CHOOSING THE RIGHT SUBJECT

NEW DP MATHEMATIC COURSES

From the IB graduates at

Lanterna education

Contents

Choosing the right subject: New DP mathematics courses

All IB subjects are changing after a seven-year curriculum review, some changes are small with no real noticeable impact on the course structure or content but others can be quite extensive and be important to be aware of when you are choosing your subject. This year two new subjects in mathematics will be replacing the current four subjects in 2019. In addition to giving more choice to a greater number of students.

Both two new courses will be taught at the Higher level (HL) and Standard level (SL). The first is **Mathematics: analysis and approaches and the second is Mathematics: applications and interpretation.** Each course approaches topics at varying levels of teaching hours. This guide will provide some information about the new courses and their main differences. To help you choose the best fit.

The courses are separated by how they approach mathematics, described generally here:

Mathematics: analysis and approaches

- Emphasis on algebraic methods
- Develop strong skills in mathematical thinking
- Real and abstract mathematical problem solving
- For students interested in mathematics, engineering physical sciences, and some economics

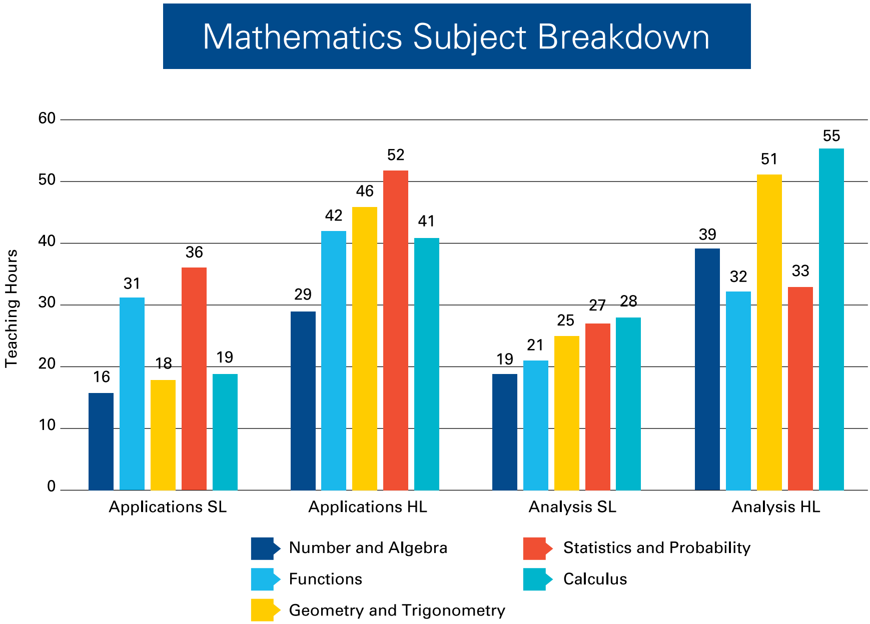
Mathematics: applications and interpretation

- Emphasis on modelling and statistics
- Develops strong skills in applying mathematics to the real-world
- Real mathematical problem solving using technology
- For students interested in social sciences, natural sciences, medicine, statistics, business, engineering, some economics, psychology and design

