MATHEMATICS **A LEVEL OCR SPECIFICATION**

	Topic	Content
Y12 Autumn Term	Problem Solving/Proof	Understand and use the structure of mathematical proof, proceeding from given assumptions through a series of logical steps to a conclusion Understand and be able to use the logical connectives
	Surds and Indices	Understand and use the laws of indices for all rational exponents Use and manipulate surds, including rationalising the denominator
	Coordinate Geometry	Understand and use the equation of a straight line; gradient conditions for two straight lines to be parallel or perpendicular. Be able to use straight line models in a variety of contexts. Understand and use the coordinate geometry of the circle including using the equation of a circle ; completing the square to find the centre and radius of a circle; use of the following properties: • the angle in a semicircle is a right angle • the perpendicular from the centre to a chord bisects the chord • the radius of a circle at a given point on its circumference is perpendicular to the tangent to the circle at that point
	Trigonometry	Understand and use the definitions of sine, cosine and tangent for all arguments; the sine and cosine rules; the area of a triangle Understand and use the sine, cosine and tangent functions; their graphs, symmetries and periodicity Understand and use some trigonometric identities Solve simple trigonometric equations in a given interval, including quadratic equations Work with radian measure, including use for arc length and area of sector. Know and use exact values of sin, cos and tan
	Quadratic Functions	Work with quadratic functions and their graphs; the discriminant of a quadratic function, including the conditions for real and repeated roots; completing the square; solution of quadratic equations including solving quadratic equations in a function of the unknown.
	Equations and Inequalities	Solve simultaneous equations in two variables by elimination and by substitution, including one linear and one quadratic equation. Solve linear and quadratic inequalities in a single variable and interpret such inequalities graphically, including inequalities with brackets and fractions Express solutions through correct use of 'and' and 'or', or through set notation Represent linear and quadratic inequalities graphically.
	Polynomials	Manipulate polynomials algebraically, including expanding brackets and collecting like terms, factorisation and simple algebraic division; use of the factor theorem.
	Vectors	Use vectors in two dimensions. Calculate the magnitude and direction of a vector and convert between component form and magnitude/direction form., Add vectors diagrammatically and perform the algebraic operations of vector addition and multiplication by scalars, and understand their geometrical interpretations, Understand and use position vectors; calculate the distance between two points represented by position vectors, Use vectors to solve problems in pure maths and in context, including forces.
Y12 Spring	Data Collection	Understand and use the terms 'population' and 'sample', Use samples to make informal inferences about the population, Understand and use sampling techniques

Term		
	Processing, presentation and interpretation	Interpret diagrams for single-variable data, Interpret scatter diagrams and regression lines for bivariate data, Interpret measures of central tendency and variation, extending to standard deviation, Recognise and interpret possible outliers in data sets and statistical diagrams. Select or critique data presentation techniques in the context of a statistical problem.
	Binomial expansion	Understand and be able to use the binomial expansion for positive integer n
	Units and Kinematics	Understand and use the language of kinematics: position; displacement; distance travelled; velocity; speed; acceleration. Understand, use and interpret graphs in kinematics for motion in a straight line: displacement against time and interpretation of gradient; velocity against time and interpretation of gradient and area under the graph. Understand, use and derive the formulae for constant acceleration for motion in a straight line.
	Differentiation	Understand and use the derivative of $\mathbf{f}(x)$ as the gradient of the tangent to the graph of $y = \mathbf{f}(x)$ at a general point (*x*, *y*); the gradient of the tangent as a limit; interpretation as a rate of change; sketching the gradient function for a given curve; second derivatives; differentiation from first principles for small positive integer powers of *x*, Understand and use the second derivative as the rate of change of gradient., Differentiate x^n, for rational values of *n,* and related constant multiples, sums and differences. Apply differentiation to find gradients, tangents and normals, maxima and minima and stationary points. Identify where functions are increasing or decreasing.
	Forces and Newton's Laws	Understand the concept and vector nature of a force; understand and use Newton's first law. Understand and use Newton's second law for motion in a straight line (restricted to forces in two perpendicular directions or simple cases of forces given as 2-D vectors), Understand and use weight and motion in a straight line under gravity; gravitational acceleration, g, and its value in S.I. units to varying degrees of accuracy, Understand and use Newton's third law; understand and use the concept of a normal reaction force; equilibrium of forces on a particle and motion in a straight line (restricted to forces in two perpendicular directions or simple cases of forces given as 2-D vectors); application to problems involving smooth pulleys and connected particles.
	Exponentials and Logs	Understand and use the laws of logarithms Solve equations of the form $a^x = b$ Use logarithmic graphs to estimate parameters in relationships of the form $y = ax^n$ and $y = kb^x$, given data for *x* and *y* Understand and use exponential growth and decay; use in modelling; consideration of limitations and refinements of exponential models
	Probability	Be able to use appropriate diagrams to assist in the calculation of probabilities. Includes tree diagrams, sample space diagrams, Venn diagrams.
	Discrete Probability Distributions	Understand and use simple, discrete probability distributions, including the binomial distribution, as a model; calculate probabilities and expectation using the binomial distribution.

