate π button on a calculator
Students must learn the formulae for the circumference and area of a circle
Also 'Cherry Pie Delicious' is $C = \pi D$ and 'Apple Pies are too' is $A = \pi r^2$
Final answers rounded to the required degree of accuracy
When estimating areas, start with finding the area of a leaf or similar object and counting squares

Module 12 APPLICATIONS **Time: 3 – 5 hours**

Tier: Foundation – Unit 2

Content: Surface area and volume **COMMON**

AG n	Find the surface area of a cylinder
AG o	Find the surface area of simple shapes (prisms) using the formulae for triangles and rectangle
AG p	Calculate the volumes of right prisms, including the triangular prism, and shapes made from cubes and cuboids
AG p	Recall and use the formula for the volume of a cuboid
AG p	Find the volume of a cylinder
AG p	Find the volume of a compound solid
AM b	*Convert between metric area measures*
AM b	*Convert between metric volume measures and between metric measures of volume and capacity*
AM d	*Understand and use compound measures in familiar contexts*

PRIOR KNOWLEDGE

Perimeter and area (Unit 1)
Surface area (Unit 1)
Knowledge of names and properties of 3-D solids
Formulae and substitution

OBJECTIVES

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

- Solve problems involving the volume and surface area of a cylinder
- Solve problems involving the volume and surface area of right prisms
- Find the surface area and the volume of more complex shapes, eg find the volume of an equilateral triangular prism
- *Convert between metric area measures*
- *Convert between metric volume measures*
- *Convert between metric measures of volume and capacity*

DIFFERENTIATION & EXTENSION

Extend to volume of a cone (not on Foundation tier)

NOTES

Use a tower of coins to model the volume of a cylinder
Final answers rounded to the required degree of accuracy
Need to constantly revise the expressions for area or volume of shapes
Students should be aware of which formulae are on the relevant page on the examination paper and which they need to learn
Functional Elements – ensure that students get practice in solving problems involving volumes and surface areas

Module 13 APPLICATIONS Time: 2 – 4 hours

Tier: Foundation – Unit 2

Content: 3-D shapes

AG i Use 2-D representations of 3-D shapes

PRIOR KNOWLEDGE:

The names of standard 2-D and 3-D shapes

OBJECTIVES

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

- Identify and name common solids: cube, cuboid, cylinder, prism, pyramid, sphere and cone
- Know the terms face, edge and vertex
- Use 2-D representations of 3-D shapes
- Use isometric grids
- Draw nets and show how they fold to make a 3-D solid
- Understand and draw front and side elevations and plans of shapes made from simple solids
- Given the front and side elevations and the plan of a solid, draw a sketch of the 3-D solid

DIFFERENTIATION & 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 2-D
Euler's theorem
A useful topic for a wall display – students tend to like to draw 3-D shapes and add interest by using a mixture of colours in the elevations

NOTES

Accurate drawing skills need to be reinforced
Some students find visualising 3-D object difficult so using simple models will help

Module 14 APPLICATIONS Time: 3 – 5 hours

Tier: Foundation – Unit 2

Content: Bearings and accurate drawings

AG k	Draw triangles and other 2-D shapes using a ruler, pair of compasses and a protractor
AG b	Understand and use the angle properties of parallel and intersecting lines, and quadrilaterals
AM e	Understand and use bearings
AG j	Use and interpret maps and scale drawings

PRIOR KNOWLEDGE

The ability to use a ruler and a protractor
Know that angles in a triangle add up to 180°
Know that angles at a point on a straight line sum to 180°
Know that a right angle = 90°

OBJECTIVES

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

- Make accurate drawing of triangles and other 2-D shapes using a ruler and a protractor
- Make an accurate scale drawing from a diagram
- Use bearings to specify direction
- Use three figure bearings to specify direction
- Mark on a diagram the position of point *B* given its bearing from point *A*
- Give a bearing between the points on a map or scaled plan
- Given the bearing of point *A* from point *B*, work out the bearing of *B* from *A*

DIFFERENTIATION & EXTENSION

Practical activities help with the understanding of the properties and proofs – games like 'Guess who I am?'
Use the angle properties of triangles to find missing angles in combinations of triangles
Explore other properties in triangles, quadrilaterals and parallel lines

NOTES

All diagrams should be presently neatly and accurately
Give students a lot of drawing practice, and encourage students to check their drawings
Angles should be accurate to within 2° and lengths accurate to the nearest mm

Module 15 APPLICATIONS Time: 3 – 5 hours

Tier: Foundation – Unit 2

Content: Constructions

AG l Use straight edge and a pair of compasses to do constructions
AG m Construct loci

PRIOR KNOWLEDGE:

Knowledge of types of triangle
Knowledge of the difference between a line and a region

OBJECTIVES

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

- Use straight edge and a pair of compasses to do standard constructions such as:
  - Construct a triangle
  - Construct an equilateral triangle
  - Understand, from the experience of constructing them, that triangles satisfying SSS, SAS, ASA and RHS are unique, but SSA triangles are not
  - Construct the perpendicular bisector of a given line
  - Construct the perpendicular from a point to a line
  - Construct the bisector of a given angle
  - Construct angles of 60°, 90°, 30°, 45°
  - Draw parallel lines
  - Construct diagrams of everyday 2-D situations involving rectangles, triangles, perpendicular and parallel lines
- Draw and construct diagrams from given instructions
  - A region bounded by a circle and an intersecting line
  - A given distance from a point and a given distance from a line
  - Equal distances from 2 points or 2 line segments
  - Regions which may be defined by ‘nearer to’ or ‘greater than’
  - Find and describe regions satisfying a combination of loci

DIFFERENTIATION & EXTENSION

Try to do this module as practically as possible using real life situations, eg horses tethered to ropes, mobile phone masts etc
Use the internet to source ideas for this module
Use loci problems that require a combination of loci

NOTES

All constructions should be presently neatly and accurately
A sturdy pair of compasses is essential
Construction lines should not be erased as they carry valuable method marks
All lines should be correct to within 2 mm and angles correct to 2°

Module 16 APPLICATIONS Time: 7 – 9 hours

Tier: Foundation – Unit 2

Content: Probability

AS a Understand and use the vocabulary of probability and probability scale
AS c Understand and use estimates or measures of probability from relative frequency
AS b Understand and use theoretical models for probabilities including the model of equally likely outcomes
AS r Understand that when a statistical experiment is repeated there will usually be , different outcomes, and that increasing sample size generally leads to better estimates of probability and population characteristics
AS s Discuss and start to estimate risk

PRIOR KNOWLEDGE

Elementary fractions decimals and percentages
Ability to read from a two-way table

OBJECTIVES

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

- Distinguish between events which are: impossible, unlikely, even chance, likely, and certain to occur
- Mark events and/or probabilities on a probability scale of 0 to 1
- Write probabilities in words, fractions, decimals and percentages
- Find the probability of an event happening using theoretical probability
- Find the probability of an event happening using relative frequency
- Estimate the number of times an event will occur, given the probability and the number of trials
- List all outcomes for single events systematically
- List all outcomes for two successive events systematically
- Use and draw sample space diagrams
- Add simple probabilities
- Compare experimental data and theoretical probabilities
- Compare relative frequencies from samples of different sizes
- Identify threats that may have an effect on the outcome of an event
- Understand and use decision tree diagrams to estimate the effect of risk
- Begin to use estimates of costs and probabilities

DIFFERENTIATION & EXTENSION

Use this as an opportunity for practical work
Experiments with dice and spinners
Show sample space for outcomes of throwing two dice (36 outcomes)
Use ‘the horse race’/drawing pins/let students make their own biased dice and find experimental probability

NOTES

Students should express probabilities as fractions, percentages or decimals
Probabilities written as fractions don’t need to be cancelled to their simplest form

Foundation course objectives (1MA0)

Unit 1

Number

AN a	Multiply and divide by negative numbers
AN a	Multiply or divide any number by powers of 10, and any number by a number between 0 and 1
AN a	Add and subtract decimal numbers
AN a	Divide by a decimal by transforming it to a problem involving division by an integer
AN a	Use brackets and the hierarchy of operations
AN a	Use one calculation to find the answer to another
AN a	Understand and use number operations and the relationship between them, including inverse operations and hierarchy of operations (fractions)
AN a	Use the four operations with fractions
AN a, d	Understand place value and round to the nearest integer and to a given power of 10
AN a, d	Check and estimate answers to problems, by using approximations or inverse operations
AN b	Understand and use negative integers both as positions and translations on a number line
AN b	Order integers
AN b	Write decimal numbers in order of size
AN b	Find squares and cubes of numbers and find square roots and cube roots of numbers
AN b	Order fractions
AN b	Compare fractions (and decimals)
AN b	Find equivalent fractions, cancel fractions, and use mixed numbers
AN b	Convert between mixed numbers and improper fractions
AN b	Use index notation and index laws for multiplication and division of integer powers and powers of powers
AN b	Use index laws to simplify and calculate the value of numerical expressions involving multiplication and division of integers
AN c	Understand even, odd and prime numbers
AN c	Find factors and multiples of numbers
AN c	Find common factors and common multiples
AN c	Understand index notation for powers of 10, squares and cubes
AN d	Check and estimate answers to problems using integers
AN d	Round to a given number of significant figures and decimal places
AN f	Convert between fractions, decimals and percentages
AN f	Use fractions, decimals and percentages to compare proportions
AN g	Use multipliers for percentage change, including simple and compound interest
AN g, h	Use percentages
AN h	Find a fraction of a quantity
AN h	Find a percentage of a quantity
AN h	Express a number as a fraction of another number
AN h	Express a given number as a percentage of another
AN h	Interpret fractions, decimals and percentages as operators
AN i	Find proportional change
AN m	Use calculators effectively and efficiently

Financial and Business Applications

AF a	Carry out calculations relating to enterprise, saving and borrowing, appreciation and depreciation
AF b	Use mathematics in the context of personal and domestic finance including loan repayments, budgeting, RPI and CPI, loan rates and commission
AF c	Use spreadsheets to model financial situations
AF d	Construct and use flow charts (financial)