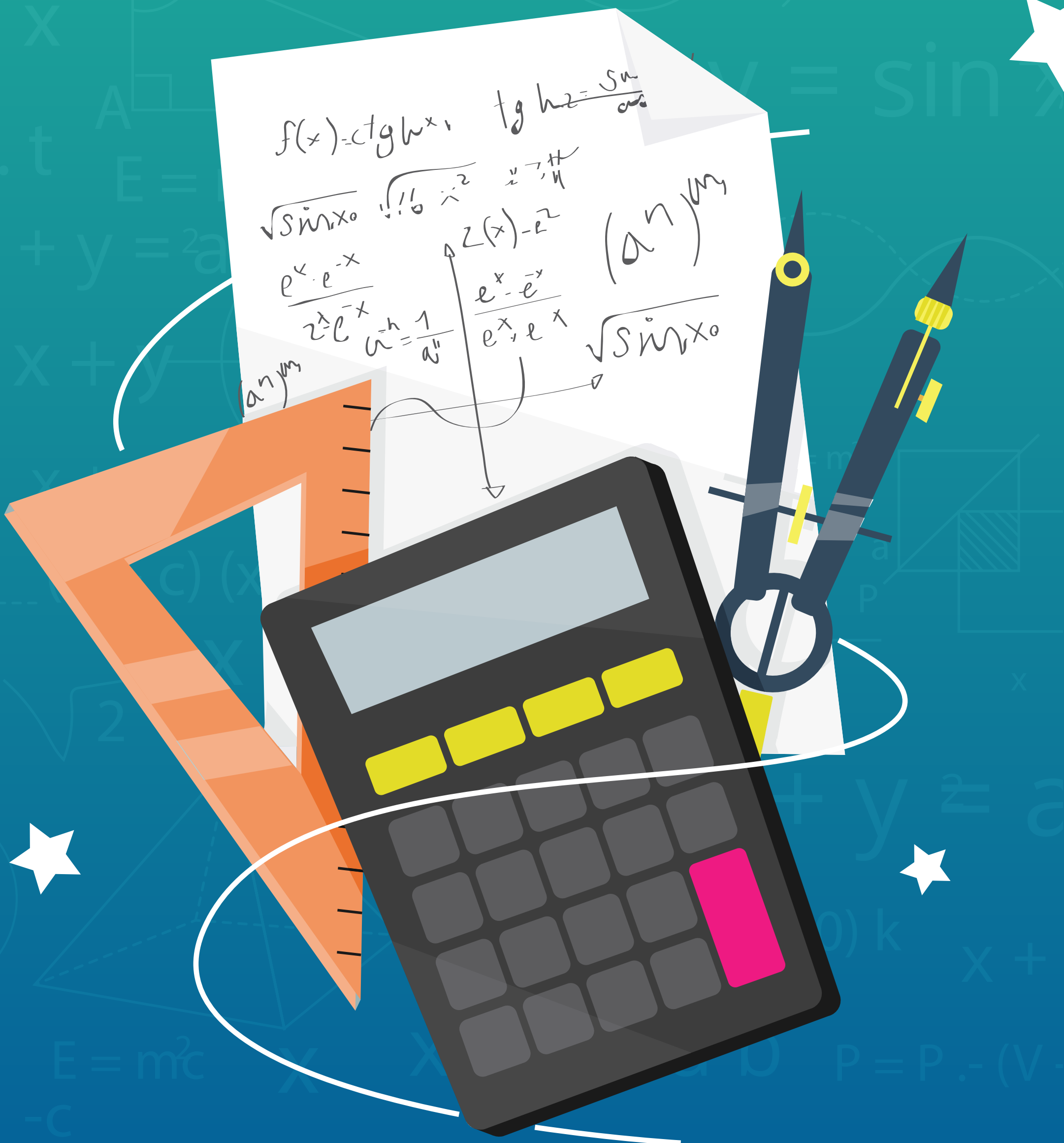
Subject breakdown

All of the courses outlined in the table above (SL and HL in each) cover the same 5 topics within mathematics but emphasize different area: number and algebra, functions, geometry and trigonometry, statics and probability, and calculus.

The chart below may help you select the right course based on the amount of time dedicated to a given topic.



NUMBER AND ALGEBRA



Diving even deeper into the content, the tables on the following pages shows the detailed breakdown of course materials within each topic:

Number and Algebra - (Standard level (SL) comparison)

Applications and interpretation SL

- Operations with numbers in the form $a^{x}\ 10_{k}$ **where 1** $\leq a < 10$ and k is an integer
- Arithmetic sequences and series
- Use of the formulae for the *n*th term and the sum of the first *n*terms of the sequence
- Use of sigma notation for sums of arithmetic sequences, applications
- Analysis, interpretation and prediction where a model is not perfectly arithmetic in real life
- Geometric sequences and series
- Use of the formulae for the nth term and the sum of the first *n*terms of the sequence
- Use of sigma notation for the sums of geometric sequences, applications
- Financial applications of geometric sequences and series: compound interest, annual depreciation
- Laws of exponents with integer exponents
- Introduction to logarithms with base 10 and e
- Numerical evaluation of logarithms using technology
- Approximation: decimal places, significant figures
- Upper and lower bounds of rounded numbers
- Percentage errors
- Estimation
- Amortization and annuities using technology
- Use technology to solve: systems of linear equations in up to 3 variables, polynomial equations

