Pure mathematics **(M208)** content listing

Unit A1 *Sets, functions and vectors*	Revises important foundations of pure mathematics and the mathematical language used to describe them.
Unit A2 *Number systems*	Systems of numbers most widely used in mathematics: the integers, rational numbers, real numbers, complex numbers and modular or 'clock' arithmetic, and looks at when and how certain types of equations can be solved in the system.
Unit A3 *Mathematical language and proof*	Writing of pure mathematics and some of the methods used to construct proofs, and as a further introduction to abstract mathematical thinking equivalence relations are introduced.
Unit A4 *Real functions, graphs and conics*	Reminder of the principles underlying the sketching of graphs of functions and other curves.
Unit B1 *Symmetry and groups*	Symmetry of plane figures and solids, and shows how this topic leads to the definition of a group, which is a set of elements that can be combined with each other in a way that has four basic properties called group axioms.
Unit B2 *Subgroups and isomorphisms*	Subgroups, which are groups that lie inside other groups, and also at cyclic groups, which are groups whose elements can all be obtained by repeatedly combining a single element with itself. It also investigates groups that appear different but have identical structures.
Unit B3 *Permutations*	Functions that rearrange the elements of a set: it shows how these functions form groups and looks at some of their properties.
Unit B4 *Lagrange's Theorem and small groups*	Fundamental theorem about groups, and uses it to investigate the structures of groups that have only a few elements, before focusing on improving skills in understanding theorems and proofs in the context of group theory.
Unit C1 *Linear equations and matrices*	Why simultaneous equations may have different numbers of solutions, and also explains the use of matrices.
Unit C2 *Vector spaces*	Generalises the plane and three-dimensional space, providing a common structure for studying seemingly different problems.
Unit C3 *Linear transformations*	Mappings between vector spaces that preserve many geometric and algebraic properties.
Unit C4 *Eigenvectors*	Diagonal representation of a linear transformation, and applications to conics and quadric surfaces.
Unit D1 *Numbers*	Real numbers as decimals, rational and irrational numbers, and goes on to show how to manipulate inequalities between real numbers.
Unit D2 *Sequences*	The 'null sequence' approach, used to make rigorous the idea of convergence of sequences, leading to the definitions of *pi* and *e*.
Unit D3 *Series*	Convergence of series of real numbers and the use of series to define the exponential function.
Unit D4 *Continuity*	Sequential definition of continuity, some key properties of continuous functions, and their applications.
Unit E1 *Cosets and normal subgroups*	Revision of Units B1–B4 and looks at how a group can be split into 'shifts' of any one of its subgroups.
Unit E2 *Quotient groups and conjugacy*	How to 'divide' a group by one of its subgroups to obtain another group, and how in any group some elements and some subgroups are similar to each other in a particular sense.
Unit E3 *Homomorphisms*	Functions that map groups to other groups in a way that respects at least some of the structure of the groups.
Unit E4 *Group actions*	How group elements can sometimes be applied to elements of other sets in natural ways. This leads to a method of counting how many different objects there are of certain types, such as how many different coloured cubes can be produced if their faces can be painted any of three different colours.
Unit F1 *Limits*	The epsilon-delta approach to limits and continuity, and relates these to the sequential approach to limits of functions.
Unit F2 *Differentiation*	Differentiable functions and gives L'Hôpital's rule for evaluating limits. *Integration* explains the fundamental theorem of calculus, the Maclaurin integral test and Stirling's formula.
Unit F3 *Integration*	The fundamental theorem of calculus, the Maclaurin integral test and Stirling's formula.
Unit F4 *Power series*	Finding power series representations of functions, their properties and applications.