Algebra

AA a	Simplify terms, products and sums
AA a	Multiply a single term over a bracket
AA a	Take out common factors
AA a	Substitute into given expressions and formulae
AA a	Use squares and cubes to write expressions
AA a	Use index laws to simplify expressions
AA b	Set up simple equations
AA b	Solve equations by using inverse operations or by transforming both sides in the same way
AA b	Solve linear equations with integer or fractional coefficients, in which the unknown appears on either side or on both sides of the equation
AA b	Solve 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
AA b	Set up and solve simple inequalities in one variable
AA d	Use the conventions for coordinates in the plane
AA d	Plot points in all four quadrants
AA d	Find the midpoint of a line segment
AA e	Draw, label and scale axes
AA e	Recognise (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
AA e	Plot graphs of functions in which y is given explicitly in terms of x, or implicitly
AA e	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
AA j	Find the gradient of a straight line from a graph
AA j	Find gradients of linear functions
AA j	Interpret gradients in context

Geometry and Measures

AG a	Basic angle facts on a straight line, at a point, on a straight line, vertically opposite angles
AG b	Understand and use the sum of angles in a triangle is 180°
AG b	Give reasons for angle calculations
AG b	Angles associated with intersecting lines
AG b, c	Properties of triangles and quadrilaterals
AG d	Recognise and visualise reflection and rotational symmetry of 2-D shapes
AG d	Be able to identify and draw lines of reflection
AG d	Start the line of reflective symmetry as a simple algebraic equation
AG d	Be able to identify the order of rotational symmetry of a 2-D shape
AG e	Identify shapes which are similar
AG e	Identify shapes which are congruent
AG e	Understand what makes two shapes similar or congruent
AG e	Recognise that enlargements preserve angle but not length
AG e	Understand the relationship between lengths in similar figures
AG h	Recall names and definitions of parts of a circle
AG h	Draw circles accurately
AG h	Understand related circle terms such as semi-circle and quarter circle
AG o	Recall and use formulae to find the area of triangles, rectangles, parallelograms
AG o	Find the area of a trapezium
AG o	Find the perimeter and area of shapes made from triangles and rectangles
AG o	Find the surface area using rectangles and triangles
AM a	Interpret scales on a range of measuring instruments, and recognise the inaccuracy of measurements
AM b	Convert measurements from one unit to another
AM c	Make sensible estimates of a range of measures
AM f	Measure and draw lines

Statistics and Probability

AS d	Understand and use statistical problem solving process (handling data cycle)
AS e	Design an experiment or survey, identifying possible sources of bias
AS f	Design data-collection sheets distinguishing between different types of data
AS g	Extract data from publications, charts, tables and lists
AS h	Design, use and interpret two-way tables for discrete and grouped data
AS i	Look at data to find patterns and exceptions
AS j	Compare distributions and make inferences
AS k	Produce charts and diagrams for categorical data including bar chart and pictograms
AS k	Produce and interpret charts and diagrams for categorical data (pie charts)
AS l	Produce and interpret diagrams for ungrouped discrete numerical data, including vertical line charts and stem-and-leaf diagrams
AS l	Produce and interpret diagrams for ungrouped discrete numerical data including (ordered) stem and leaf diagrams
AS m	Produce and interpret diagrams for grouped discrete data and continuous data
AS o	Work with time series including their graphical representation
AS p	Calculate median, mean, range, mode and modal class
AS q	Recognise correlation and draw and/or use lines of best fit by eye, understanding and interpreting what these represent, appreciating that correlation does not imply causality

Unit 2

Number

AN a	Add, subtract, multiply and divide integers, fractions and decimals with a calculator
AN a	Understand and use number operations and the relationships between them, including inverse operations and hierarchy of operations
AN a	Find reciprocals
AN a	Solve a problem involving division by a decimal
AN b	Recall the fraction to decimal conversion of familiar simple fractions
AN b	Convert between fractions and decimals
AN k	Understand and use direct proportion
AN k	Solve word problems about proportion and ratio
AN l	Divide a quantity in a given ratio
AN m	Use calculators effectively and efficiently

Algebra

AA b	Set up linear inequalities in one variable
AA c	Substitute numbers into a formula
AA c	Substitute positive and negative numbers into expressions such as $3x^2 + 4$ and $2x^3$
AA c	Use formulae from mathematics and other subjects expressed initially in words and then using letters and symbols
AA c	Derive a formula, including those with square, cubes and roots
AA d	Calculate the length of a line segment
AA f	Solve simple linear inequalities in one variable and represent the solution set on a number line
AA f	Use the correct notation to show inclusive and exclusive inequalities
AA i	Find approximate solutions of equations using systematic trial and improvement
AA i	Generate points and plot graphs of quadratic functions
AA i	Find approximate solutions of a quadratic equation from the graph of the corresponding quadratic function
AA k	Construct linear functions from real-life problems and plotting their corresponding graphs
AA m	Recognise and use graphs that illustrate direct proportion
AA m	Use and interpret maps and scale drawings
AA n	Discuss, plot and interpret graphs (which may be non-linear) modelling real situations including journeys/travel graphs
AA o	Estimate areas of irregular shapes

Geometry and Measures

AG b	Properties of triangles and quadrilaterals
AG b	Understand some simple geometric proofs
AG b	Mark parallel lines on a diagram
AG b	Angles associated with parallel lines
AG b	Understand and use the angle properties of parallel and intersecting lines, and quadrilaterals
AG e, b	Give reasons for angle calculation
AG e	Understand congruence and similarity including the relationship between lengths in similar shapes
AG f	Understand, recall and use Pythagoras' theorem in 2-D
AG i	Use 2-D representations of 3-D shapes
AG j	Use and interpret maps and scale drawings
AG k	Draw triangles and other 2-D shapes using a ruler, pair of compasses and a protractor
AG l	Use straight edge and a pair of compasses to do constructions
AG m	Construct loci
AG n	Find circumferences of circles and areas enclosed by circles, recalling relevant formulae
AG n	Find the perimeter and area of semi circles and quarter circles
AG n	Find the surface area of a cylinder
AG o	Find the surface area of simple shapes (prisms) using the formulae for triangles and rectangles
AG p	Calculate the volumes of right prisms, including the triangular prism, and shapes made from cubes and cuboids
AG p	Recall and use the formula for the volume of a cuboid
AG p	Find the volume of a cylinder
AG p	Find the volume of a compound solid
AM b	Convert between metric area measures
AM b	Convert between metric volume measures and between metric measures of volume and capacity
AM d	Understand and use compound measures including speed
AM d	Understand and use compound measures in familiar contexts
AM e	Understand and use bearings

Statistics and Probability

AS a	Understand and use the vocabulary of probability and probability scale
AS b	Understand and use theoretical models for probabilities including the model of equally likely outcomes
AS c	Understand and use estimates or measures of probability from relative frequency
AS r	Understand that when a statistical experiment is repeated there will usually be different outcomes, and that increasing sample size generally leads to better estimates of probability and population characteristics
AS s	Discuss and start to estimate risk

GCSE in Applications of Mathematics (2AM01)

Higher Tier

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.

Unit	Module	Title	Estimated teaching hours
1	1	Integers, decimals and fractions	4
1	2	Factors and multiples	2.5
1	3	Laws of indices	2.5
1	4	Standard form	3
1	5	Percentages 1	4.5
1	6	Algebraic manipulation	5
1	7	Percentages 2	3
1	8	Financial and business applications	4
1	9	Solving linear equations	5
1	10	Linear graphs and $y = mx + c$	6
1	11	Linear programming	6
1	12	Angle facts and geometric shapes	3
1	13	Line and rotational symmetry	2.5
1	14	Simultaneous equations	3
1	15	Measures	3
1	16	Area and perimeter	3
1	17	Similarity and congruence	3
1	18	Collecting data	3
1	19	Displaying data	6
1	20	Averages and range	7
2	1	Integers, decimals and fractions	4
2	2	Compound measures	6
2	3	Trial and improvement	3
2	4	Real-life graphs	3
2	5	Exponential growth and decay	2.5
2	6	Ratio and proportion	3.5
2	7	Solving linear inequalities	5
2	8	Formulae	3.5
2	9	Gradients and tangents	2.5
2	10	Estimating areas	2.5
2	11	Direct and inverse proportion	3.5
2	12	Quadratic functions	4
2	13	Further simultaneous equations	4.5
2	14	Scale drawings	1.5
2	15	2-D and 3-D shapes	3
2	16	Angle facts and polygons	3
2	17	Bearings	1.5
2	18	Similar shapes	4
2	19	Pythagoras' theorem and trigonometry in 2-D	6.5
2	20	Pythagoras' theorem and trigonometry in 3-D	5
2	21	Constructions and loci	4
2	22	Circles, cones, pyramids and spheres	5
2	23	Probability	6
		TOTAL	**166**

Unit 1: Applications 1 - Higher

Centres may wish to teach this unit alongside Unit 2 if they prefer to deliver their curriculum in a holistic manner.
They would enter students for both papers at the same time.
However, some centres may prefer to concentrate on Unit 1 first and enter their students in either June 2011 or in November 2011. The benefit of this model is that it allows a full analysis of the paper using ResultsPlus before students are prepared for a possible resit (one resit per unit is permitted).
In addition, some centres that traditionally organise their mock examinations in November or December may use this opportunity for an external body to mark and analyse their papers. It may also flag up any students who would benefit from a change of tier for either their resit examination or Unit 2 assessment.