Analysis and approaches SL

- Operations with numbers in the form $a^{x}\ 10_{k}$ **where 1** $\leq a < 10$ and k is an integer
- Arithmetic sequences and series
- Use of the formulae for the nth term and the sum of the first *n*terms of the

sequence

- Use of sigma notation for sums of arithmetic sequences
- Geometric sequences and series
- Use of sigma notation for the sums of geometric sequences
- Financial applications of geometric sequences and series: compound interest, annual depreciation.
- Laws of exponents with integer exponents
- Introduction to logarithms with base 10 and e
- Numerical evaluation of logarithms using technology
- Simple deductive proof, numerical and algebraic; how to lay out a left-hand side to right-hand side (LHS to RHS) proof
- The symbols and notation for equality and identity
- Laws of exponents with rational exponents
- Laws of logarithms
- Change of base of a logarithm
- Solving exponential equations, including using logarithms
- Sum of infinite convergent geometric sequences
- The binomial theorem
- Use of Pascal's triangle and ${}_nC_r$

Number and Algebra - (Higher level (HL) comparison)

Applications and interpretation HL

- Laws of logarithms
- Simplifying expressions, both numerically and algebraically, involving rational exponents
- The sum of infinite geometric sequences
- Complex numbers: number i such that i2 = -1
- Cartesian form: z = a+ bi; the terms real part, imaginary part, conjugate, modulus, argument
- Calculate sums, differences, products, quotients, by hand and with technology
- Calculating powers of complex numbers, in Cartesian form, with technology
- The complex plane
- **Complex numbers as solutions to quadratic equations of the form ax2 + bx + c = 0, a ≠ 0, with real coefficients where b2– 4ac < 0**
- Modulus–argument (polar) form: z = r (cosθ + isinθ) = rcisθ
- Exponential form: z = reiθ
- Conversion between Cartesian, polar and exponential forms, by hand & with technology
- Calculate products, quotients and integer powers in polar or exponential forms
- Adding sinusoidal functions with the same frequencies but different phase shift angles
- Geometric interpretation of complex numbers
- Definition of a matrix: the terms element, row, column and order for m x nmatrices
- Algebra of matrices: equality; addition; subtraction; multiplication by a scalar for m x nmatrices
- Multiplication of matrices
- Properties of matrix multiplication: associativity, distributivity & non-commutativity
- Identity and zero matrices
- Determinants and inverses of n x nmatrices with technology, & by hand for 2 x 2 matrices

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- Awareness that a system of linear equations can be written in the form Ax= b
- Solve systems of equations with inverse matrix
- Eigenvalues and eigenvectors
- Characteristic polynomial of 2 x 2 matrices
- Diagonalization of 2 x 2 matrices (restricted to cases with distinct real eigenvalues)
- Applications to powers of 2 x 2 matrices

Analysis and approaches HL

- Counting principles, including permutations and combinations
- Extension of the binomial theorem to fractional and negative indices
- Partial fractions
- Complex numbers: the number i, where i2= -1
- Cartesian form z = a + bi; the terms real part, imaginary part, conjugate, modulus and argument
- The complex plane
- Modulus–argument (polar) form
- Euler form
- Sums, products and quotients in Cartesian, polar or Euler forms and their geometric interpretation
- Complex conjugate roots of quadratic and polynomial equations with real coefficients
- De Moivre's theorem and its extension to rational exponents
- Powers and roots of complex numbers
- Proof by mathematical induction
- Proof by contradiction
- Use of a counterexample to show that a statement is not always true
- Solutions of systems of linear equations (a maximum of three equations in three unknowns), including cases where there is a unique solution, an infinite number of solutions or no solution

GEOMETRY AND TRIGONOMETRY

Geometry and trigonometry - (Standard level (SL) comparison)

