SCHEME OF WORK FOR IB MATHEMATICAL STUDIES SL
Main resource: Mathematics, Mathematical Studies for the international student. Haese and Harris publications.

PART 1

**Number and algebra.** (syllabus ref: 1.2 – 1.3, 1.5 – 1.6)

Standard form. Operations with numbers expressed in the form $a \times 10^k$, where $1 \leq a \leq 10$ and $k \in \mathbb{Z}$.

SI and other basic units of measurements: kg, m, s, l, m/s, Celsius scale.

Approximations, estimation. Rounding; decimal places, significant figures.

Percentage error.

Currency conversions.

Basic algebra: Laws of exponents, expanding brackets, linear equations, formula substitution and formula rearrangement. (Presumed knowledge)

Linear simultaneous equations in two variables, by use of GDC. Including problem solving.

Quadratic equations. Including problem solving.

(Chapter 2, 3, 4)

**Test (Approx. end of September, year 1)**

PART 2

**Number and algebra.** (syllabus ref: 1.7 – 1.9)

**SEQUENCES AND SERIES**

Arithmetic sequences, and their applications.
Use of the formula $u_n = u_1 + (n-1)d$ for the $n^{th}$ term of an arithmetic sequence.

Use of the formula $S_n = \frac{n}{2}(2u_1 + (n-1)d) = \frac{n}{2}(u_1 + u_n)$ for the sum of $n$ terms in an arithmetic series.

Geometric sequences and their applications.
Use of the formula $u_n = u_1 r^{n-1}$ for the $n^{th}$ term in a geometric sequence.
Use of the formula \( S_n = \frac{u_1(r^n - 1)}{r - 1} = \frac{u_1(1 - r^n)}{1 - r} \) for the sum of \( n \) terms in a geometric series.

Financial applications of geometric sequences and series: Compound interest. Annual depreciation.

(Chapter 5)

**Statistics 1**, (syllabus ref: 2.1 – 2.6)

Classification of data as discrete or continuous.
Use of sigma notation. Frequency tables.
Grouped data: frequency tables, mid-interval values, upper and lower boundaries.
Histograms.
Cumulative frequency tables for grouped data.
Cumulative frequency graphs, median and quartiles.
Box and whisker plots.
Percentiles and quartiles.

Averages: mean, mode and median.
Estimated mean from grouped data.
Modal class.

Measures of dispersion: range, interquartile range, standard deviation.

Use of calculator.

(Chapter 6)

**Test (Approx. end of November, year 1)**

**PART 3**

**Sets, logic and probability 1** (syllabus ref: 1.1, 3.5 – 3.7)

**SETS AND VENN DIAGRAM**

Number sets: natural numbers, integers, rational numbers and real numbers.
Basic concepts of set theory: subsets, intersection, union, complements of sets.

Venn diagrams and simple applications.

**PROBABILITY**

Sample space: event \( A \) and complementary event \( A' \). \( P(A') = 1 - P(A) \)

Probability of an event \( A \) given by \( P(A) = \frac{n(A)}{n(U)} \)

Probability from tree diagram and Venn diagram.
Solution of problems using “with replacement” and “without replacement”.

Laws of probability.

Combined events:
\[ P(A \cup B) = P(A) + P(B) - P(A \cap B) \]

Mutually exclusive events:
\[ P(A \cup \bar{B}) = P(A) + P(B) \]

Independent events:
\[ P(A \cap B) = P(A)P(B) \]

Conditional probability:

(Problems should be solved using the most appropriate method in solving individual questions).

(Chapter 7, 9)

Test (Approx. end of January, year 1)

PART 4

Introduction to the Internal Assessment, the project. (End of January)

Statistics 2, (syllabus ref: 4.1 – 4.4)

The normal distribution. The concept of a random variable, the parameters \( \mu \) and \( \sigma \), the bell shape, the symmetry about \( x = \mu \).
Diagrammatic representation.
Normal probability calculations.
Expected value.
Inverse normal calculations.

Bivariate data.

Scatter diagram, the concept of correlation, interpretation of positive, zero and negative correlation.
Measuring correlation: Pearson’s correlation coefficient. Use of calculator to calculate \( r \) is expected.
Regression line. Use of regression line for prediction purposes. Dependent and independent variables, outliers. Use of calculator to find regression line is expected.