Module 1 APPLICATIONS Time: 3 – 5 hours

Tier: Higher – Unit 1

Content: Integers, decimals and fractions COMMON

AN b	Understand and use negative integers both as positions and translations on a number line
AN a	Multiply and divide by negative numbers
AN a	Multiply or divide any number by powers of 10, and any positive number by a number between 0 and 1
AN d	Round to a given number of significant figures (and decimal places)
AN a	Add and subtract decimal numbers
AN a, d	Check and estimate answers to problems, by approximations or inverse operations (decimals)
AN a	Use brackets and the hierarchy of operations
AN a	Use one calculation to find the answer to another
AN b	Order fractions, understand equivalent fractions, simplify fractions and divide fractions
AN a	Add, subtract, multiply and divide fractions
AN b	Order integers, decimals and fractions

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 concepts of a fraction and a decimal

OBJECTIVES

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

- Add, subtract, multiply and divide integers (BIDMAS)
- Add, subtract, multiply and divide fractions and decimals
- Round whole numbers to the nearest 10, 100, 1000, …
- Multiply and divide whole numbers by a given multiple of 10
- Check their calculations by rounding, eg $29 \times 31 \approx 30 \times 30$
- Approximate decimals to a given number of decimal places or significant figures
- Multiply and divide decimal numbers by whole numbers and decimal numbers (up to 2 dp), eg $266.22 \div 0.34$
- Know that, eg $13.5 \div 0.5 = 135 \div 5$

DIFFERENTIATION & EXTENSION

Teachers may 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 $\square\square\square - \square\square$

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, eg 2.5×0.01, 0.001

Directed number work with two or more operations, or with decimals

Introduce standard form for very large or small numbers

Money calculations that require rounding answers to the nearest penny

Multiply and divide decimals by decimals (more than 2 dp)

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 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

Module 2 APPLICATIONS **Time: 1 – 4 hours**

Tier: Higher – Unit 1

Content: Factors and multiples **COMMON**

AN c Understand prime numbers
AN c Find factors and multiples of numbers
AN c Find common factors and common multiples
AN b Find squares and cubes of numbers and find square roots and cube roots of numbers

PRIOR KNOWLEDGE

Number complements to 10 and multiplication or 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:

- 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 $108 = 2^2 \times 3^3$

DIFFERENTIATION & EXTENSION

Calculator exercise to check factors of larger numbers
Further work on indices to include negative and fractional indices (introduction to next section)
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)

NOTES

All of the work in this unit is easily reinforced by starters and plenaries
Calculators should only be used when appropriate
Encourage student to learn square, cube, prime and common roots as Unit 1 is a non-calculator examination
Functional Elements – include practice of problems that require common factors and/or common multiples

Module 3 APPLICATONS **Time: 1 – 4 hours**

Tier: Higher – Unit 1

Content: Laws of indices **COMMON**

AN b Use index notation and index laws for multiplication and division of integer powers

AN b Use index laws to simplify and calculate the value of numerical expressions involving multiplication and division of integers, fractional and negative powers

AN b Recall the fact that $n^0 = 1$ and $n^{-1} = \frac{1}{n}$ for positive integers n, the corresponding rule for negative integers, $n^{\frac{1}{2}}$ = square root n and $n^{\frac{1}{3}}$ = cube root n for any positive number n

PRIOR KNOWLEDGE

Knowledge of squares, square roots, cubes and cube roots

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, $8^{-\frac{2}{3}}$
- Know that, eg $x^3 = 64 \Rightarrow x = 64^{\frac{1}{3}}$

DIFFERENTIATION & EXTENSION

Use index rules to simplify algebraic expressions

Treat index rules as formulae (state which rule is being used at each stage in a calculation)

NOTES

Use a simple division example to illustrate how zero and negative indices occur, eg $3^3 \div 3^3$ for zero index and $3^3 \div 3^4$ for a negative index

Show that $x^{\frac{1}{2}} \times x^{\frac{1}{2}} = x$, so $x^{\frac{1}{2}}$ is the square root of x

Module 4 APPLICATIONS **Time: 2 – 4 hours**

Tier: Higher – Unit 1

Content: Standard form **COMMON**

AN b	Use standard index form, expressed in standard notation and on a calculator display
AN b	Calculate with standard index form
AN b	Convert between ordinary and standard index form representations
AN b	Convert to standard index form to make sensible estimates for calculations involving multiplication or division
AN b, m	*Use standard index form display and know how to enter numbers in standard index form*

PRIOR KNOWLEDGE

Round decimals to a given number of decimal places or significant figure
Multiply decimal numbers with, and without, a calculator
Some experience with powers of 10, eg know that $10^2 = 100$, $10^3 = 1000$, $10^{-1} = 0.1$
Negative indices and laws of indices

OBJECTIVES

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

- Understand the standard form convention
- Convert numbers to, and from, standard form
- Calculate with numbers given in standard form without a calculator
- Round numbers given in standard form to a given number of significant figures
- *Calculate with numbers given in standard form with a calculator*
- *Understand standard form on a calculator display*

DIFFERENTIATION & EXTENSION

Use standard index form in real-life situations, eg stellar distances, sizes of populations and atomic distances for small numbers

NOTES

This work can be enriched by using examples drawn from the sciences,
eg Avogadro's Number 6.02×10^{-23}

Module 5 APPLICATIONS **Time: 3 – 6 hours**

Tier: Higher – Unit 1

Content: Percentages 1 **(COMMON TO METHODS Unit 2)**

AN h	Find percentages of quantities
AN h, f	Interpret percentage as the operator 'so many hundredths of'
AN f	Convert between fractions, decimals and percentages
AN f	Use percentages, fractions and decimals to compare proportions
AN h	Calculate a given fraction of a given quantity
AN h	Express a given number as a percentage of another
AN h	Use percentages (and fractions) in real-life situations
AN h	Solve percentage problems, including increase and decrease
AN h	Use a multiplier to increase or decrease a percentage in any scenario where percentages are used

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
- 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 (or fraction) of a given amount
- Find a percentage increase or decrease of an amount
- Use a multiplier to increase by a given percent, eg 1.10×64 increases 64 by 10%
- Use multipliers to calculate repeated proportional change

DIFFERENTIATION & 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

NOTES

Amounts of money should always be rounded to the nearest penny where necessary
Functional Elements – provide plenty of practice of problems in context using percentages

Module 6 APPLICATIONS **Time: 4 – 6 hours**

Tier: Higher – Unit 1

Content: Algebraic manipulation **COMMON**

AA a Simplify terms, products and sums
AA a Multiply a single term over a bracket
AA a Take out common factors
AA a Substitute positive and negative numbers into expressions such as $3x^2 + 4$ and $2x^3$
AA a Use instances of index laws, including use of fractional, zero and negative powers and power of a power

PRIOR KNOWLEDGE

Know that a letter can be used to represent a number
Ability to use negative numbers with the four operations
Experience of using BIDMAS in calculations without a calculator

OBJECTIVES

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

- Simplify expressions with like terms, eg $x^2 + 3x^2$; $3ab + 5ab + 2c^2$
- Expand and factorise expressions with one pair of brackets, eg expand $x(2x + 3y)$; factorise $3xy^2 – 6x^2y$
- Simplify expressions such as $3x^3 \times 4x^7$, $(8x^6)^{1/3}$
- Expand and simplify expressions involving more than one pair of brackets, eg $3(x + 4) – 2(x – 3)$

DIFFERENTIATION & 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 which involve the addition of fractions

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
Link the difference of two squares with the rationalisation of surds

Module 7 APPLICATIONS **Time: 2 – 4 hours**

Tier: Higher – Unit 1

Content: Percentages 2 **(COMMON TO METHODS Unit 2)**

AN g	Use percentages in real-life situations
AN g, h	Compound interest, depreciation
AN g	Reverse percentage calculations
AN i	Represent repeated proportional change using a multiplier raised to a power
AN m	Use calculators for reverse percentages calculations by doing an appropriate division

PRIOR KNOWLEDGE

Four operations of number
Awareness that percentages are used in everyday life
Percentages 1

OBJECTIVES

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

- Find a percentage increase or 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

DIFFERENTIATION & EXTENSION

Combine multipliers to simplify a series of percentage changes
Comparisons between simple and compound interest calculations
Formulae in simple interest or compound interest methods
Increase and decrease leading to a combined multiplier to use (eg 10% decrease then 5% increase)

NOTES

Reiterate when to round in repeated proportional change calculations
Functional Elements – provide plenty of practice of problems in context using percentages

Module 8 APPLICATIONS Time: 3 – 5 hours

Tier: Higher – Unit 1

Content: Financial and business applications

AF a	Carry out calculations relating to enterprise, saving and borrowing, appreciation and depreciation
AF a	Understand and use AER
AF b	Use mathematics in the context of personal and domestic finance including loan repayments, budgeting, RPI and CPI, loan rates and commission
AN g	Use multipliers for percentage change
AN i	Find proportional change
AN m	Use calculators effectively and efficiently
AF c	Use spreadsheets to model financial situations
AF d	Construct and use flow charts (financial)

PRIOR KNOWLEDGE

Four operations of number
The concepts of a fraction and a decimal
Number complements to 10 and multiplication tables
Awareness that percentages are used in everyday life

OBJECTIVES

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

- Use percentages to solve problems
- Convert between fractions, decimals and percentages to find percentage change
- Find a percentage of a quantity in order to increase or decrease
- Use percentages in real-life situations
  - price after VAT
  - profit or loss
  - simple interest
  - income tax calculations
  - annual rate of inflation
- Use percentages and multipliers for savings, borrowing, exchange rates
- Understand and use AER, for example given two different yearly interest rates work out an AER
- Use simple index numbers (RPI and CPI)
- Use spreadsheets to model a financial problem or budget
- Construct a flow chart
- Use a flow chart

DIFFERENTIATION & EXTENSION

Use a mixture of calculator and non-calculator methods
Use functional skills questions to look at questions in context
Combine multipliers to simplify a series of percentage changes
Problems which lead to the necessity of rounding to the nearest penny, eg real-life contexts
Investigate comparisons between simple and compound interest calculations

NOTES

Use plenty of practical examples that can be linked to Functional Elements, eg VAT calculations
Newspapers and the internet can be a source of financial information for comparison and discussion

Module 9 APPLICATIONS **Time: 4 – 6 hours**

Tier: Higher – Unit 1

Content: Solving linear equations **COMMON**

AA b Set up simple equations
AA b Solve equations by using inverse operations or by transforming both sides in the same way
AA b Solve linear equations with integer or fractional coefficients, in which the unknown appears on either side or on both sides of the equation
AA b Solve 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
AA b *Set up and solve simple linear inequalities*

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

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 brackets or variables on both sides
- Form linear equations from word problems in a variety of contexts and relating the answer back to the original
- *Set up and solve simple linear inequalities*

DIFFERENTIATION & EXTENSION

Use of inverse operations and rounding to 1 sf could be applied to more complex calculations
Derive equations from geometric situations (such as finding unknown angles in polygons or perimeter problems)
Solve equations where manipulation of fractions (including the negative fractions) is required
Solve linear inequalities where manipulation of fractions is involved