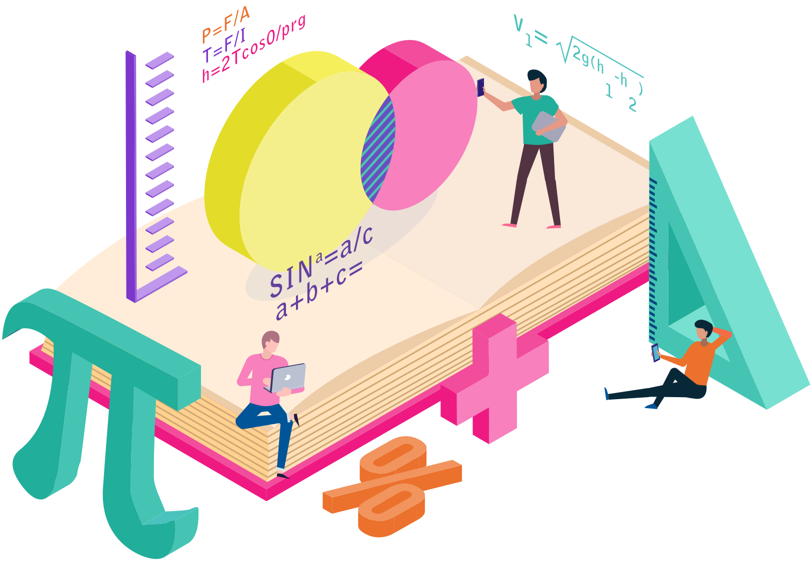
Applications and interpretation SL

- The distance between two points in three-dimensional space, and their midpoint
- Volume and surface area of three-dimensional solids including right-pyramid, right cone, sphere, hemisphere and combinations of these solids
- The size of an angle between two intersecting lines or between a line and a plane
- Use of sine, cosine and tangent ratios to find the sides and angles of right-angled triangles
- The sine rule: a / sinA= b / sinB = c / sinC
- The cosine rule: c2 = a2 + b2 – 2abcosC
- cosC = (a_2 + b_2 – c_2) / 2ab
- Area of a triangle as 1/2absinC
- Applications of right and non-right angled trigonometry, including Pythagoras' theorem
- Angles of elevation and depression
- Construction of labelled diagrams from written statements
- The circle: length of an arc; area of a sector
- Equations of perpendicular bisectors
- Voronoi diagrams: sites, vertices, edges, cells
- Addition of a site to an existing Voronoi diagram
- Nearest neighbour interpolation
- Applications

Analysis and approaches SL

- The distance between two points in three-dimensional space + midpoint
- Volume and surface area of three-dimensional solids including right-pyramid, right cone, sphere, hemisphere and combinations
- Angle size between two intersecting lines or between a line & a plane
- Find sides & angles of right-angled triangles with sine, cosine & tangent
- The sine and cosine rules
- Area of a triangle using ½absinC
- Applications of right and non-right angled trigonometry, including

Pythagoras's theorem
- Angles of elevation and depression
- Construction of labelled diagrams from written statements
- The circle: radian measure of angles; length of an arc; area of a sector.
- Definition of cosθ, sinθ (unit circle)
- Definition of tanθ as sinθ / co\sθ
- Exact values of trigonometric ratios of 0, π/6 , π/4 , π/3 , π/2 and their multiples
- Extension of the sine rule to the ambiguous case
- Pythagorean identity cos2θ + sin2θ = 1
- Double angle identities for sine and cosine
- Relationship trigonometric ratios
- Circular functions sinx, cosx, & tanx; amplitude, periodic nature, and graphs
- Composite functions of the form
- f(x) = asin(b(x + c)) + d
- Transformations and Real-life contexts
- Solving trigonometric equations in a finite interval, graphically and analytically
- Equations leading to quadratic equations in sinx, cosx or tanx



Geometry and trigonometry - (Higher level (HL) comparison)

Applications and interpretation HL

- Composite functions in context
- The notation $(f \circ g)(x) = f(g(x))$
- Inverse function f-1, including domain restriction
- Finding an inverse function
- Transformations of graphs
- Translations: $y = f(x) + b$;$y = f(x – a)$
- Reflections: in the xaxis $y = –f(x)$, and in the y axis $y = f(–x)$
- Vertical stretch with scale factor p: $y = pf(x)$
- Horizontal stretch with scale factor 1 / q : $y = f(qx)$
- Composite transformations
- Exponential models to calculate half-life
- Natural logarithmic models
- Sinusoidal models
- Logistic models
- Piecewise models
- Scaling very large or small numbers using logarithms
- Linearizing data using logarithms to determine if the data has an exponential or a power relationship using best-fit straight lines to determine parameters
- Interpretation of log-log and semi-log graphs

Analysis and approaches HL

- Polynomial functions, their graphs and equations; zeros, roots and factors
- The factor and remainder theorems
- Sum and product of the roots of polynomial equations
- Rational functions
- Odd and even functions
- Finding the inverse function, f-1(x), including domain restriction
- Self-inverse functions
- Solutions of g(x)   f(x), both graphically and analytically
- The graphs of the functions, $y = |f(x)|$ and $y = f(|x|)$, $y = 1 / f(x)$, $y = f (ax + b)$, y= [f(x)]2
- Solution of modulus equations and in-equalities

CALCULUS

Calculus - (Standard level (SL) comparison)