Y12 Summer Term	(Including Binomial)	
	Graphs and Transformations	Understand and use graphs of functions; sketch curves defined by simple equations including polynomials, $y = \frac{a}{x}$ and $y = \frac{a}{x^2}$ (including their vertical and horizontal asymptotes); interpret algebraic solution of equations graphically; use intersection points of graphs to solve equations, Understand and use proportional relationships and their graphs., Understand the effect of simple (single) transformations on the graph of $y = \mathrm{f}(x)$ including sketching associated graphs: $y = a\,\mathrm{f}(x), y = \mathrm{f}(x) + a, y = \mathrm{f}(x + a), y = \mathrm{f}(ax)$
	Integration	Know and use the Fundamental Theorem of Calculus, Integrate x^n (excluding *n* = -1), and related sums, differences and constant multiples, Evaluate definite integrals; use a definite integral to find the area under a curve
	Variable Acceleration	Use calculus in kinematics for motion in a straight line: $\mathrm{v} = \frac{dr}{dt}, a = \frac{dv}{dt} = \frac{d^2r}{dt^2}, r = \int v\,dt,\ v = \int a\,dt$
Y13 Autumn Term	Hypothesis Testing 1	Understand and use the language of statistical hypothesis testing, developed through a binomial model: null hypothesis, alternative hypothesis, significance level, test statistic, 1-tail test, 2-tail test, critical value, critical region, acceptance region, *p*-value, Be able to conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret the results in context, Understand that a sample is being used to make an inference about the population and appreciate that the significance level is the probability of incorrectly rejecting the null hypothesis.
	Algebra	Be able to simplify rational expressions. Includes factorising and cancelling, and algebraic division by linear expressions. Be able to decompose rational functions into partial fractions (denominators not more complicated than squared linear terms and with no more than 3 terms, numerators constant or linear).
	3D Vectors	Use vectors in three dimensions. In particular, find the magnitude of a 3D vector
	Differentiation	Understand and use the second derivative in connection to convex and concave sections of curves and points of inflection, Apply differentiation to find points of inflection, Differentiate using the product rule, the quotient rule and the chain rule, including problems involving connected rates of change and inverse functions
	Forces and motion	Understand and use Newton's second law for motion in a straight line; extended to situations where forces need to be resolved. Understand and use Newton's third law; equilibrium of forces on a particle and motion in a straight line application to problems involving smooth pulleys and connected particles; resolving forces in 2 d; equilibrium of a particle under coplanar forces Understand and use addition of forces; resultant forces; dynamics for motion in a plane.
	Friction	Understand and use the $F \le \mu R$ model for friction; coefficient of friction; motion of a body on a rough surface; limiting friction and statics
	Kinematics 2	Understand, use and derive the formulae for constant acceleration, for motion in a straight line using vectors in 2d, Use calculus in kinematics for motion in a straight line using vectors in 2d: $\mathrm{v} = \frac{dr}{dt}, a = \frac{dv}{dt} = \frac{d^2r}{dt^2}, r = \int v\,dt,\ v = \int a\,dt$, Use trigonometric functions to solve problems in context, including