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

Module 10 APPLICATIONS **Time: 5 – 7 hours**

Tier: Higher – Unit 1

Content: Linear graphs and $y = mx + c$ **COMMON**

AA d	Use axes and coordinates to specify points in all four quadrants in 2-D and 3-D
AA d	Identify points with given coordinates
AA d	Find the coordinates of the midpoint of the line segment *AB*, given the coordinates of *A* and *B*
AA e	Recognise (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
AA e	Plot graphs of functions in which *y* is given explicitly in terms of *x*, or implicitly
AA j	Find the gradient of a straight line
AA j	Find the gradient of lines given by equations of the form $y = mx + c$ (when values are given for *m* and *c*)
AA j	*Use the method of finding the gradient to see how one variable increases in relation to another*
AA j	*Analyse problems and use gradients to interpret how one variable changes in relation to another*

PRIOR KNOWLEDGE

Substitute positive and negative numbers into algebraic expressions
Plot coordinates in the first quadrant
Calculate the mean of two numbers
Knowledge of basic shapes
Rearrange to change the subject of a formula

OBJECTIVES

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

- Add a point to a coordinate grid to complete a given shape (parallelogram; rhombus; trapezium; square)
- Use the formula to calculate the midpoint of a line segment
- Understand how to represent points in 1-D, 2-D and 3-D
- Substitute values of *x* into linear functions to find corresponding values of *y*
- Find the gradient of a straight line from a graph
- Plot points for linear functions on a coordinate grid and draw the corresponding straight lines

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 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
Cover horizontal and vertical lines ($x = c$ and $y = c$) [Students often forget these]

NOTES

Careful annotation should be encouraged. Label the coordinate axes 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, ie science, geography etc

A-Level Text books (C1) are a good source of extension questions on this topic

Interpret straight line graphs for Functional Elements problems

– Ready reckoner graphs

– Conversion graphs

– Fuel bills and mobile phone tariffs

– Fixed charge (standing charge) and cost per unit

Module 11 APPLICATIONS **Time: 5 – 7 hours**

Tier: Higher – Unit 1

Content: Linear programming

AA g Express real life constraints in terms of linear inequalities
AA g Use constraints and conditions
AA g Draw graphs of linear inequalities
AA g Write down the objective function for a real-life problem
AA g Find the feasible region
AA g Be able to use graphs of linear inequalities to solve maximisation or minimisation problems
AA g Use either the profit line or point testing to find an optimal solution
AA g Interpret graphs of linear inequalities as a real life problem

PRIOR KNOWLEDGE

Set up linear inequalities
Set up linear equations
Draw graphs of the form $y = mx + c$
Substitute values into equations

OBJECTIVES

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

- Set up a linear inequality from given information
- Write down the objective function for a real life problem
- Draw graphs of linear inequalities
- Use shading to show feasible region
- Find the optimal solution by using the profit line or point testing
- Use linear programming to solve maximisation or minimisation problems
- Interpret graphs of linear inequalities as real life problems

DIFFERENTIATION & EXTENSION

More demanding linear programming problems can be found in D1 AS textbooks

NOTES

The general convention is to shade the unwanted region so leaving the feasible region unshaded
Students should practice both drawing graphs given linear inequalities and writing down linear inequalities from a graph

Module 12 APPLICATIONS **Time: 2 – 4 hours**

Tier: Higher – Unit 1

Content: Angle facts and geometric shapes **COMMON**

AG a Basic angle facts for a straight line, at a point and vertically opposite angles
AG b, c Properties of triangles and quadrilaterals
AG b Angles associated with intersecting lines
AG b Give reasons for angle calculations

PRIOR KNOWLEDGE

The concept of parallel lines
The concept of vertical and horizontal
The concept of an angle between two lines
Experience in drawing triangles, quadrilaterals and circles

OBJECTIVES

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

- Recall and use properties of angles
  – angles at a point
  – angles at a point on a straight line
  – perpendicular lines
  – vertically opposite angles
- Find the size of missing angles
- Use two letter notation for a line and three letter notation for an angle
- Identify triangles by their properties (scalene, isosceles, equilateral, right-angled, obtuse, and acute)
- Prove the angle sum in a triangle is 180°
- Use the angle properties of triangle to find missing angles
- Prove the exterior angle of a triangle is equal to the sum of the two opposite interior angles
- Identify quadrilaterals by their properties (trapezium, parallelogram, rhombus, rectangle, square, kite and arrowhead)

DIFFERENTIATION & EXTENSION

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

NOTES

Lots of practical drawing examples to help illustrate properties of various shapes
Diagrams used in examinations are seldom drawn accurately
Encourage students to always put the reasons and ‘quote’ the angle fact or theorem used [important for the new assessment objectives]

Module 13 APPLICATIONS **Time: 2 – 3 hours**

Tier: Higher – Unit 1

Content: Line and rotational symmetry **COMMON**

AG d Recognise and visualise reflection and rotational symmetry of 2-D shapes

PRIOR KNOWLEDGE

Knowledge and properties of 2-D shapes

OBJECTIVES

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

- Recognise line and rotational symmetry in 2-D shapes
- Draw in the line of symmetry (or state its equation if the shape is on a coordinate grid) and state the order of rotational symmetry
- Complete a shape for a given order of rotational symmetry

DIFFERENTIATION & EXTENSION

Extend to planes of symmetry for 3-D solids

NOTES

Accurate drawing skills need to be reinforced
Some students find visualising 3-D objects difficult and simple models will assist
Use tracing paper or mirrors to help with symmetry questions

Module 14 APPLICATIONS Time: 2 – 4 hours

Tier: Higher – Unit 1

Content: Simultaneous equations

AA h Set up and solve simple equations including simultaneous equations in two unknowns

PRIOR KNOWLEDGE

Introduction to algebra
Linear functions

OBJECTIVES

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

- Find the exact solutions of two simultaneous equations in two unknowns
- Use elimination or substitution to solve simultaneous equations
- Interpret a pair of simultaneous equations as a pair of straight lines and their solution as the point of intersection. Consider the real life applications, eg mobile phone bills
- Set up and solve a pair of simultaneous equations in two variables

DIFFERENTIATION & EXTENSION

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
Students will need practice in setting up simultaneous equations from given information to solve problems

Module 15 APPLICATIONS Time: 2 – 4 hours

Tier: Higher – Unit 1

Content: Measures

AM a Interpret scales on a range of measuring instruments and recognize the inaccuracy of measurements
AM b Convert measurements from one unit to another
AM c Make sensible estimates of a range of measures
AM f Measure and draw lines and angles

PRIOR KNOWLEDGE

Use decimals

OBJECTIVES

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

- Interpret scales on a range of measuring instruments
- Indicate measures on a scale
- Know that measurements using real numbers depend upon the choice of unit
- Recognise the inaccuracy of measurements
- Recognise that measurements given to the nearest whole unit may be inaccurate by up to half a unit in either direction
- Convert between units of time
- Convert between units of measure in the same system
- Know metric equivalents of pounds, feet, miles, pints and gallons
- Convert between imperial and metric measures
- Make sensible estimates of a range of measure in everyday settings
- Choose appropriate units for estimating or carrying out measurements
- Measure and draw lines to the nearest mm
- Measure and draw angles to the nearest degree

DIFFERENTIATION & EXTENSION

Extend to compound units, eg convert 30 miles/hour to km/h

NOTES

Measurement is essentially a practical activity
Use a range of everyday objects to bring reality to lessons
Use Functional Elements as a source of practical activities

Module 16 APPLICATIONS **Time: 2 – 4 hours**

Tier: Higher – Unit 1

Content: Area and perimeter **COMMON**

AG o Use formulae to find the area of triangles, parallelograms, and trapeziums
AG o Calculate perimeters of shapes made from triangles and rectangles
AG o Calculate areas of shapes made from triangles and rectangles
AG o Find the area of compound shapes
AG o Calculate the perimeter and area of compound shapes made from triangles, rectangles and other shapes
AG h *Distinguish between centre, radius, chord, diameter, circumference, tangent, arc, sector and segment*

PRIOR KNOWLEDGE

The names of quadrilaterals
Ability to substitute numbers into a formula
Some notion of the difference between length and area
Properties of cubes, cuboids and other common 3-D objects

OBJECTIVES

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

- Use the area formulae for triangles, parallelograms and trapeziums
- Find the perimeter of compound shapes
- Find the area of compound shapes
- *Name circle parts*

DIFFERENTIATION & EXTENSION

Further problems involving combinations of shapes
Using compound shape methods to investigate the areas of other standard shapes, eg kites
Practical activities, eg using estimation and accurate measuring to calculate perimeters and areas of floors

NOTES

Discuss the correct use of language and units
Ensure that students can distinguish between perimeter and area
Try to impress upon them that perimeter starts with a ‘P’ which reminds them to plus the sides
Many students have little real understanding of perimeter and area
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, optimisation type questions, which pack of tiles give the best value?