Applications and interpretation SL

- Introduction to concept of a limit
- Derivative interpreted as gradient function and as rate of change
- Increasing and decreasing functions
- Graphical interpretation of f ′(x) > 0, f ′(x) = 0, f ′(x) < 0
- **Derivative of f(x) = axn is f ′(x) = anxn– 1, n ∈ Z**
- The derivative of functions of the form f(x) = axn + bxn – 1 + – where all exponents are integers
- Tangents and normals at a given point, and their equations
- **Introduction to integration as anti-differentiation of functions of the form f(x) = axn + bxn – 1 + …, where n ∈ Z, n ≠ -1**
- Anti-differentiation with a boundary condition to determine the constant term
- Definite integrals using technology
- Area of a region enclosed by a curve y= f(x) and the x-axis, where f(x) > 0
- Values of x where the gradient of a curve is zero
- Solution of f ′(x) = 0
- Local maximum and minimum points
- Optimisation problems in context
- Approximating areas using the trapezoidal rule

Analysis and approaches SL

- Introduction to the concept of a limit
- Derivative interpreted as gradient function and as rate of change
- Increasing and decreasing functions
- Graphical interpretation of f ′(x) > 0, f ′(x) = 0, f ′(x) < 0
- **Derivative of f(x) = axn is f ′(x) = anxn-1 , n ∈ Z**
- Derivative of functions of the form f(x) = axn + bxn-1. . . where all exponents are integers
- Tangents and normals at a given point, and their equations
- **Intro to integration as anti-differentiation of functions of the formf(x) = axn + bxn – 1 + …., where n ∈ Z, n ≠ – 1**
- Anti-differentiation with a boundary condition to determine the constant term

- Definite integrals using technology
- Area of a region enclosed by a curve y= f(x) and the x-axis, where f(x) > 0
- **Derivative of xn (n ∈ Q), sinx, cosx, ex and lnx**
- Differentiation of a sum & multiple of functions
- The chain rule for composite functions
- The product and quotient rules
- The second derivative
- Graphical behaviour of functions, including the relationship between the graphs of f , f ′ and f ″
- Local maximum and minimum points
- Testing for maximum and minimum
- Optimization
- Points of inflexion w zero & non-zero gradients
- Kinematic problems involving displacement s, velocity v, acceleration a and total distance travelled
- **Indefinite integral of xn (n ∈ Q), sinx, cosx, 1/x and ex**
- The composites of any of these with the linear function ax + b

- **Integration by inspection (reverse chain rule) or by substitution for expressions of the form: ∫ kg′(x)f(g(x))dx**
- Definite integrals, incl. analytical approach
- Areas of a region enclosed by a curve y= f(x) and the x-axis, where f(x) can be positive or negative, without the use of technology
- Areas between curves

Calculus - (Higher level (HL) comparison)

Applications and interpretation HL

- **The derivatives of sin x, cos x, tan x, ex , ln x, xn where n ∈ Q**
- Chain rule, product rule & quotient rules
- Related rates of change
- The second derivative
- Use of second derivative test to distinguish between a maximum and a minimum point
- **Definite and indefinite integration of xnwhere n ∈ Q, including n = – 1 , sin x, cos x, 1 / cos2xand ex**
- Integration by inspection, or substitution of the form f(g(x))g′(x)dx
- Area of the region enclosed by a curve and the x or y-axes in a given interval
- Volumes of revolution about the x– axis or y– axis
- Kinematic problems involving displacement s, velocity v and acceleration a
- Setting up a model/differential equation from a context
- Solving by separation of variables
- Slope fields and their diagrams
- Euler's method for finding the approximate solution to first order differential equations
- Numerical solution of dy / dx = f(x, y)
- Numerical solution of the coupled system dx / dt = f1 (x, y, t) and dy / dt = f2 (x, y, t)
- Phase portrait for the solutions of coupled differential equations of form: dx / dt = ax + by and dy / dt = cx + dy
- Qualitative analysis of future paths for distinct, real, complex and imaginary eigenvalues
- Sketching trajectories and using phase portraits to identify key features

such as equilibrium points, stable populations and saddle points
- Solutions of (d2x/dt2) = f[x, (dx/dt), t] by Euler's method

