IAS Maths (One Year)

	Week Number	Unit	Lessons	MCQ	Tutor Marked
Year 1	1-7	Unit 1	☐	☐	
	Break				
	8	Unit 1 continued	☐	☐	
	9	Mock exam			Mock exam
	10-14	Unit 2			
	Break				
	15 - 17	Unit 2 continued	☐	☐	
	18	Mock exam			Mock exam
	19	Unit 3			
	Break				
	20 - 25	Unit 3 continued	☐	☐	
	Break				
	26	Unit 3 continued	☐	☐	
	27	Mock exam	☐	☐	Mock exam
	28 - 30	Revision	☐	☐	
	Break				
	31 - 36	Revision and exam period			

Pure Mathematics 1

		Title	Estimated hours
1		**Algebra and functions**	
	a	Algebraic expressions: basic algebraic manipulation, indices and surds	**4**
	b	Quadratic functions: factorising, solving, graphs and discriminants	**4**
	c	Equations: quadratic/linear simultaneous	**4**
	d	Inequalities: linear and quadratic (including graphical solutions)	**5**
	e	Graphs: cubic and reciprocal	**5**
	f	Transformations: transforming graphs; f(x) notation	**5**
2		**Trigonometry**	
	a	Trigonometric ratios and graphs, and area of a triangle in the form $\frac{1}{2}ab\sin C$	**6**
	b	Radians (exact values), arcs and sectors	**4**
3		**Coordinate geometry in the (x, y) plane:** Straight-line graphs, parallel/perpendicular, length and area problems	**6**
4		**Differentiation**	
	a	Definition, differentiating polynomials, second derivatives	**6**
	b	Gradients, tangents and normals	**5**
5		**Integration:** Definition as opposite of differentiation, indefinite integrals of x^n	**6**
			60 hours

Pure Mathematics 2

Unit		Title	Estimated hours
1		**Proof:** Examples including proof by deduction, proof by exhaustion and disproof by counter-example	4
2		**Algebra and functions:** Algebraic division and the factor and the remainder theorems	4
3		**Coordinate geometry in the (*x*, *y*) plane:** Circles: equation of a circle, geometric problems on a grid	7
4		**Sequences and series**	
	a	Recurrence and iterations	3
	b	Arithmetic and geometric sequences and series (proofs of 'sum formulae')	4
	c	Sigma notation	2
	d	The binomial expansion	7
5		**Exponentials and logarithms:** Exponential functions and the laws of logarithms	8
6		**Trigonometry:** Trigonometric identities and equations	10
7		**Differentiation:** Maxima and minima	4
8		**Integration**	
	a	Definite integrals and areas under curves	5
	b	The trapezium rule	2
			60 hours

A level Mathematics: Pure Mathematics 1

Further Pure Mathematics 1

Unit		Title	Estimated hours
1		**Complex numbers**	
	a	Introduction of complex numbers, basic manipulation	**3**
	b	Complex conjugate, division and solving polynomial equations	**5**
	c	Argand diagrams	**2**
	d	Modulus and argument	**4**
2		**Roots of quadratic equations**	
	a	Roots of polynomial equations	**4**
	b	Formation of polynomial equations	**2**
3		**Numerical solution of equations:**	
	a	Numerical solution of equations	**4**
	b	Newton-Raphson method	**2**
4		**Coordinate systems**	
	a	Equations of parabola and rectangular hyperbola and the focus-directrix properties of the parabola	**6**
	b	Tangents and normals to the parabola and hyperbola	**4**
5		**Matrix algebra integration**	
	a	Matrix addition, subtraction and multiplication	**3**
	b	Inverse of 2×2 matrices	**3**
6		**Transformations using Matrices:** Linear transformations	**8**
7		**Series:** Sums of series	**4**
8		**Proof:** Proof by mathematical induction	**6**
			60 hours

A level Mathematics: Further Pure Mathematics 2

Further Pure Mathematics 2

Unit		Title	Estimated hours
1		**Inequalities:** Algebraic inequalities and inequations	**5**
2		**Series:** Method of differences	**4**
3		**Further complex numbers**	
	a	Know and use $z = re^{i\theta} = r(\cos\theta + i\sin\theta)$	**3**
	b	De Moivre's theorem	**5**
	c	Loci	**3**
	d	Elementary transformations from the z-plane to the w-plane	**5**
4		**First order differential equations**	
	a	Integrating factors to solve first order differential equations	**5**
	b	Differential equations reducible by means of a given substitution	**3**
5		**Second order differential equations**	
	a	Second order differential equations of the form $a\frac{d^2y}{dx^2} + b\frac{dy}{dx} + cy = f(x)$	**6**
	b	Differential equations reducible by means of a given substitution	**3**
6		**Maclaurin and Taylor series**	
	a	Maclaurin series	**5**
	b	Derivation and use of Taylor series	**4**
7		**Polar coordinates**	
	a	Convert between Cartesian and polar and sketch $r(\theta)$	**4**
	b	Area enclosed by a polar curve	**5**
			60 hours

