MATHEMATICS AND STATISTICS

ADVANCED SUPPLEMENTARY LEVEL

INTRODUCTION

This syllabus has been designed mainly for candidates who wish to further their study of mathematics beyond the Certificate of Education level, but who may not intend to specialize in the physical sciences and engineering.

AIMS

The aim of the examination is to test, with reference to the subject matter listed in the syllabus below, the candidates'

1. understanding of the mathematical and statistical concepts, principles and methods, and ability to apply them,
2. ability to formulate models and to identify and apply appropriate techniques for the solution of problems.

THE EXAMINATION

The examination will consist of a three-hour written paper with two sections. Section A (40%) will consist of 6-8 short and relatively straightforward questions all of which are to be attempted. Section B (60%) will consist of 6 long and harder questions of which candidates will be required to answer 4.

Notes:
1. Knowledge of the subject matter in the current Mathematics Syllabus at the level of the Hong Kong Certificate of Education Examination is assumed. However, Additional Mathematics is not a prerequisite.
2. Electronic calculators* and mathematical drawing instruments may be used in the examination.
3. Statistical tables will be printed in the question paper where appropriate.

THE SYLLABUS

	Syllabus	*Notes*
1.	Permutations and combinations.	Simple applications to problems including arrangements and selections.
2.	Use of the binomial expansion of $(1+x)^n$ when (a) n is a positive integer; (b) n is rational and $\lvert x \rvert < 1$.	Formal proof of the expansion is not required. Determination of the greatest term and relations between coefficients are excluded. Knowledge of the $\sum$ notation is expected.
3.	The exponential functions.	Properties and graphs of the functions. Solution of simple equations with unknown indices. Knowledge that $e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots$ is expected.
4.	The logarithmic functions.	Properties and graphs of the functions to any base (the change of base is not expected). Solution of simple equations involving logarithms. Application to reduction of the relations $y = kx^n$ and $y = ka^x$ to linear relations.
5.	Differentiation of powers of x, e^x and $\ln x$.	Intuitive concepts of limits and derivatives are expected. Differentiation of the trigonometric functions is excluded.
6.	Differentiation of a sum, a product, and a quotient of functions. Differentiation of composite functions and inverse functions. Second derivatives.	Proofs of differentiation rules will not be examined.

	Syllabus	*Notes*
7.	Applications of differentiation to small increments, gradients, rates of change, maxima and minima, and sketching of simple curves.	Including graphs of polynomials and rational functions of the form $\frac{ax+b}{cx+d}$, their convexity, points of inflexion, horizontal and vertical asymptotes.
8.	Indefinite integration as the reverse process of differentiation. Integration of simple functions. Integration by substitution.	Including integration of $\frac{1}{x}$ and e^x. Integration by parts is not required.
	Definite integrals and their simple properties. Application to finding plane areas.	Proofs of these properties are not required.
9.	Approximation of definite integrals using the trapezoidal rule.	Error estimation is not expected.
10.	First notions of population parameters and sample statistics.	Population with mean μ and variance σ^2. Knowledge that the sample mean $\bar{x}$ and the sample variance s^2 tend to μ and σ^2 respectively as the sample size tends to ∞.
	Basic statistical measures and their interpretations.	Mean (including weighted means with application to index numbers), mode, modal class, median, range, interquartile range, percentiles, variance and standard deviation. Frequency distributions, cumulative frequency distributions and their graphical representation, including stem-and-leaf as well as box-and-whisker diagrams.

Syllabus	*Notes*
11. Sample space and events; probability of an event.	The use of set notation is expected. The concept of mutually exclusive, exhaustive and complementary events is included. Calculation of probabilities may include the use of simple permutations and combinations.
12. The addition rule, conditional probabilities and the multiplication rule; Bayes' theorem.	$\mathrm{P}(A \cup B) = \mathrm{P}(A) + \mathrm{P}(B) - \mathrm{P}(A \cap B)$; $\mathrm{P}(A \cap B) = \mathrm{P}(A)\,\mathrm{P}(B \mid A)$; $\mathrm{P}(A \cap B) = \mathrm{P}(A)\,\mathrm{P}(B)$, where A and B are independent events. For Bayes' theorem, only simple cases are expected. Tree diagrams may be found useful for calculating probabilities.
13. Bernoulli, binomial, geometric and Poisson distributions and their applications.	Knowledge of formulae for their means and variances is expected but proofs of these formulae are not required:

Distribution	Mean	Variance
Bernoulli (p)	p	$p(1-p)$
Binomial (n , p)	np	$np(1-p)$
Geometric (p)	$\frac{1}{p}$	$\frac{1-p}{p^2}$
Poisson (λ)	λ	λ

	Syllabus	*Notes*
14.	The normal distribution and its applications.	Use of the normal table. Approximating binomial probabilities using normal distributions is not required.
15.	Comparison of observed frequency distributions with fitted frequency distributions.	Poisson, binomial and normal cases only. No formal statistical test of fit is required. Comparison of observed and expected frequencies in class intervals only.

* See Regulation 5.15.