Analysis and approaches HL

- Informal understanding of continuity and differentiability of a function at a point
- Understanding of limits (convergence and divergence)
- Definition of derivative from first principles
- Higher derivatives
- Evaluation of limits using L'Hôpital's rule or the Maclaurin series
- Repeated use of l'Hôpital's rule
- Implicit differentiation
- Related rates of change
- Optimisation problems
- Derivatives of tanx, secx, cosecx, cotx, ax, logax, arcsinx, arccosx, arctanx
- Indefinite integrals of the derivatives of any of the above functions
- The composites of any of these with a linear function
- Use of partial fractions to rearrange the integrand
- Integration by substitution and parts
- Repeated integration by parts
- Area of the region enclosed by a curve and the y-axis in a given interval
- Volumes of revolution about the x-axis or y-axis
- First order differential equations
- Numerical solution of dy / dx = f(x, y) using Euler's method
- Variables separable
- Homogeneous differential equation dy / dx = f(y / x) using the substitution y = vx
- Solution of y' + P(x)y= Q(x), using the integrating factor
- **Maclaurin series to obtain expansions for ex, sinx, cosx, ln(1 + x), (1 + x)p , p ∈ Q**
- Use of simple substitution, products, integration and differentiation to obtain other series
- Maclaurin series developed from differential equation

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FUNCTIONS

$\vec{\tau} = \vec{\mu} \times \vec{B}$
$A = \frac{1}{2}(P + P') \times a$
$A_b + A_b$
$V = \frac{1}{3} h(A_b + A_b)$
$\sqrt{A_b A_b})$

Functions (Standard level (SL) comparison)

Applications and interpretation SL

- Different forms of the equation of a straight line
- Gradient; intercepts
- Lines with gradients m1 and m2 Parallel lines m1 = m2. Perpendicular lines m1   m2 = – 1
- Concept of a function, domain, range and graph
- Function notation, for example f(x), v(t), C(n)
- The concept of a function as a mathematical mode
- Informal concept that an inverse function reverses or undoes the effect of a function
- Inverse function as a reflection in the line y= x, and the notation f-1(x)
- The graph of a function; its equation y = f(x)
- Creating a sketch from information given or a context, including transferring a graph from screen to paper
- Using technology to graph functions including their sums and differences
- Determine key features of graphs
- Finding the point of intersection of two curves or lines using technology
- Modelling with the following functions: linear, quadratic, exponential, cubic, sinusoidal
- Linear models
- f(x) = mx + c
- Quadratic models
- Exponential growth and decay models
- Equation of a horizontal asymptote
- Direct/inverse variation
- Cubic models
- Sinusoidal models
- Modelling skills: develop and fit the model, determine a reasonable domain, find the parameters, test and reflect upon the model, use the model
- Develop and fit the model: given a context recognize and choose an appropriate model and possible parameters
- Determine a reasonable domain for a model
- Find the parameters of a model
- Test and reflect upon the model: comment on the appropriateness and

reasonableness of a model, justify the choice of a particular model, based on the shape of the data, properties of the curve and/or on the context of the situation

- Use the model: reading, interpreting and making predictions based on the model

Analysis and approaches SL

- Different forms of the equation of a straight line
- Gradient; intercepts
- Lines with gradients m1 and m2
- Parallel lines m1 = m2
- Perpendicular lines m1   m2 = -1
- Concept of a function, domain, range and graph
- Function notation
- The concept of a function as a mathematical model
- Informal concept that an inverse function reverses or undoes the effect of a function
- Inverse function as a reflection in the line y= x, and the notation f-1(x)
- The graph of a function; its equation y = f(x)
- Creating a sketch from information given or a context, including transferring a graph from screen to paper
- Using technology to graph functions including their sums and differences
- Determine key features of graphs
- Finding the point of intersection of two curves or lines using technology
- Composite functions
- Identity function
- Finding the inverse function f–1(x)
- The quadratic function f(x) = ax2 + bx + c: its graph, y-intercept (0, c). Axis of symmetry
- **The form f(x) = a (x – p)(x – q), x-intercepts (p, 0) and (q, 0)**
- **The form f(x) = a (x – h)2 + k, vertex (h, k)**
- Solution of quadratic equations and inequalities
- The quadratic formula
- **The discriminant Δ = b2 – 4ac and the nature of the roots, that is, two distinct real roots, two equal real roots, no real roots**

- **The reciprocal function f(x) = 1/x , x≠ 0: its graph and self-inverse nature**
- Rational functions
- Equations of vertical and horizontal asymptotes
- Exponential functions and their graphs
- Logarithmic functions and their graphs
- Solving equations, both graphically and analytically
- Use of technology to solve a variety of equations, including those where there is no appropriate analytic approach
- Applications of graphing skills and solving equations that relate to real-life situations
- Transformations of graphs, translations, reflections (in both axes), vertical stretch with scale factor, horizontal stretch with scale factor
- Composite transformations