A level Mathematics: Pure Mathematics 3

Further Pure Mathematics 3

Unit		Title	Estimated hours
1		**Hyperbolic functions**	
	a	sinh x, cosh x, tanh x and their inverses	**4**
	b	Logarithmic forms of the inverse hyperbolic functions, solving equations involving hyperbolic functions	**4**
2		**Further coordinate systems**	
	a	Equations of the ellipse and hyperbola and their focus-directrix properties	**3**
	b	Tangents and normals to the ellipse and hyperbola	**3**
	c	Simple loci problems	**4**
3		**Differentiation**	
	a	Differentiate the hyperbolic functions	**3**
	b	Differentiate inverse trigonometric and hyperbolic functions	**4**
4		**Integration**	
	a	Integration of the hyperbolic and inverse hyperbolic functions	**3**
	b	Integrate using hyperbolic and trigonometric substitutions	**3**
	d	Reduction formulae	**4**
	e	The calculation of arc length	**2**
	f	The calculation of the area of a surface of revolution	**2**
5		**Vectors**	
	a	The vector product $\mathbf{a} \times \mathbf{b}$ and the scalar triple product $\mathbf{a} . \mathbf{b} \times \mathbf{c}$, and their applications	**3**
	b	Problems involving points, lines and planes	**5**
	c	Vector and Cartesian equations of a line and a plane	**3**
6		**Further matrix algebra**	
	a	Linear transformations	**2**
	b	Inverse of and 3 × 3 matrices	**2**
	c	Eigenvalues and eigenvectors of 2 × 2 and 3 × 3 matrices	**4**
	d	Reduction of symmetric matrices to diagonal form	**2**
			60 hours

A level Mathematics: Mechanics 1

Mechanics 1

Unit		Title	Estimated hours
1		**Quantities and units in mechanics:** Introduction to mathematical modelling and standard S.I. units of length, time and mass	**1**
2		**Vectors in mechanics**	
	a	Definitions, magnitude/direction, addition and scalar multiplication	**7**
	b	Position vectors, distance between two points, application of vectors to displacement, velocity, acceleration and forces	**7**
3		**Kinematics of a particle moving in a straight line**	
	a	Graphical representation of velocity, acceleration and displacement	**5**
	b	Motion in a straight line under constant acceleration; *suvat* formulae for constant acceleration; Vertical motion under gravity	**6**
4		**Forces and Newton's laws**	
	a	Newton's first law, Newton's third law, force diagrams	**3**
	b	Newton's second law, 'F = ma', resolving forces, connected particles, problems involving smooth pulleys	**8**
	c	Momentum and impulse; derivation of units and formulae Impulse-momentum principle. Conservation of momentum applied to collisions and 'jerking' string problems	**8**
	d	Friction forces (including coefficient of friction μ)	**4**
5		**Statics of a particle:** Equilibrium, Forces in vector form, Maximum value of the frictional force	**4**
6		**Moments:** Forces' turning effects	**7**
			60 hours

A level Mathematics: Mechanics 2

Mechanics 2

Unit		Title	Estimated hours
1		**Kinematics of a particle moving in a straight line or plane**	
	a	Motion in a vertical plane under gravity; projectiles	**6**
	b	Variable acceleration (use of calculus and finding vectors $\dot{\boldsymbol{r}}$ and $\ddot{\boldsymbol{r}}$ at a given time)	**6**
2		**Centres of mass**	
	a	Centre of mass of a discrete mass distribution in one or two dimensions, framework and uniform lamina (rectilinear shapes)	**5**
	b	Centre of mass of triangular, circular-based and composite laminas and centre of mass of a uniform circular arc	**5**
	c	Modelling equilibrium: hanging bodies and systems free to rotate (about a fixed horizontal axis)	**4**
3		**Work and energy**	
	a	Work and kinetic energy; derivation of units and formulae	**4**
	b	Potential energy, work–energy principle, conservation of mechanical energy, problem solving	**6**
	c	Power; derivation of units and formula	**4**
4		**Collisions**	
	a	Momentum as a vector (**i**, **j** problems); Impulse–momentum principle in vector form	**4**
	b	Direct impact of elastic spheres. Newton's law of restitution. Loss of kinetic energy due to impact	**6**
	c	Problem solving (including 'successive' impacts)	**4**
5		**Statics of rigid bodies:** Equilibrium and statics (including ladder problems)	**6**
			60 hours