Module 17 APPLICATIONS **Time: 2 – 4 hours**

Tier: Higher – Unit 1

Content: Similarity and congruence **COMMON**

AG e Understand similarity of triangles and of other plane figures and use this to make geometric inferences
AG e Identify similar solids
AG e Recognise that enlargements preserve angle but not length
AG e Understand the relationship between lengths, areas and volumes in similar figures

PRIOR KNOWLEDGE

The special names of triangles (and angles)
Understand the terms perpendicular, parallel and arc
Transformations (particularly enlargements)

OBJECTIVES

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

- Prove formally geometric properties of triangles, eg that the base angles of an isosceles triangle are equal
- 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
- Recognise similarity and apply it to solve problems involving similar figures

DIFFERENTIATION & EXTENSION

Link with the information to be able to construct a triangle, eg SSS, ASA, SAS
Link with tessellations and transformations
Link with similar areas and volumes
Harder problems in congruence

NOTES

All working should be presented clearly, and accurately
If a student is not sure how to approach a question, advise them to write 'easy' numbers in pencil on their diagram, use these to approach the problem initially, then repeat the process with the 'real' values on the question

Module 18 APPLICATIONS Time: 2 – 4 hours

Tier: Higher – Unit 1

Content: Collecting data

AS d Understand and use statistical problem solving process/handling data cycle
AS e Design an experiment or survey, identifying possible sources of bias
AS f Design data-collection sheets distinguishing between different types of data
AS g Extract data from publications, charts, tables and lists
AS h Design, use and interpret 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
- Decide what data to collect and what statistical analysis is needed
- Collect data from a variety of suitable primary and secondary sources
- Use suitable data collection techniques
- Process and represent the data
- Interpret and discuss the data
- Discuss how data relates to a problem, identify possible sources of bias and plan to minimise it
- Understand how different sample sizes may affect the reliability of conclusions drawn
- Identify which primary data they need to collect and in what format, including grouped data
- Consider fairness
- Design a question, with response boxes, for a questionnaire by identifying key questions that can be addressed by statistical methods
- Criticise questions for a questionnaire
- Design an experiment or survey
- Select and justify a sampling scheme and a method to investigate a population, including random and stratified sampling
- Use stratified sampling
- Design and use data-collection sheets for grouped, discrete and continuous data
- Collect data using various methods
- Sort, classify and tabulate data and discrete or continuous quantitative data
- Group discrete and continuous data into class intervals of equal width
- Extract data from lists and tables
- Design and use two-way tables for discrete and grouped data
- Use information provided to complete a two way table

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
Investigation into other sampling schemes, such as cluster 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 it is 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 19 APPLICATIONS Time: 5 – 7 hours

Tier: Higher – Unit 1

Content: Displaying data

AS k Produce and interpret charts and diagrams for categorical data including bar charts, pie charts and pictogram

AS l Produce and interpret diagrams for ungrouped discrete numerical data, including vertical line charts and stem-and-leaf diagrams

AS m Produce and interpret diagrams for grouped discrete data and continuous data, including histograms with unequal class intervals

AS n Produce and use cumulative frequency graphs and box-and-whisker plots

AS q, g Recognise correlation and draw and/or use lines of best fit by eye, understanding what these represent, and appreciating that correlation does not imply causality

AS i Look at data to find patterns and exceptions

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: Pie charts, frequency polygons, histograms with equal class intervals and frequency diagrams for grouped discrete data, scatter graphs, line graphs, frequency polygons for grouped data, grouped frequency tables for continuous data
- Interpret: composite bar charts, comparative and dual bar charts, pie charts, scatter graphs, frequency polygons and histograms
- Recognise simple patterns, characteristics and relationships in line graphs and frequency polygons
- Find the median from a histogram or any other information from a histogram, such as the number of people in a given interval
- From line graphs: read off frequency values, calculate total population, find greatest and least values
- From pie charts: find the total frequency and find the frequency represented by each sector
- From histograms: complete a grouped frequency table and understand and define frequency density
- Present findings from databases, tables and charts
- Look at data to find patterns and exceptions, explain an isolated point on a scatter graph
- Draw lines of best fit by eye, understanding what these represent
- Use a line of best fit, or otherwise, to predict values of one variable given values of the other variable
- Distinguish between positive, negative and zero correlation using lines of best fit
- Understand that correlation does not imply causality
- 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’

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 20 APPLICATIONS Time: 6 – 8 hours

Tier: Higher – Unit 1

Content: Averages and range

AS p Calculate, and for group data estimate, median, mean, range, quartiles and interquartile range, mode and modal class
AS j Compare distributions and make inferences
AS o Work with time series and moving averages, including their graphical interpretation
AN m 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
- Recognise the advantages and disadvantages between measures of average
- Produce ordered stem and leaf diagrams and use them to find the range and averages
- Calculate averages and range from frequency tables (Use Σx and Σfx)
- Estimate the mean for large data sets with grouped data (and understand that it is an estimate)
- Draw cumulative frequency tables and graphs
- Use cumulative frequency graphs to find median, quartiles and interquartile range
- Draw box plots from a cumulative frequency graph
- Compare the measures of spread between a pair of box plots/cumulative frequency graphs
- Interpret box plots to find median, quartiles, range and interquartile range
- Find the median from a histogram
- Compare distributions and make inferences, using the shapes of distributions and measures of average and spread, including median and quartiles
- Draw and produce time series graphs (line graphs) from given and experimental data
- Calculate an appropriate moving average
- Identify seasonality and trends in time series
- Use moving average to identify trend

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: '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

Unit 2: Applications 2 – Higher tier

Centres may wish to teach this unit alongside Unit 1 if they prefer to deliver their curriculum in a holistic manner.
They would enter students for both papers at the same time.
However, some centres may prefer to concentrate on Unit 1 first and enter their students in either June 2011 or in November 2011. The benefit of this model is that it allows a full analysis of the paper using ResultsPlus before students are prepared for a possible resit (one resit per unit is permitted).
In addition, some centres that traditionally organise their mock examinations in November or December may use this opportunity for an external body to mark and analyse their papers. It may also flag up any students who would benefit from a change of tier for either their resit examination or Unit 2 assessment.

Module 1 APPLICATIONS **Time: 3 – 5 hours**

Tier: Higher – Unit 2

Content: Integers, decimals and fractions **COMMON**

AN a Add, subtract, multiply and divide integers, fractions and decimals (with a calculator)
AN b Recall the fraction-to-decimal conversion of familiar fractions
AN b Convert between fractions and decimals using a calculator
AN a Solve a problem involving division by a decimal
AN a Understand reciprocal
AN a Understand and use unit fractions as multiplicative inverses
AN a Understand that the inverse operation of raising a positive number to a power n is raising the result of this operation to the power $\frac{1}{n}$

PRIOR KNOWLEDGE

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 fraction and a decimal

OBJECTIVES

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

- Use brackets and the hierarchy of operations (BIDMAS)
- Add, subtract, multiply and divide integers, negative numbers, decimals and fractions with a calculator
- Check answers to a division sum using multiplication, eg use inverse operations
- Convert between common fractions and decimals (recurring and terminating)
- Find reciprocals

DIFFERENTIATION & EXTENSION

Prove that $0.nnnnnn\ldots$ can be written as a fraction $\frac{n}{9}$ and look at the case when $n = 9$

NOTES

The expectation for most students studying Higher tier is that some of this material can be delivered or reinforced during other topics. For example, using inverses could be used with trigonometry
Present all working clearly with decimal points in line
Emphasise that all working needs to be shown
Functional Elements – provide practice with arithmetic of integers, decimals and fractions to solve problems

Module 2 APPLICATIONS Time: 5 – 7 hours

Tier: Higher – Unit 2

Content: Compound measures

AM b Convert measurements from one unit to another
AM d Understand and use compound measures in familiar and unfamiliar contexts
AN e Understand and use 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, eg $100 \times 100 = 10\,000$

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)
- Know rough metric equivalents of pounds, feet, miles, pints and gallons:
  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
- Use the relationship between distance, speed and time to solve problems
- Convert between metric units of speed, eg km/h to m/s
- Construct and interpret distance time graphs
- 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
- Calculate speed when, eg fractions of an hour must be entered as fractions or as decimals
- Calculate the upper and lower bounds of calculations, particularly when working with measurements
- Find the upper and lower bounds of calculations involving perimeter, areas and volumes of 2-D and 3-D shapes
- Find the upper and lower bounds in real life situations using measurements given to appropriate
- degrees of accuracy
- Give the final answer to an appropriate degree of accuracy following an analysis of the upper and lower bounds of a calculation

DIFFERENTIATION & EXTENSION

Perform calculations on a calculator by using standard form
Convert imperial units to metric units, eg mph into km/h
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
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 and 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 3 APPLICATIONS Time: 2 – 4 hours

Tier: Higher – Unit 2

Content: Trial and improvement

AA i Use systematic trial and improvement to find approximate solutions of equations where there is no simple analytical method of solving them

AN m 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 functions by successive substitution of values of x
- Use systematic trial and improvement to find approximate solutions of equations where there is no simple analytical method of solving them
- Understand the connections between changes of sign and location of roots

DIFFERENTIATION & EXTENSION

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

Look at 'practical examples'. A room is 2 m longer than it is wide. If its area is 30 m², what is its perimeter?

NOTES

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 4 APPLICATIONS Time: 2 – 4 hours

Tier: Higher – Unit 2

Content: Real-life graphs

AA k Construct linear functions from real-life problems and plotting their corresponding graphs
AA k Construct linear, quadratic and other functions from real-life problems and plot their corresponding graphs
AA n Discuss, plot and interpret graphs (which may be non-linear and/or periodic) modelling real situations including journeys/travel graphs
AM d Understand and use compound measures including speed

PRIOR KNOWLEDGE

Experience at plotting points in all quadrants
Experience at labelling axes and reading scales

OBJECTIVES

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

- Draw distance time graphs
- Calculate speed
- Interpret distance time graphs and solve problems
- Draw graphs representing 'real' examples like filling a bath/containers
- Interpret and draw linear graphs, including conversion graphs, fuel bills etc
- Solve problems relating to mobile phone bills with fixed charge and price per unit
- Interpret non-linear graphs like the number of cans in a vending machine at times throughout the day
- Interpret quadratic and periodic graphs in a real-life context

DIFFERENTIATION & EXTENSION

Use open ended questions that test student awareness of what intersections mean, eg mobile phone bills
Use spreadsheets to generate straight-line graphs and pose questions about gradient of lines
Use ICT packages or graphical calculators to draw straight line graphs and quadratic graphs
Extend to parabolas modelling projectiles

NOTES

Clear presentation is important with axes clearly labelled
Students need to be able to recognise linear graphs and to recognise when their graph is incorrect
Link graphs and relationships in other subject areas, eg science, geography
Students should have plenty of practice interpreting linear graphs for Functional Elements problems

Module 5 APPLICATIONS **Time: 2 – 4 hours**

Tier: Higher – Unit 2

Content: Exponential growth and decay

AN j Understand the meaning of exponential growth
AN j Use multipliers to explore exponential growth and decay
AN j Use exponential growth in real life problems

PRIOR KNOWLEDGE

Substituting numbers into algebraic expressions
Be able to draw graphs given y as a function of x
Be able to use the function x^y on a calculator
Dealing with decimals on a calculator
Using multipliers for percentage increase and decrease

OBJECTIVES

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

- understand the meaning of exponential growth and decay
- use multipliers to explore exponential growth and decay
- interpret multipliers
- interpret graphs showing exponential growth or decay
- use exponential growth in real life problems – could be within financial or scientific applications