The \( \chi^2 \) test for independence.
The null hypothesis and the alternative hypothesis.
Significance levels. Degrees of freedom. Use of tables for critical values.
Contingency tables, expected values.
Degrees of freedom.
The $p$-values.

Use of calculator to find $\chi^2$ in the examination.

(Chapter 10, 11)

**Test (Approx. beginning of March, year 1)**

**PART 5**

**Geometry and trigonometry, (syllabus ref: 5.1 )**

Distances between points. Midpoints.
Gradients, intercepts, points of intersection between lines.
Parallel lines and perpendicular lines.
Equation of a line, the forms $y = mx + c$ (gradient- intercept form) and $ax + by + c = 0$
(general form).

(Chapter 13)

**Mathematical models, (syllabus ref: 6.1 – 6.7)**

Concept of a function, domain, range and graph.
Function notation.
Linear models. Linear functions and their graphs, $f(x) = mx + c$.

(Chapter 16)

Quadratic models.
Quadratic functions and their graphs, $f(x) = ax^2 + bx + c$.
Properties of a parabola: vertex, intercepts on the x-axis and y-axis,
zeros, axis of symmetry; $x = -\frac{b}{2a}$, vertex, intercepts, transformations of graphs.

(Chapter 17)

**Work on examination questions or test. (Approx. end of April, year 1)**

Exponential models.
Exponential functions and their graphs:
$f(x) = ka^x + c$
$f(x) = ka^{-x} + c$
$a \in \mathbb{Q}, a \neq 1, k \neq 0$
Concept and equation of a horizontal asymptote.

(Chapter 18)
Models using functions of the form \( f(x) = ax^m + bx^n + \ldots, \ m, n \in \mathbb{Z} \)
Functions of this type and their graphs.
The y-axis as a vertical asymptote.

(Chapter 19)

Drawing accurate graphs. Creating a sketch from information given. Transferring a graph from GDC to paper. Included all the functions above and additions and subtractions. Use GDC to solve equations involving combinations of the functions above.

Test. (Approx. end of May, year 1)

Work on Internal Assessment

PART 6

Introduction to differential calculus, (syllabus ref: 7.1 – 7.6)

Concept of the derivative as a rate of change. Tangent to a curve.

Simple rules of differentiation.

Notation \( f'(x) = \frac{dy}{dx} \)

Gradients of curves for given values of x.
Equation of the tangent at a given point.
Equation of the line perpendicular to the tangent at a given point.

Increasing and decreasing functions.

Interpretation of:

\[ f'(x) > 0 \]
\[ f'(x) = 0 \]
\[ f'(x) < 0 \]

Values of x where the gradient of a curve is zero.
Solution of \( f'(x) = 0 \).
Stationary points
Local maximum and minimum points.

Optimizing problems.

Behaviour of the gradient of the line as one point approaches the other.

(Chapter 20, 21)

Test (Approx. beginning October, year 2)
PART 7

Sets, logic and probability 2 (syllabus ref: 3.1 – 3.4)

LOGIC

Basic concepts of symbolic logic: propositions, notations.

Compound statements:
Implication ⇒
Equivalence ⇔
Negation ¬
Conjunction ∧
Disjunction ∨
Exclusive disjunction ⊕

Translation between verbal statements, symbolic form and Venn diagram.

Truth tables. A maximum of three propositions will be used.

Concepts of logical contradiction and tautology.

Definition of implication:
Converse
Inverse
Contrapositive

Logical equivalence.

(Chapter 8)

Geometry and trigonometry (syllabus ref: 5.2 – 5.5)

And

Number and algebra, (syllabus ref: 1.4)

SI-units.

Use of the ratios of sine, cosine and tangent of right angled triangles.

Angles of depression and elevation.

The sine rule: \[ \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} \] or

\[ \frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c} \]
The cosine rule: \[ a^2 = b^2 + c^2 - 2bc \cos A \] or \[ \cos A = \frac{b^2 + c^2 - a^2}{2bc} \]

The area of a triangle: \[ A = \frac{1}{2} ab \sin C \]

Construction of labelled diagrams from verbal statements.

Geometry of three-dimensional shapes:
- Cuboid
- Prism
- Pyramid
- Cylinder
- Sphere
- Hemisphere
- Cone

Volume and surface areas of the three-dimensional solids.

Three-dimensional problems including:

Size of angles between two lines and between lines and planes.

**REVISION**