A level Further Mathematics: Mechanics 3

Mechanics 3

Unit		Title	Estimated hours
1		**Further kinematics:** Motion in a straight line when the acceleration is a function of the displacement (x) or time (t); Setting up and solving differential equations	**6**
2		**Elastic strings and springs and elastic energy**	
	a	Hooke's law and definition of modulus of elasticity. Derivation of elastic potential energy formula	**6**
	b	Problem solving: equilibrium and using the work–energy principle	**5**
3		**Further dynamics**	
	a	Particle moving in straight line with variable applied force; Using $F = ma$ to set up differential equations and solving	**6**
	b	Newton's law of gravitation	**4**
	c	Simple harmonic motion	**5**
4		**Motion in a circle**	
	a	Angular speed, central force, radial acceleration	**3**
	b	Uniform motion in a horizontal circle	**6**
	c	Motion in a vertical circle	**6**
5		**Statics of rigid bodies**	
	a	Centre of mass of uniform rod, lamina, 3D rigid body using integration (and symmetry); Deriving formulae in formula book	**5**
	b	Centre of mass of composite bodies; Simple cases of equilibrium of rigid bodies.	**4**
	c	Conditions for toppling/sliding	**4**
			60 hours

Statistics 1

Unit		Title	Estimated hours
1		**Representation and summary of data**	
	a	Calculation and interpretation of measures of location; Calculation and interpretation of measures of variation; Understand and use coding	**5**
	b	Use statistical diagrams for single-variable data to draw simple conclusions and to compare distributions; Understand and identify outliers; Understand and determine skewness	**8**
2		**Probability:**	
	a	Mutually exclusive events; Independent events	**4**
	b	Using set notation for probability; Conditional probability	**6**
3		**Correlation and regression**	
	a	Scatter diagrams and least squares linear regression	**9**
	b	The product moment correlation coefficient	**7**
4		**Discrete random variables**	
	a	Use a discrete probability distribution to model simple situations; Identify the discrete uniform distribution	**6**
	b	Mean and variance of discrete probability distributions	**7**
5		**The Normal distribution:** Understand and use the Normal distribution	**8**
			60 hours

Statistics 2

Unit		Title	Estimated hours
1		**The binomial and Poisson distributions**	
	a	The binomial distribution	**5**
	b	The Poisson distribution	**6**
	c	Mean and variance of the binomial and Poisson distributions	**5**
	d	Poisson distribution as an approximation to the binomial distribution	**5**
2		**Continuous random variables**	
	a	Continuous random variables, the probability density function and the cumulative distribution function	**9**
	b	Summary statistics for continuous random variables	**6**
3		**Continuous distributions**	
	a	The continuous uniform distribution	**3**
	b	Using the Normal distribution as an approximation to the binomial and Poisson distributions; Selecting the appropriate distribution	**7**
4		**Hypothesis tests**	
	a	Introduction to sampling terminology; Advantages and disadvantages of sampling	**3**
	b	Language of hypothesis testing; Significance levels; Critical regions	**2**
	c	Carry out hypothesis tests involving the binomial distribution	**5**
	d	Hypothesis test for the mean of a Poisson distribution	**4**
			60 hours

Statistics 3

Unit		Title	Estimated hours
1		**Combinations of random variables:** Distribution of linear combinations of independent Normal random variables	7
2		**Statistical sampling:** Understand and use sampling techniques; Compare sampling techniques in context	4
3		**Estimation, confidence intervals and tests**	
	a	Concepts of standard error, estimator and bias, including the quality of estimators	5
	b	Concept of a confidence interval and its interpretation	2
	c	Confidence interval for the mean of a Normal distribution with known variance	3
	d	Statistical hypothesis testing for the mean of the Normal distribution	6
	e	Use of the Central Limit Theorem	4
	f	Hypothesis test for the difference between the means of two independent Normal distributions with known variances	3
	g	Use of large sample results, hypothesis test for the difference between the means of two independent distributions with unknown variances	3
4		**Goodness of fit and contingency tables:** Chi-squared tests	12
5		**Regression and correlation**	
	a	Spearman's rank correlation coefficient	5
	b	Hypothesis testing for zero correlation	6
			60 hours

Decision Mathematics 1

Unit		Title	Estimated hours
1		**Algorithms**	
	a	Introduction to algorithms	**4**
	b	Sorting, searching and packing algorithms	**8**
2		**Algorithms on graphs**	
	a	Introduction to graph theory	**2**
	b	Minimum connectors (spanning trees)	**4**
	c	Dijkstra's algorithm	**4**
3		**Algorithms on graphs II**	
	a	Route inspection problem	**4**
	b	Travelling salesman problem	**8**
4		**Critical path analysis**	
	a	Activity networks; precedence tables	**5**
	b	Critical path algorithm; earliest and latest event times	**4**
	c	Total float; Gantt charts	**3**
	d	Scheduling	**5**
5		**Linear programming**	
	a	Formulation of problems	**3**
	b	Graphical solutions	**4**
	c	Integer solutions	**2**
			60 hours