Functions - (Higher level (HL) comparison)

Applications and interpretation HL

- Composite functions in context
- **The notation (f ∘ g)(x) = f(g(x))**
- Inverse function f-1, including domain restriction
- Finding an inverse function
- Transformations of graphs
- Translations: y = f(x) + b ;y = f(x – a)
- Reflections: in the xaxis y = –f(x), and in the y axis y = f(–x)
- Vertical stretch with scale factor p: y = pf(x)
- Horizontal stretch with scale factor 1 / q : y = f(qx)
- Composite transformations
- Exponential models to calculate half-life
- Natural logarithmic models
- Sinusoidal models
- Logistic models
- Piecewise models
- Scaling very large or small numbers using logarithms
- Linearizing data using logarithms to determine if the data has an exponential or a power relationship using best-fit straight lines to determine parameters
- Interpretation of log-log and semi-log graphs

Analysis and approaches HL

- Polynomial functions, their graphs and equations; zeros, roots and factors
- The factor and remainder theorems
- Sum and product of the roots of polynomial equations
- Rational functions
- Odd and even functions
- Finding the inverse function, f-$_1$(x), including domain restriction
- Self-inverse functions
- **Solutions of g(x) ≥ f(x), both graphically and analytically**
- The graphs of the functions, y = |f(x)| and y = f(|x|), y = 1 / f(x) , y = f (ax + b), y= [f(x)]2
- Solution of modulus equations and inequalities

STATISTICS AND PROBABILITY

Statistics and probability - (Standard level (SL) comparison)

Applications and interpretation SL

- Concepts of population, sample, random sample, discrete and continuous data
- Reliability of data sources and bias in sampling
- Histograms, Interpretation of outliers & Sampling techniques and their effectiveness
- Presentation of data (discrete and continuous): frequency distributions (tables)
- Cumulative frequency; cumulative frequency graphs; use to find median, quartiles, percentiles, range and interquartile range (IQR)
- Production and understanding of box and whisker diagrams
- Measures of central tendency (mean, median and mode)
- Estimation of mean from grouped data and model class
- Measures of dispersion (interquartile range, standard deviation and variance)
- Effect of constant changes on the original data
- Quartiles of discrete data and linear correlation of bivariate data
- Pearson's product-moment correlation coefficient, r
- Scatter diagrams; lines of best fit, by eye, passing through the mean point
- Equation of the regression line of y on x
- Use of the equation of the regression line for prediction purposes
- Interpret the meaning of the parameters, a and b, in a linear regression $y = ax + b$
- Concepts of trial, outcome, equally likely outcomes, relative frequency, sample space (U) and event
- Probability of an event A is $P(A) = n(A) / n(U)$
- The complementary events A and A′ (not A)
- Expected number of occurrences & Combined events and mutually exclusive events
- Use of Venn diagrams, tree diagrams, sample space diagrams and tables of outcomes to calculate probabilities
- Concept of discrete random variables and their probability distributions
- Expected value (mean), E(X) for discrete data
- Binomial distribution and mean and variance of the binomial distribution

- The normal distribution and curve
- Properties of the normal distribution and diagrammatic representation
- Normal probability calculations and inverse normal calculations
- Spearman's rank correlation coefficient, rs
- Awareness of the appropriateness and limitations of Pearson's product moment correlation coefficient and Spearman's rank correlation coefficient, and the effect of outliers on each
- Formulation of null and alternative hypotheses, H0 and H1
- Significance levels and p -values as well as expected and observed frequencies
- The $\chi 2$ test for independence: contingency tables, degrees of freedom, critical value
- The $\chi 2$ goodness of fit test and the t -test & Using one-tailed and two-tailed tests
- Use of the p -value to compare the means of two populations