DIFFERENTIATION & EXTENSION

Could be extended into the use of logs using AS level textbooks

NOTES

Practice of drawing and using graphs representing exponential growth and decay should be provided
Students should be able to use graphs to find growth or decay in a particular period of time
Students should be able to find the value of the multiplier from a graph

Module 6 APPLICATIONS **Time: 2 – 4 hours**

Tier: Higher – Unit 2

Content: Ratio and proportion **COMMON**

AN l Divide a quantity in a given ratio
AN l Solve word problems about ratio, including using informal strategies and the unitary method of solution
AN k Calculate an unknown quantity from quantities that vary in direct or inverse proportion

PRIOR KNOWLEDGE

Fractions and decimals

OBJECTIVES

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

- Appreciate that, eg the ratio 1:2 represents $\frac{1}{3}$ and $\frac{2}{3}$ 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 similar pencils 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
- Solve simple direct and inverse proportion problems using the unitary method or by proportional change (from a table of values or a worded problem)

DIFFERENTIATION & EXTENSION

Currency calculations using currency exchange rates
Harder problems involving multi-stage calculations

NOTES

Students often find three-part ratios difficult
Also link ratios given in different units to metric and imperial units
Link direct and inverse proportion with the graphs and the topic 'Direct and inverse proportion' in algebra (using the proportion '$\propto$' symbol)

Module 7 APPLICATIONS **Time: 4 – 6 hours**

Tier: Higher – Unit 2

Content: Solving linear inequalities

AA b Solve simple linear inequalities in one variable, and represent the solution set on a number line
AA b Use the correct notation to show inclusive and exclusive inequalities
AA f Solve simple linear inequalities in two variables
AA f Use the correct notation to show inclusive and exclusive inequalities
AA f *Show the solution set of several inequalities in two variables on a graph*

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
Be able to draw a number line
Linear equations and inequalities

OBJECTIVES

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

- Solve linear inequalities in one variable and present the solution set on a number line
- Solve simple linear inequalities two variables
- Use the correct notation to show inclusive and exclusive inequalities
- *Show the solution set of several inequalities in two variables on a graph*

DIFFERENTIATION & EXTENSION

Use of inverse operations and rounding to 1 sf could be applied to more complex calculations
Derive inequalities from geometric situations (such as finding unknown angles in polygons or perimeter problems)
Solve linear inequalities where manipulation of fractions is required

NOTES

Students can leave their answers in fractional form where appropriate
Interpreting the direction of an inequality is a problem for many students
Students should use the correct notation when showing inequalities on a number line, eg a solid circle to show inclusion of a point, an empty circle to show exclusion of a point
Equations and inequalities in two variables will be covered again after simultaneous equations

Module 8 APPLICATIONS **Time: 3 – 6 hours**

Tier: Higher – Unit 2

Content: Formulae

AA c Substitute numbers into formulae
AA c Use 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
AA c Derive a formula

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
Solving linear equations

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
- 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

DIFFERENTIATION & EXTENSION

Use negative numbers in formulae involving indices
Various investigations leading to generalisations
Further problems in generating formulae from given information
Apply to equation of a straight line, eg what is the gradient of the line $4x + 2y = 12$?
Apply changing the subject to physics formulae, ie pendulum, equations of motion, focal length formula

NOTES

Emphasise good use of notation, eg $3ab$ means $3 \times a \times b$
Students need to be clear on the meanings of the words expression, equation, formula and identity
Show a linear equation first and follow the same steps for the similarly structured formula to be rearranged
Link with formulae for area, volume, surface area

Module 9 APPLICATIONS **Time: 2 – 3 hours**

Tier: Higher – Unit 2

Content: Gradients and tangents

AA l Interpret the gradient at a point on the curve as the rate of change

PRIOR KNOWLEDGE

Be able to use and interpret scales on graphs
Be able to find the gradient of a straight line

OBJECTIVES

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

- Know that the gradient of a curve at a point is given by the gradient of the tangent at that point
- Draw in a tangent to a curve at a given point
- Work out the gradient at a point on a curve by finding the gradient of the tangent
- Interpret the gradient as the rate of change in context of the given real life problem
- Find the acceleration at a point from a speed-time graph

DIFFERENTIATION & EXTENSION

Can extend into differentiation using AS level text books

NOTES

Students will need practice in drawing tangents to curves
Care should be taken when working out gradients from graphs using different scales on the axes
Students should know that the gradient of a distance-time graph gives the velocity
Students should know that the gradient of a velocity-time graph gives the acceleration
Students are expected to be able to interpret the gradient of a given graph. For example, from a graph showing volume of water plotted against time, work out the gradient and know that this represents the rate of change of volume at that time

Module 10 APPLICATIONS **Time: 2 – 3 hours**

Tier: Higher – Unit 2

Content: Estimating areas

AA o Estimate areas of irregular shapes by approximating area to area of known shapes
AA o Estimate area under curves by dividing area into strips of equal widths
AA o Understand that if the area is divided into a greater number of strips then the effect is to increase the accuracy of the approximation

PRIOR KNOWLEDGE

Find areas of rectangles, triangles and trapeziums

OBJECTIVES

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

- Estimate areas of irregular shapes by approximating area to area of known shapes
- Estimate area under curves by dividing area into strips of equal widths
- Know that as the number of strips increases then so does the accuracy of the approximation

DIFFERENTIATION & EXTENSION

Link into integration and the trapezium rule using AS level tex books

NOTES

Emphasise idea of dividing an area under a graph into trapezia in order to find the area
Students should be able to recall the formula of a trapezium to find the area of individual strips
Students should find the area under a curve by dividing it into a different number of strips to appreciate that the more strips, the more accurate the answer
Use a graphical package to demonstrate the use of the trapezium rule to find the area under a curve
Students are not expected to learn the trapezium rule

Module 11 APPLICATIONS **Time: 3 – 5 hours**

Tier: Higher – Unit 2

Content: Direct and inverse proportion **COMMON**

AA m Set up and use equations to solve word and other problems involving direct proportion or inverse proportion and relating algebraic solutions to graphical representations of the equations

AA m Calculate an unknown quantity from quantities that vary in direct or inverse proportion

AA m Relate algebraic solutions to graphical representation of the equations

PRIOR KNOWLEDGE

Substitute numbers into algebraic formulae
Rearrange the subject of a formula
Direct and inverse proportion (Topic 6)

OBJECTIVES

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

- Revise simple direct and inverse proportion problems using the unitary method or by proportional change (or from a table of values)
- 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 ($y \propto x$, $y \propto x^2$, $y \propto x^3$, $y \propto \frac{1}{x}$, $y \propto \frac{1}{x^2}$)

DIFFERENTIATION & EXTENSION

Link unitary method with ratio
Problems involving other types of proportionality (eg surface area to volume of a sphere)
Link to graphs to show direct and inverse proportion, eg $y = \frac{k}{x}$ etc

NOTES

Students should be encouraged to show all steps in their working
Students often forget the "square" in inverse square proportionality

Module 12 APPLICATIONS **Time: 3 – 5 hours**

Tier: Higher – Unit 2

Content: Quadratic functions **COMMON**

AA k Generate points and plot graphs of quadratic functions
AA k, i Find approximate solutions of a quadratic equation from the graph of the corresponding quadratic function

PRIOR KNOWLEDGE

Graphs
Solving equations

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

DIFFERENTIATION & EXTENSION

Use graphical calculators or ICT graph package where appropriate to enable students to get through examples more rapidly

NOTES

There may be a need to remove a factor of a trinomial before factorising to make the factorisation easier
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, eg negative length

Module 13 APPLICATIONS **Time: 3 – 5 hours**

Tier: Higher – Unit 2

Content: Further simultaneous equations **COMMON**

AA k Find the intersection points of the graphs of linear and quadratic functions, and know that these are the approximate solutions of the corresponding simultaneous equation representing the linear and quadratic functions

PRIOR KNOWLEDGE

Quadratic functions
Straight line graphs
Algebraic manipulation and solving linear and quadratic equations

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 and establish the equations properties
- Find graphically the approximate solutions of linear and circular simultaneous equations

DIFFERENTIATION & EXTENSION

Find graphically the approximate solutions of quadratic and circular simultaneous equations
Look at circles whose centre is not the origin $(x - 2)^2 + (y - 3)^2 = 4$

NOTES

Clear presentation of workings is essential
Stress which variable it is easiest to work with when assessing the linear equation
ICT graph drawing packages make this topic more dynamic and easier to picture
Further examples and questions can be obtained from A-Level papers (C1)

Module 14 APPLICATIONS **Time: 1 – 2 hours**

Tier: Higher – Unit 2

Content: Scale drawings

AG j Use and interpret maps and scale drawings
AG k Draw triangles and other 2-D shapes using a ruler, pair of compasses and protractor

PRIOR KNOWLEDGE

Be able to use ruler, compasses and protractor
Be able to use ratio

OBJECTIVES

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

- Use and interpret maps and scale drawings
- Read and construct scale drawings
- Draw lines and shapes to scale
- Estimate lengths using a scale diagram
- Make accurate drawing of triangles and other 2-D shapes using a ruler and a protractor
- Make an accurate scale drawing from a diagram

DIFFERENTIATION & EXTENSION

Practice drawing more complicated scale drawings
Link with bearings and plan routes using maps

NOTES

Measurements should be ±2mm
Angles should be $\pm 2^{o}$

Module 15 APPLICATIONS Time: 2 – 4 hours

Tier: Higher – Unit 2

Content: 2-D and 3-D shapes

AG i Use 2-D representations of 3-D shapes

PRIOR KNOWLEDGE

Construction and loci

OBJECTIVES

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

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

DIFFERENTIATION & EXTENSION

Make solids using equipment such as clixi or multi-link with different coloured cubes
Draw shapes made from multi-link on isometric paper
Construct combinations of 2-D shapes to make nets
Build shapes from cubes that are represented in 2-D
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 is essential
Accurate drawing skills need to be reinforced
Some students find visualising 3-D objects difficult- simple models will assist

Module 16 APPLICATIONS **Time: 2 – 4 hours**

Tier: Higher – Unit 2

Content: Angle facts and polygons **COMMON**

AG b Properties of triangles and quadrilaterals
AG b Give reasons for angle calculations
AG b Angles associated with parallel lines

