# AS and A-Level Overview and SOW – September 2018

## Year 1: AS Mathematics pure content

## Pure Mathematics

| Unit | | Title | Estimated hours |
|---|---|---|---|
| 1 | | **Algebra and functions** | |
| | a | Algebraic expressions – basic algebraic manipulation, indices and surds | 4 |
| | b | Quadratic functions – factorising, solving, graphs and the discriminants | 4 |
| | c | Equations – quadratic/linear simultaneous | 4 |
| | d | Inequalities – linear and quadratic (including graphical solutions) | 5 |
| | e | Graphs – cubic, quartic and reciprocal | 5 |
| | f | Transformations – transforming graphs – f($x$) notation | 5 |
| 2 | | **Coordinate geometry in the ($x$, $y$) plane** | |
| | a | Straight-line graphs, parallel/perpendicular, length and area problems | 6 |
| | b | Circles – equation of a circle, geometric problems on a grid | 7 |
| 3 | | **Further algebra** | |
| | a | Algebraic division, factor theorem and proof | 8 |
| | b | The binomial expansion | 7 |
| 4 | | **Trigonometry** | |
| | a | Trigonometric ratios and graphs | 6 |
| | b | Trigonometric identities and equations | 10 |
| 5 | | **Vectors (2D)** | |
| | a | Definitions, magnitude/direction, addition and scalar multiplication | 7 |
| | b | Position vectors, distance between two points, geometric problems | 7 |
| 6 | | **Differentiation** | |
| | a | Definition, differentiating polynomials, second derivatives | 6 |
| | b | Gradients, tangents, normals, maxima and minima | 6 |
| 7 | | **Integration** | |
| | a | Definition as opposite of differentiation, indefinite integrals of $x^n$ | 6 |
| | b | Definite integrals and areas under curves | 5 |
| 8 | | **Exponentials and logarithms:** Exponential functions and natural logarithms | 12 |
| | | | 120 hours |

# AS and A-Level Overview and SOW – September 2018

## Year 1: AS Mathematics applied content
## Statistics and Mechanics

| Unit | Title | Estimated hours |
|---|---|---|
| | **Section A – Statistics** | |
| 1 | **Statistical sampling** | |
| a | Introduction to sampling terminology; Advantages and disadvantages of sampling | 1 |
| b | Understand and use sampling techniques; Compare sampling techniques in context | 2 |
| 2 | **Data presentation and interpretation** | |
| a | Calculation and interpretation of measures of location; Calculation and interpretation of measures of variation; Understand and use coding | 4 |
| b | Interpret diagrams for single-variable data; Interpret scatter diagrams and regression lines; Recognise and interpret outliers; Draw simple conclusions from statistical problems | 8 |
| 3 | **Probability**: Mutually exclusive events; Independent events | 3 |
| 4 | **Statistical distributions**: Use discrete distributions to model real-world situations; Identify the discrete uniform distribution; Calculate probabilities using the binomial distribution (calculator use expected) | 5 |
| 5 | **Statistical hypothesis testing** | |
| a | Language of hypothesis testing; Significance levels | 2 |
| b | Carry out hypothesis tests involving the binomial distribution | 5 |
| | | **30 hours** |
| | **Section B – Mechanics** | |
| 6 | **Quantities and units in mechanics** | |
| a | Introduction to mathematical modelling and standard S.I. units of length, time and mass | 1 |
| b | Definitions of force, velocity, speed, acceleration and weight and displacement; Vector and scalar quantities | 2 |
| 7 | **Kinematics 1 (constant acceleration)** | |
| a | Graphical representation of velocity, acceleration and displacement | 4 |
| b | Motion in a straight line under constant acceleration; *suvat* formulae for constant acceleration; Vertical motion under gravity | 6 |
| 8 | **Forces & Newton's laws** | |
| a | Newton's first law, force diagrams, equilibrium, introduction to **i**, **j** system | 4 |
| b | Newton's second law, '$F = ma$', connected particles (no resolving forces or use of $F = \mu R$); Newton's third law: equilibrium, problems involving smooth pulleys | 6 |
| 9 | **Kinematics 2 (variable acceleration)** | |
| a | Variable force; Calculus to determine rates of change for kinematics | 4 |
| b | Use of integration for kinematics problems i.e. $r = \int v\,dt$, $v = \int a\,dt$ | 3 |
| | | **30 hours** |