Analysis and approaches SL

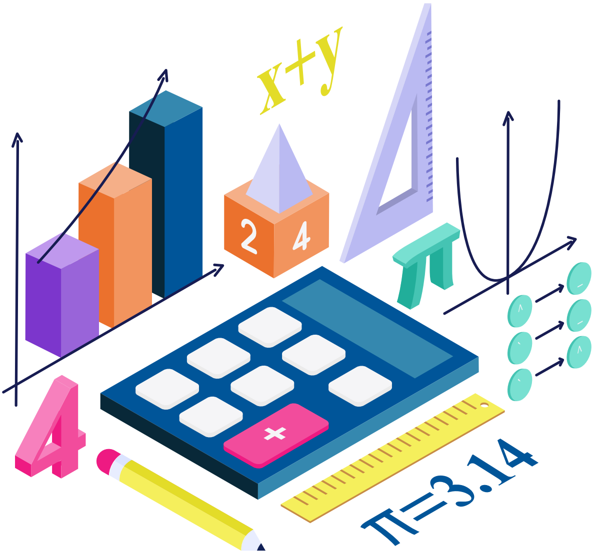
- Concepts of population, sample, random sample, discrete and continuous data
- Reliability of data sources and bias in sampling
- Histograms and Interpretation of outliers
- Sampling techniques and their effectiveness
- Presentation of data (discrete and continuous): frequency distributions (tables)
- Cumulative frequency; cumulative frequency graphs; use to find median, quartiles, percentiles, range and interquartile range (IQR)
- Production and understanding of box and whisker diagrams
- Measures of central tendency (mean, median and mode)
- Estimation of mean from grouped data
- Model class
- Measures of dispersion (interquartile range, standard deviation and variance)
- Effect of constant changes on the original data
- Quartiles of discrete data
- Linear correlation of bivariate data

- Pearson's product-moment correlation coefficient, r
- Scatter diagrams; lines of best fit, by eye, passing through the mean point
- Equation of the regression line of y on x
- Use of the equation of the regression line for prediction purposes
- Interpret the meaning of the parameters, a and b, in a linear regression y = ax + b
- Concepts of trial, outcome, equally likely outcomes, relative frequency, sample space (U) and event
- The probability of an event A is P(A) = n(A) / n(U)
- The complementary events A and A′ (not A)
- Use of Venn diagrams, tree diagrams, sample space diagrams and tables of outcomes to calculate probabilities
- Combined events, mutually exclusive events and independent events
- Conditional probability
- Concept of discrete random variables and their probability distributions
- Expected value (mean), for discrete data
- Applications and Binomial distribution
- Mean and variance of the binomial distribution
- The normal distribution and curve
- Properties of the normal distribution
- Diagrammatic representation
- Normal probability calculations and Inverse normal calculations
- Equation of the regression line of x on y
- Use of the equation for prediction purposes
- Use of the probability formulae for conditional and independent events
- Standardization of normal variables (z– values)
- Inverse normal calculations where mean and standard deviation are unknown

Statistics and probability - (Higher level (HL) comparison)

Applications and interpretation HL

- Design of valid data collection methods, such as surveys and questionnaires
- Selecting relevant variables from many variables
- Choosing relevant and appropriate data to analyse



- Categorizing numerical data in a χ2table and justifying the choice of categorization
- Choosing an appropriate number of degrees of freedom when estimating parameters from data when carrying out the χ2 goodness of fit test
- Definition of reliability and validity
- Reliability tests
- Validity tests
- Non-linear regression
- Evaluation of least squares regression curves using technology
- Sum of square residuals (SSres) as a measure of fit for a model
- The coefficient of determination (R2)
- Evaluation of R2 using technology
- Linear transformation of a single random variable
- Expected value of linear combinations of n random variables
- Variance of linear combinations of nindependent random variables
- Unbiased estimates for means and variance
- A linear combination of n independent normal random variables is normally distributed

- Central limit theorem
- Confidence intervals for the mean of a normal population
- Poisson distribution, its mean and variance
- Sum of two independent Poisson distributions has a Poisson distribution
- Critical values and critical regions
- Test for population mean for normal distribution
- Test for proportion using binomial distribution
- Test for population mean using Poisson distribution
- Use of technology to test the hypothesis that the population product moment correlation coefficient (ρ) is 0 for bivariate normal distributions.
- Type I and II errors including calculations of their probabilities
- Transition matrices
- Powers of transition matrices
- Regular Markov chains
- Initial state probability matrices
- Calculation of steady state and long-term probabilities by repeated multiplication of the transition matrix or by solving a system of linear equations

Analysis and approaches HL

- Use of Bayes' theorem for a maximum of three events
- Variance of a discrete random variable
- Continuous random variables and their probability density functions
- Mode and median of continuous random variables
- Mean, variance and standard deviation of both discrete and continuous random variables
- The effect of linear transformations of X

To sum up, the Maths curriculum is changing to give students a wider variety of subjects and topics to choose from. This guide has hopefully made you choose a little easier: if you are really into numbers, algebraic methods and physical sciences - go for **Mathematics: analysis and approaches.** But if you are not the biggest fan of mathematical calculations and rather wants to understand how Maths can be used in the "real-life" - choose **Mathematics: applications and interpretation.**

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