AS and A level Mathematics:

Content changes summary between legacy (2008) and new (2017) specifications

Pure Mathematics – AS content

What's new?

- Understand and use the structure of mathematical proof, proceeding from given assumptions through a series of logical steps to a conclusion; use methods of proof, including: Proof by deduction, Proof by exhaustion, Disproof by counter example Interpreting inequalities graphically
- Express solutions through correct use of 'and' and 'or', or through set notation. (Set notation is required and is one of the Overarching themes OT1.3))
- Represent linear and quadratic inequalities such as $y > x + 1$ and $y > ax^2 + bx + c$ graphically
- Understand and use graph of functions; sketch curves defined by simple equations including polynomials such as quartic functions and sketch the curve $y = a / x^2$ (including their vertical and horizontal asymptotes)
- Understand and use proportional relationships and their graphs
- Be able to use straight line models in a variety of contexts
- Binomial link to binomial probabilities
- Know and use the function e^x and its graph
- Know and use $\ln x$ as the inverse function of e^x
- Know that the gradient of e^{kx} is equal to ke^{kx} and hence understand why the exponential model is suitable in many applications
- Use logarithmic graphs to estimate parameters in relationships of the form $y = ax^n$ and $y = kb^x$, given data for x and y
- Use exponential growth and decay in modelling (examples may include the use of e in continuous compound interest, radioactive decay, drug concentration decay, exponential growth as a model for population growth); consideration of limitations and refinements of exponential models
- Sketching the gradient function for a given curve
- Differentiation from first principles for small positive integer powers of x
- Calculate the magnitude and direction of a vector and convert between component form and magnitude/direction form
- Add vectors/Understand and use vectors/Use vectors to solve problem/ Use vectors in two dimensions

What's gone?

- Remainder Theorem (currently in C2) not included in new specification
- Radian measure including use for arc length and area of sector and for solution of trigonometric equations (C2) (Now in A level only)
- Sequences and series including iteration (C1) arithmetic series (C1) and geometric series (C2). Also use of sigma notation (Now in A level only)
- Approximation of area under a curve using the trapezium rule (C2) (Now in A level only)

Pure Mathematics – remaining A level content

What's new?

- Use parametric equations in modelling in a variety of contexts
- Increasing sequences; decreasing sequences; periodic sequences
- Use sequences and series in modelling
- Understand and use the standard small angle approximations of sine, cosine and tangent: $\sin \theta \approx \theta$, $\cos \theta \approx 1 - (\theta^2/2)$, $\tan \theta \approx \theta$ where θ is in radians
- Know and use exact values of sin (not specified previously)
- Use trigonometric functions to solve problems in context, including problems involving vectors, kinematics and forces
- Differentiation from first principles for $\sin x$ and $\cos x$
- Understand and use the second derivative as the rate of change of gradient; connection to convex and concave sections of curves and points of inflexion
- Use of definite integral to find the area between two curves
- Understand and use integration as the limit of a sum
- Integration by substitution includes finding a suitable substitution
- Interpret the solution of a differential equation in the context of solving a problem, including finding limitations of the solution; includes links to kinematics
- In numerical analysis understand how change of sign methods can fail
- Be able to draw associated cobweb and staircase diagrams
- Solve equations using Newton Raphson method and understand how methods using recurrence relations may fail
- Use numerical methods to solve problems in context

What's gone?

- Evaluation of volume of revolution
- Vector equations of lines
- The scalar product. Its use in calculating the angle between two lines

What's different?

- Sequences and series including iteration arithmetic series and Geometric Series. Also use of sigma notation. (These are no longer in AS Level)
- Radian measure including use for arc length and area of sector and for solution of trigonometric equations (These are no longer in AS Level)
- Approximation of area under a curve using the trapezium rule (moved from AS) or summation of rectangles
- Differentiate using the product rule, the quotient rule and the chain rule, including problems involving connected rates of change and inverse functions. - Extends further than the old specification by mentioning inverse functions
- The use of $dy/dx = 1 / (dx/dy)$ is not specifically mentioned in the new specification (currently in C3) but is implied by chain rule and differentiation of inverse functions

Content not explicitly mentioned in the old specification (considered implied knowledge) but explicitly mentioned in the new specification:

- Interpret the solution of a differential equation in the context of solving a problem, including identifying limitations of the solution; includes links to kinematics
- Understand how change of sign methods can fail

Statistics – AS content

What's new?

- Select or critique data presentation techniques in the context of a statistical problem
- Be able to clean data, including dealing with missing data, errors and outliers
- The binomial distribution
- Hypothesis tests and critical regions

What's gone?

- Stem and leaf diagrams not on new specification
- Skewness not explicitly mentioned in new specification
- Calculation of regression lines and correlation coefficients
- Calculation of mean and variance of discrete distributions
- Normal distribution

What's different?

- Interpretation of regression line is expected but not calculations involving regression line

Content not explicitly mentioned in the new specification (considered implied knowledge) but explicitly mentioned in the old specification:

- Elementary probability
- Sum and product laws
- Explanatory (independent) and response (dependent) variables. Applications and interpretations

Statistics – remaining A level content

What's new?

- Correlation coefficients as measures of how close data points lie to a straight line and be able to interpret a given correlation coefficient using a given p-value or critical value (calculation of correlation coefficients is excluded)

What's gone?

- Hypothesis testing using the Normal distribution
- Continuous uniform distribution (in new Further Mathematics)
- Poisson distribution

What's different?

Content not explicitly mentioned in the new specification (considered implied knowledge) but explicitly mentioned in the old specification:

- The concept of a discrete random variable
- Select an appropriate probability distribution for a context, with appropriate reasoning, including recognising when the binomial or Normal model may not be appropriate

Mechanics – AS content

What's gone?

- Impulse, momentum and dynamics of a particle (in further mathematics now)

What's different?

- Using resolving forces is not required in AS but it is in A level Mathematics.
- Using vectors in 2 dimensions for motion in a straight line with constant acceleration is not required in AS but it is in A level Mathematics.
- Using calculus in kinematics for motion in a straight line is now required for AS and this extends to A level with use of calculus in kinematics for motion in a straight line where quantities are given as vectors.
- Friction and coefficient of friction are not required for AS but are for A level.

Content not explicitly mentioned in the old specification (considered implied knowledge) but explicitly mentioned in the new specification:

- Understand and use fundamental quantities and units in the S.I. system: length, time, mass.
- Understand and use derived quantities and units: velocity, acceleration, force, weight, moment.
- Understand and use the language of kinematics: position; displacement; distance travelled; velocity; speed; acceleration.

Mechanics – remaining A level content

What's different?

- The new specification extends the use of moments in simple static contexts to those where there are non-parallel forces e.g. ladder problems (currently on M2)
- The new specification covers Projectiles (currently on M2)