PRIOR KNOWLEDGE

The concept of parallel lines
The concept of vertical and horizontal
The concept of an angle between two lines
Experience in drawing triangles, quadrilaterals and circles

OBJECTIVES

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

- Identify triangles by their properties (scalene, isosceles, equilateral, right-angled, obtuse, and acute)
- Prove the angle sum in a triangle is 180° and explain why the angles inside a quadrilateral add up to 360°
- Use the angle properties of a triangle to find missing angles
- Prove the exterior angle of a triangle is equal to the sum of the two opposite interior angles
- Identify quadrilaterals by their properties (trapezium, parallelogram, rhombus, rectangle, square, kite)
- Use alternate, corresponding and co-interior angles in parallel lines to find missing angles

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 tessellations

NOTES

Lots of practical drawing examples to help illustrate properties of various shapes
Diagrams used in examinations are usually not drawn accurately
Use tracing paper to show which angles in parallel lines are equal
Useful memory device ‘the FUZ is the CIA’ (F, U and Z angles’ real names are Corresponding, Interior and Alternate)
Encourage students to always put the reasons and ‘quote’ the angle fact or theorem used
[Important for the new assessment objectives]

Module 17 APPLICATIONS **Time: 1 – 2 hours**

Tier: Higher – Unit 2

Content: Bearings

AM e Understand and use bearings

PRIOR KNOWLEDGE

The ability to use a ruler and a protractor
Know that angles in a triangle add up to 180º
Know that angles at a point on a straight line sum to 180°
Know that a right angle = 90°

OBJECTIVES

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

- Use three-figure bearings to specify direction
- Draw and measure bearings
- Use bearings to solve loci problems
- Mark on a diagram the position of point *B* given its bearing from point *A*
- Give a bearing between the points on a map or scaled plan
- Given the bearing of point *A* from point *B*, work out the bearing of *B* from *A*

DIFFERENTIATION & EXTENSION

Use bearings in conjunctions with maps to describe journeys
Link in with use of scales

NOTES

All diagrams should be presently neatly and accurately
Give students a lot of drawing practice, and encourage them to check their drawings
Angles should be accurate to within 2° and lengths accurate to the nearest mm

Module 18 APPLICATIONS **Time: 3 – 5 hours**

Tier: Higher – Unit 2

Content: Similar shapes* **COMMON**

AG e Understand the effect of enlargement for perimeter, area and volume of shapes and solids
AG e Understand that enlargement does not have the same effect on area and volume
AG e Understand and use the effect of enlargement on areas and volumes of shapes and solids
AG e Know the relationship between linear, area and volume scale factors of mathematically similar shapes and solids

**This topic builds on Unit 1*

PRIOR KNOWLEDGE

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

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

DIFFERENTIATION & EXTENSION

Find algebraic formulae for the areas and volumes of similar shapes
Extend to questions which give the ratio for area and asks for length or volume

NOTES

Students will need to be reminded of this work on a regular basis, link it to ratios
1 : L (Length)
1: L^2 (Area)
1: L^3 (Volume)
A good starter is to bring in a small bottle of water and a larger bottle (ideally twice the length). Show by pouring that eight small bottles will fill the larger bottle. [This can also be done with one small cube and a larger box with lengths twice as long]. Initially the class will say **two** bottles will fill the larger double size bottle

Module 19 APPLICATIONS **Time: 5 – 7 hours**

Tier: Higher – Unit 2

Content: Pythagoras' theorem and trigonometry in 2-D **COMMON**

AG f	Understand, recall and use Pythagoras' theorem
AA d	Given the coordinates of points *A* and *B* calculate the length of *AB*
AG g	Understand, recall and use trigonometrical relationships in right-angled triangles, and use these to solve problems
AG g	Find angles of elevation and angles of depression
AN m	Use calculators effectively and efficiently

PRIOR KNOWLEDGE

Names of triangles and quadrilaterals
Knowledge of the properties of rectangles, parallelograms and triangles
Indices, equations and changing the subject

OBJECTIVES

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

- Find missing sides of right-angle triangles by using Pythagoras' theorem
- Find the distance between two coordinates using Pythagoras' theorem
- Give answers as decimals or surds for Pythagoras problems
- 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 (2-D)
- Solve problems involving geometric figures (including triangles within circles) in which a right-angled triangle has to be extracted in order to solve it by Pythagoras and/or trigonometry

DIFFERENTIATION & EXTENSION

Introduce 3-D trigonometry and show that the trig ratios above will only work for right-angled triangles

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 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 dp 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
Organise a practical surveying lesson to find the heights of buildings or trees around your school grounds. All you need is a set of tape measures (or trundle wheels) and clinometers

Module 20 APPLICATIONS **Time: 4 – 6 hours**

Tier: Higher – Unit 2

Content: Pythagoras' theorem and Trigonometry in 3-D **COMMON**

AG f, g Use Pythagoras' theorem and trigonometrical ratios in 3-D
AG f Calculate the length of a diagonal of a cuboid

PRIOR KNOWLEDGE

Pythagoras' theorem and trigonometry
3-D solids

OBJECTIVES

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

- 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

DIFFERENTIATION & EXTENSION

Harder problems involving multi-stage calculations

NOTES

The angle between two planes or two skew lines is not required

Module 21 APPLICATIONS **Time: 3 – 5 hours**

Tier: **Higher – Unit 2**

Content: **Constructions and loci**

AG l Use straight edge and a pair of compasses to carry out constructions
AG m 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 the student should be able to:

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

DIFFERENTIATION & EXTENSION

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

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 22 APPLICATIONS **Time: 4 – 6 hours**

Tier: Higher – Unit 2

Content: Circles, cones, pyramids and spheres **COMMON**

AG n	Find circumferences of circles and areas enclosed by circles, recalling relevant formulae
AG n	Calculate the lengths of arcs and the areas of sectors of circles
AG n	Find the surface area of a cylinder
AG o	Find the surface area of simple shapes (prisms) using the formulae for triangles, rectangles and other shapes
AG o, p	Find the surface areas and volumes of compound solids constructed from spheres, hemispheres, cylinders and solve problems including examples of solids in everyday use
AG o, p	Solve problems involving surface areas and volumes of (right) prisms and cylinders
AG r	Solve problems involving surface areas and volumes of cones and pyramids
AG r	Solve problems involving more complex shapes, including segments of circles, length of a chord and frustums of cones
AG r	Find the area of a segment of a circle given the radius and length of the chord

PRIOR KNOWLEDGE

Perimeter and area (Unit 1)
Surface area (Unit 1)
Formulae, substitution and changing the subject
Surds and exact form

OBJECTIVES

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

- Know that the ratio between the circumference and diameter is always constant for a circle (ie π)
- Know the formula for circumference and area of a circle
- Solve problems involving the circumference and area of a circle
- Find the area of a sector and length of an arc
- Solve problems involving the volume of a prism and cylinder
- 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

DIFFERENTIATION & EXTENSION

Find the volume of a cylinder given its surface area, leaving the answer in terms of π
Find the volume of a right hexagonal cone of side x and height h (researching the method for finding the volume of any cone)

NOTES

For the volume of a right prism, show that it is effectively the number of 'slices' of the area of the front (or cross-section)

'Now! I Know π' is a good way to learn the approximate 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 or volume of shapes

Students should be aware of which formulae are on the relevant page on the examination paper and which they need to learn

Functional Elements – this topic lends itself to practice using problems set in context

Module 23 APPLICATIONS Time: 5 – 7 hours

Tier: Higher – Unit 2

Content: Probability

AS a Understand and use the vocabulary of probability and probability scale
AS b, c Understand and use estimates or measures of probability from theoretical models (including equally likely outcomes), or from relative frequency
AS r Understand that when a statistical experiment or survey is repeated there will usually be different outcomes and that increasing sample size generally leads to better estimates of probability and population characteristics
AS s Discuss and start to estimate risk

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 statistics, 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
- Understand and use estimates or measures of probability
- Use theoretical models to include outcomes using dice, spinners, coins etc
- Understand the probability of successive events, such as several throws of a single dice
- Compare experimental data and theoretical probabilities
- Compare relative frequencies from samples of different sizes
- Identify threats that may have an effect on the outcome of an event
- Understand and use decision tree diagrams to estimate the effect of risk
- Quantify risk using risk = probability of event × cost/ desired outcome

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 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 needed not be cancelled to their lowest terms. This makes it easier to calculate tree diagram probabilities, eg easier to add like denominators

Show that each cluster of branches adds up to 1

Higher course objectives (1MA0)

Unit 1

Number

AN a	Multiply and divide by negative numbers
AN a	Multiply or divide any number by powers of 10, and any positive number by a number between 0 and 1
AN a	Add and subtract decimal numbers
AN a	Use brackets and the hierarchy of operations
AN a	Use one calculation to find the answer to another
AN a	Add, subtract, multiply and divide fractions
AN a, d	Check and estimate answers to problems, by approximations or inverse operations (decimals)
AN b	Understand and use negative integers both as positions and translations on a number line
AN b	Order fractions, understand equivalent fractions, simplify fractions and divide fractions
AN b	Order integers, decimals and fractions
AN b	Find squares and cubes of numbers and find square roots and cube roots of numbers
AN b	Use index notation and index laws for multiplication and division of integer powers
AN b	Use index laws to simplify and calculate the value of numerical expressions involving multiplication and division of integers, fractional and negative powers
AN b	Recall the fact that $n^0 = 1$ and $n^{-1} = \frac{1}{n}$ for positive integers n, the corresponding rule for negative integers, $n^{\frac{1}{2}} = \sqrt{n}$ and $n^{\frac{1}{3}} = \sqrt[3]{n}$ for any positive number n
AN b	Use standard index form, expressed in standard notation and on a calculator display
AN b	Calculate with standard index form
AN b	Convert between ordinary and standard index form representations
AN b	Convert to standard index form to make sensible estimates for calculations involving multiplication and or division
AN b, m	Use standard index form display and know how to enter numbers in standard index form
AN c	Understand prime numbers
AN c	Find factors and multiples of numbers
AN c	Find common factors and common multiples
AN d	Round to a given number of significant figures (and decimal places)
AN f	Convert between fractions, decimals and percentages
AN f	Use percentages, fractions and decimals to compare proportions
AN g	Use percentages in real-life situations
AN g	Reverse percentage calculations
AN g	Use multipliers for percentage change
AN g, h	Compound interest, depreciation
AN h	Find percentages of quantities
AN h	Calculate a given fraction of a given quantity
AN h	Express a given number as a percentage of another
AN h	Use percentages (and fractions) in real-life situations
AN h	Solve percentage problems, including increase and decrease
AN h	Use a multiplier to increase or decrease a percentage in any scenario where percentages are used
AN h, f	Interpret percentage as the operator ‘so many hundredths of’
AN i	Represent repeated proportional change using a multiplier raised to a power
AN i	Find proportional change