		problems involving vectors, kinematics and forces
	Further differentiation	Understand and use the derivative of $\sin x$ and $\cos x$; be able to show differentiation from first principles for $\sin x$ and $\cos x$ Differentiate e^{kx} and a^{kx}, $\sin kx$, $\cos kx$, $\tan kx$ and related sums, differences and constant multiples, Understand and use the derivative of $\ln x$, Differentiate simple functions and relations defined implicitly, for first derivative only
	Functions	Understand and use the modulus of a linear function (including sketching functions involving a single mod sign; solving equations and inequalities), Understand and use composite functions; inverse functions and their graphs, Understand the effect of combinations of transformations on the graph of $y = f(x)$ including sketching associated graphs; transformations may be combinations of $y = af(x), y = f(x) + a, y = f(x + a), y = f(ax)$, Use of functions in modelling, including consideration of limitations and refinements of the models
	Algebra	Simplify rational expressions including by factorising and cancelling, and algebraic division (by linear expressions only), Decompose rational functions into partial fractions (denominators not more complicated than squared linear terms and with no more than 3 terms, numerators constant or linear), Extend [the binomial expansion] to any rational *n*, including its use for approximation; be aware that the expansion is valid for $\left\|\frac{bx}{a}\right\| < 1$
	Normal distribution	Understand and use the Normal distribution as a model; find probabilities using the Normal distribution; Normal approximation to the Binomial. [Questions explicitly requiring calculations using the normal approximation to the binomial distribution are excluded.] Link to histograms, mean, standard deviation, points of inflection and the binomial distribution, Select an appropriate probability distribution for a context, with appropriate reasoning, including recognising when the binomial or Normal model may not be appropriate.
Y13 Spring Term	Trigonometry 2 (Small Angles)	Understand and use the standard small angle approximations of sine, cosine and tangent $\sin\theta \approx \theta, \cos\theta \approx 1 - \frac{\theta^2}{2}, \tan\theta \approx \theta$ where θ is in radians
	Trigonometric functions	Understand and use the definitions of secant, cosecant and cotangent and of arcsin, arccos and arctan; their relationships to sine, cosine and tangent; understanding of their graphs; their ranges and domains., Understand and use $\sec^2\theta = 1 + \tan^2\theta$ and $\operatorname{cosec}^2\theta = 1 + \cot^2\theta$
	Trigonometric identities	Understand and use double angle formulae; use of formulae for $\sin(A \pm B), \cos(A \pm B)$ and; understand geometrical proofs of these formulae. $\tan(A \pm B)$, Understand and use expressions for $a\cos\theta + b\sin\theta$ in the equivalent forms of $r\cos(\theta \pm \alpha)$ or $r\sin(\theta \pm \alpha)$, Construct proofs involving trigonometric functions and identities
	Integration	Integrate e^{kx}, $\frac{1}{x}$, $\sin kx$, $\cos kx$ and related sums, differences and constant multiples, Use a definite integral to find the area between two curves, Understand and use integration as the limit of a sum, Carry out simple cases of integration by substitution and integration by parts; understand these methods as the inverse processes of the chain and product rules respectively, Integrate using partial fractions that are linear in the denominator
	Differential equations	Construct simple differential equations in pure mathematics and in context, (contexts may include kinematics, population growth and modelling the relationship between price and demand), Evaluate the analytical solution of simple first order differential equations with separable variables,

		including finding particular solutions, (Separation of variables may require factorisation involving a common factor), Interpret the solution of a differential equation in the context of solving a problem, including identifying limitations of the solution; includes links to kinematics
	Parametric equations	Understand and use the parametric equations of curves and conversion between Cartesian and parametric forms (includes sketching simple parametric curves), Use parametric equations in modelling in a variety of contexts, Differentiate simple functions and relations defined parametrically, for first derivative only
	Moments	Understand and use moments in simple static contexts; understand equilibrium of rigid bodies
Y13 Summer Term	Hypothesis testing (Normal, Binomial, correlation)	Understand and apply the language of statistical hypothesis testing, developed through a Normal model: null hypothesis, alternative hypothesis, significance level, test statistic, 1-tail test, 2-tail test, critical value, critical region, acceptance region, *p*-value Conduct a statistical hypothesis test for the mean of a Normal distribution with known, given or assumed variance and interpret the results in context, Conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret the results in context, Understand that a sample is being used to make an inference about the population and appreciate that the significance level is the probability of incorrectly rejecting the null hypothesis.
	Projectiles	Model motion under gravity in a vertical plane using vectors; projectiles, Use trigonometric functions to solve problems in context, including problems involving vectors, kinematics and forces
	Revision	