# AS and A-Level Overview and SOW – September 2018

## Year 2: Remaining A Level Mathematics pure content

## Pure Mathematics

| Unit | | Title | Estimated hours |
|---|---|---|---|
| 1 | | **Proof**: Examples including proof by deduction* and proof by contradiction | 3 |
| 2 | | **Algebraic and partial fractions** | |
| | a | Simplifying algebraic fractions | 2 |
| | b | Partial fractions | 3 |
| 3 | | **Functions and modelling** | |
| | a | Modulus function | 2 |
| | b | Composite and inverse functions | 3 |
| | c | Transformations | 3 |
| | d | Modelling with functions*<br>*examples may be Trigonometric, exponential, reciprocal etc. | 2 |
| 4 | | **Series and sequences** | |
| | a | Arithmetic and geometric progressions (proofs of 'sum formulae') | 4 |
| | b | Sigma notation | 2 |
| | c | Recurrence and iterations | 3 |
| 5 | | **The binomial theorem** | |
| | a | Expanding $(a + bx)^n$ for rational $n$; knowledge of range of validity | 4 |
| | b | Expansion of functions by first using partial fractions | 3 |
| 6 | | **Trigonometry** | |
| | a | Radians (exact values), arcs and sectors | 4 |
| | b | Small angles | 2 |
| | c | Secant, cosecant and cotangent (definitions, identities and graphs); Inverse trigonometrical functions; Inverse trigonometrical functions | 3 |
| | d | Compound* and double (and half) angle formulae<br>*geometric proofs expected | 6 |
| | e | $R\cos(x \pm \alpha)$ or $R\sin(x \pm \alpha)$ | 3 |
| | f | Proving trigonometric identities | 4 |
| | g | Solving problems in context (e.g. mechanics) | 2 |
| 7 | | **Parametric equations** | |
| | a | Definition and converting between parametric and Cartesian forms | 3 |
| | b | Curve sketching and modelling | 2 |

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| Unit | | Title | Estimated hours |
|---|---|---|---|
| 8 | | **Differentiation** | |
| | a | Differentiating sin $x$ and cos $x$ from first principles | 2 |
| | b | Differentiating exponentials and logarithms | 3 |
| | c | Differentiating products, quotients, implicit and parametric functions. | 6 |
| | d | Second derivatives (rates of change of gradient, inflections) | 2 |
| | e | Rates of change problems* (including growth and kinematics)<br>*see Integration (part 2) – Differential equations | 3 |
| 9 | | **Numerical methods*** | |
| | a | Location of roots | 1 |
| | b | Solving by iterative methods (knowledge of 'staircase and cobweb' diagrams) | 3 |
| | c | Newton-Raphson method | 2 |
| | d | Problem solving | 2 |
| | | *See Integration (part 2) for the trapezium rule | |
| 10 | | **Integration (part 1)** | |
| | a | Integrating $x^n$ (including when $n = -1$), exponentials and trigonometric functions | 4 |
| | b | Using the reverse of differentiation, and using trigonometric identities to manipulate integrals | 5 |
| 11 | | **Integration (part 2)** | |
| | a | Integration by substitution | 4 |
| | b | Integration by parts | 3 |
| | c | Use of partial fractions | 2 |
| | d | Areas under graphs or between two curves, including understanding the area is the limit of a sum (using sigma notation) | 4 |
| | e | The trapezium rule | 2 |
| | f | Differential equations (including knowledge of the family of solution curves) | 4 |
| 12 | | **Vectors (3D):** Use of vectors in three dimensions; knowledge of column vectors and **i**, **j** and **k** unit vectors | 5 |
| | | | **120 hours** |

# AS and A-Level Overview and SOW – September 2018

## Year 2: Remaining A Level Mathematics applied content

## Statistics and Mechanics

| Unit | | Title | Estimated hours |
|---|---|---|---|
| | | **Section A – Statistics** | |
| 1 | | **Regression and correlation** | |
| | a | Change of variable | 2 |
| | b | Correlation coefficients<br>Statistical hypothesis testing for zero correlation | 5 |
| 2 | | **Probability** | |
| | a | Using set notation for probability<br>Conditional probability | 5 |
| | b | Questioning assumptions in probability | 2 |
| 3 | | **The Normal distribution** | |
| | a | Understand and use the Normal distribution | 5 |
| | b | Use the Normal distribution as an approximation to the binomial distribution<br>Selecting the appropriate distribution | 5 |
| | c | Statistical hypothesis testing for the mean of the Normal distribution | 6 |
| | | | **30 hours** |
| | | **Section B – Mechanics** | |
| 4 | | **Moments**: Forces' turning effect | 5 |
| 5 | | **Forces at any angle** | |
| | a | Resolving forces | 3 |
| | b | Friction forces (including coefficient of friction $\mu$) | 3 |
| 6 | | **Applications of kinematics**: Projectiles | 5 |
| 7 | | **Applications of forces** | |
| | a | Equilibrium and statics of a particle (including ladder problems) | 4 |
| | b | Dynamics of a particle | 4 |
| 8 | | **Further kinematics** | |
| | a | Constant acceleration (equations of motion in 2D; the i, j system) | 3 |
| | b | Variable acceleration (use of calculus and finding vectors $\dot{r}$ and $\ddot{r}$ at a given time) | 3 |
| | | | **30 hours** |