AN m Use calculators for reverse percentages calculations by doing an appropriate division
AN m Use calculators effectively and efficiently
AN m Use calculators efficiently and effectively, including statistical functions

Financial and Business Applications

AF a Carry out calculations relating to enterprise, saving and borrowing, appreciation and depreciation
AF a Understand and use AER
AF b Use mathematics in the context of personal and domestic finance including loan repayments, budgeting, RPI and CPI, loan rates and commission
AF c Use spreadsheets to model financial situations
AF d Construct and use flow charts (financial)

Algebra

AA a	Simplify terms, products and sums
AA a	Multiply a single term over a bracket
AA a	Take out common factors
AA a	Substitute positive and negative numbers into expressions such as $3x^2 + 4$ and $2x^3$
AA a	Use instances of index laws, including use of fractional, zero and negative powers and power of a power
AA b	Set up simple equations
AA b	Solve equations by using inverse operations or by transforming both sides in the same way
AA b	Solve linear equations with integer or fractional coefficients, in which the unknown appears on either side or on both sides of the equation
AA b	Solve 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
AA b	Set up and solve simple linear inequalities
AA d	Use axes and coordinates to specify points in all four quadrants in 2-D and 3-D
AA d	Identify points with given coordinates
AA d	Find the coordinates of the midpoint of the line segment *AB*, given the coordinates of *A* and *B*
AA e	Recognise (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
AA e	Plot graphs of functions in which *y* is given explicitly in terms of *x*, or implicitly
AA g	Express real-life constraints in terms of linear inequalities
AA g	Use constraints and conditions
AA g	Draw graphs of linear inequalities
AA g	Write down the objective function for a real-life problem
AA g	Find the feasible region
AA g	Be able to use graphs of linear inequalities to solve maximisation or minimisation problems
AA g	Use either the profit line or point testing to find an optimal solution
AA g	Interpret graphs of linear inequalities as a real life problem
AA h	Set up and solve simple equations including simultaneous equations in two unknowns
AA j	Find the gradient of a straight line
AA j	Find the gradient of lines given by equations of the form $y = mx + c$ (when values are given for *m* and *c*)
AA j	Use the method of finding the gradient to see how one variable increases in relation to another
AA j	Analyse problems and use gradients to interpret how one variable changes in relation to another

Geometry and Measures

AG a	Basic angle facts for a straight line, at a point and vertically opposite angles
AG b	Angles associated with intersecting lines
AG b	Give reasons for angle calculations
AG b, c	Properties of triangles and quadrilaterals
AG d	Recognise and visualise reflection and rotational symmetry of 2-D shapes
AG e	Understand similarity of triangles and of other plane figures and use this to make geometric inferences
AG e	Identify similar solids
AG e	Recognise that enlargements preserve angle but not length
AG e	Understand the relationship between lengths, areas and volumes in similar figures
AG h	Distinguish between centre, radius, chord, diameter, circumference, tangent, arc, sector and segment
AG o	Use formulae to find the area of triangles, parallelograms, and trapeziums
AG o	Calculate perimeters of shapes made from triangles and rectangles
AG o	Calculate areas of shapes made from triangles and rectangles
AG o	Find the area of compound shapes
AG o	Calculate the perimeter and area of compound shapes made from triangles, rectangles and other shapes
AM a	Interpret scales on a range of measuring instruments and recognize the inaccuracy of measurements
AM b	Convert measurements from one unit to another
AM c	Make sensible estimates of a range of measures
AM f	Measure and draw lines and angles

Statistics and Probability

AS d	Understand and use statistical problem solving process/handling data cycle
AS e	Design an experiment or survey, identifying possible sources of bias
AS f	Design data-collection sheets, distinguishing between different types of data
AS g	Extract data from publications, charts, tables and lists
AS g, q	Recognise correlation and draw and/or use lines of best fit by eye, understanding what these represent, and appreciating that correlation does not imply causality
AS h	Design, use and interpret two-way tables for discrete and grouped data
AS i	Look at data to find patterns and exceptions
AS j	Compare distributions and make inferences
AS k	Produce and interpret charts and diagrams for categorical data including bar charts, pie charts and pictograms
AS l	Produce and interpret diagrams for ungrouped discrete numerical data, including vertical line charts and stem-and-leaf diagrams
AS m	Produce and interpret diagrams for grouped discrete data and continuous data, including histograms with unequal class intervals
AS n	Produce and use cumulative frequency graphs and box-and-whisker plots
AS o	Work with time series and moving averages, including their graphical interpretation
AS p	Calculate, and for group data estimate, median, mean, range, quartiles and interquartile range, mode and modal class

Unit 2

Number

AN a	Add, subtract, multiply and divide integers, fractions and decimals (with a calculator)
AN a	Solve a problem involving division by a decimal
AN a	Understand reciprocal
AN a	Understand and use unit fractions as multiplicative inverses
AN a	Understand that the inverse operation of raising a positive number to a power n is raising the result of this operation to the power $^1/_n$
AN b	Recall the fraction-to-decimal conversion of familiar fractions
AN b	Convert between fractions and decimals using a calculator
AN e	Understand and use upper and lower bounds
AN j	Understand the meaning of exponential growth
AN j	Use multipliers to explore exponential growth and decay
AN j	Use exponential growth in real life problems
AN k	Calculate an unknown quantity from quantities that vary in direct or inverse proportion
AN l	Divide a quantity in a given ratio
AN l	Solve word problems about ratio, including using informal strategies and the unitary method of solution
AN m	Use calculators effectively and efficiently

Algebra

AA b	Solve simple linear inequalities in one variable, and represent the solution set on a number line
AA b	Use the correct notation to show inclusive and exclusive inequalities
AA c	Substitute numbers into formulae
AA c	Use 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
AA c	Derive a formula
AA d	Given the coordinates of points *A* and *B*, calculate the length of *AB* in 2-D and 3-D
AA f	Solve simple linear inequalities in two variables
AA f	Use the correct notation to show inclusive and exclusive inequalities
AA f	Show the solution set of several inequalities in two variables on a graph
AA i	Use systematic trial and improvement to find approximate solutions of equations where there is no simple analytical method of solving them
AA k	Construct linear functions from real-life problems and plot their corresponding graphs
AA k	Construct linear, quadratic and other functions from real-life problems and plot their corresponding graphs
AA k	Generate points and plot graphs of quadratic functions
AA k	Find the intersection points of the graphs of linear and quadratic functions, and know that these are the approximate solutions of the corresponding simultaneous equation representing the linear and quadratic functions
AA k, i	Find approximate solutions of a quadratic equation from the graph of the corresponding quadratic function
AA l	Interpret the gradient at a point on the curve as the rate of change
AA m	Set up and use equations to solve word and other problems involving direct proportion or inverse proportion and relate algebraic solutions to graphical representations of the equations
AA m	Calculate an unknown quantity from quantities that vary in direct or inverse proportion
AA m	Relate algebraic solutions to graphical representation of the equations
AA n	Discuss, plot and interpret graphs (which may be non-linear and/or periodic) modelling real situations including journeys/travel graphs
AA o	Estimate areas of irregular shapes by approximating area to area of known shapes
AA o	Estimate area under curves by dividing area into strips of equal widths
AA o	Understand that if the area is divided into a greater number of strips then the effect is to increase the accuracy of the approximation

Geometry and Measures

AG b	Definitions and names of polygons
AG b	Properties of triangles and quadrilaterals
AG b	Give reasons for angle calculations
AG b	Angles associated with parallel lines
AG e	Understand the effect of enlargement for perimeter, area and volume of shapes and solids
AG e	Understand that enlargement does not have the same effect on area and volume
AG e	Understand and use the effect of enlargement on areas and volumes of shapes and solids
AG e	Know the relationship between linear, area and volume scale factors of mathematically similar shapes and solids
AG f	Understand, recall and use Pythagoras' theorem
AG f	Calculate the length of a diagonal of a cuboid
AG f, g	Use Pythagoras' theorem and trigonometrical ratios in 3-D
AG g	Understand, recall and use trigonometrical relationships in right-angled triangles, and use these to solve problems
AG g	Find angles of elevation and angles of depression
AG i	Use 2-D representations of 3-D shapes
AG j	Use and interpret maps and scale drawings
AG k	Draw triangles and other 2-D shapes using a ruler, pair of compasses and protractor
AG l	Use straight edge and a pair of compasses to carry out constructions
AG m	Construct loci
AG n	Find the surface area of a cylinder
AG n	Find circumferences of circles and areas enclosed by circles, recalling relevant formulae
AG n	Calculate the lengths of arcs and the areas of sectors of circles
AG o	Find the surface area of simple shapes (prisms) using the formulae for triangles and rectangles and other shapes
AG o, p	Find the surface areas and volumes of compound solids constructed from; spheres, hemispheres, cylinders and solve problems including examples of solids in everyday use
AG o, p	Solve problems involving surface areas and volumes of (right) prisms and cylinders
AG r	Solve problems involving surface areas and volumes of cones and pyramids
AG r	Solve problems involving more complex shapes, including segments of circles, length of a chord and frustums of cones
AG r	Find the area of a segment of a circle given the radius and length of the chord
AM b	Convert measurements from one unit to another
AM d	Understand and use compound measures in familiar and unfamiliar contexts
AM d	Understand and use compound measures including speed
AM e	Understand and use bearings

Probability

AS a	Understand and use the vocabulary of probability and probability scale
AS b, c	Understand and use estimates or measures of probability from theoretical models (including equally likely outcomes), or from relative frequency
AS r	Understand that when a statistical experiment or survey is repeated there will usually be different outcomes and that increasing sample size generally leads to better estimates of probability and population characteristics
AS s	Discuss and start to estimate risk

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