A Level

Mathematics

Session: 1994
Type: Syllabus
Code: 9205

SS9 (UK) 1994/5

University of Cambridge
Local Examinations Syndicate

MATHEMATICS

Examination Syllabuses for 1994 and 1995
(UK Centres only)

NOTES

Mathematical Tables

Mathematical tables are provided for use in the examination. The tables provided for A level and the Certificate in Additional Mathematics are *The Cambridge Elementary Mathematical Tables (Second Edition)* and further copies may be obtained from the Cambridge University Press, Pitt Press Buildings, Trumpington Street, Cambridge, and through booksellers. Special arrangements for AS Mathematics (8480) are described on page 25.

Lists of Formulae, etc.

Lists of formulae will be provided as follows:

(i) MF6 for A level Mathematics and Further Mathematics Syllabus C,

(ii) MF (8480) 1 for AS Mathematics,

(iii) MF (8485) 1 for AS Applicable Mathematics.

Sample copies of the lists are obtainable from the Secretary, Syndicate Buildings, 1 Hills Road, Cambridge CB1 2EU. Centres are advised to make samples of the lists (obtained by photocopying or from the Syndicate's Publications Department) available to candidates for practice in advance of the examinations.

Sample copies of the list provided for AS Statistics are obtainable from the Secretary, Oxford and Cambridge Schools Examination Board, Purbeck House, Purbeck Road, Cambridge CB2 2PU.

For the Certificate in Additional Mathematics formulae will be provided on the inside covers of the question papers in and after June 1992.

Mathematical Instruments

Apart from the usual mathematical instruments, candidates may use flexicurves in all the examinations. In addition, candidates taking Advanced level subjects may use stencils for drawing conic sections, provided that the stencils do not bear formulae not included in the list of formulae provided for use in the examinations.

Mathematical Notation

Attention is drawn to the list of mathematical notation on Pages 51–54.

Examiners' Reports

Reports on the June examinations (SR booklets) are distributed to Centres in November/December and reports on the November examinations (SR(I) booklets) are distributed to International Centres in April/May. Further copies of each are available from the Syndicate.

Certificate in Basic Numeracy and Certificate in Additional Mathematics

These special examinations are certificated separately and separate entry forms are required.

(i) The Certificate in Basic Numeracy examination will be held in March and November 1994.

(ii) The Certificate in Additional Mathematics examination will be held in June and November 1994.

For both examinations, availability in 1995 will depend upon continued inclusion in the list of approved qualifications published by the DES.

Electronic Calculators

The use of electronic calculators is expected in all papers described in this booklet apart from Certificate in Basic Numeracy Papers 1 and 2 (4090/1 and 2). The latest regulations for the use of calculators are contained in the Syndicate's Handbook for Centres.

MATHEMATICS (SYLLABUS C) (9205)

(May not be taken with AS Mathematics or Applicable Mathematics or GCSE Mathematics)

G.C.E. ADVANCED LEVEL

Introduction

In developing this syllabus, attention was paid to the following considerations:

(i) the desirability of removing the modern/traditional dichotomy between the two former syllabuses A and B;

(ii) the need to preserve those topics from Syllabuses A and B which have proved to be of value and which schools have shown, by their choices of options, that they consider to be most acceptable;

(iii) the desire to allow reasonable freedom of choice of material (compatible with school resources) while ensuring that all pupils study a sufficiency of work in common, so that realistic comparability is attainable;

(iv) the need to incorporate into the examination the agreed Inter-Board Common Core. The Core is clearly identified as Section A and will be examined, together with a small number of other topics (Section B), by means of short and longer questions in Paper 1.

Past papers are available from the Syndicate to accompany the syllabuses.

Scheme of Papers

The examination will consist of two three-hour papers as follows:

Paper 1 (50% of the marks)—a paper consisting of a first section of short questions with no choice together with a second section of seven longer questions from which candidates may answer not more than four. The paper will be set on Section A (the Inter-Board Common Core) and the additional topics given in Section B of the syllabus.

and

Paper 2 (50% of the marks)—a paper containing five questions on each of the three options: Particle Mechanics, Probability and Statistics, and Pure Mathematics, given in Section C of the syllabus. Candidates will be expected to have studied two options and may answer not more than seven questions, chosen freely from all three options except that no more than four may be chosen from any one option.

A Special Paper (3 hours) will be set in the June examination. It will contain eleven questions (five on the syllabus for Paper 1 and two on each of the options for Paper 2), and candidates may answer **any six** questions.

Detailed Syllabus

Knowledge of the Higher level content for the MEG or similar GCSE syllabuses is assumed. GCSE material which is not repeated in the syllabus below will not be tested directly but it may be required indirectly in response to questions on other topics. Candidates will be expected to be familiar with the scientific notation for the expression of compound units e.g. $5\ \mathrm{m\,s^{-1}}$ for 5 metres per second.

PAPER 1

Paper 1 will be set on Sections A and B of the syllabus. Section A is the Inter-Board Common Core.

Section A

SYLLABUS	NOTES
1. Algebraic operation on polynomials and rational functions. Factors of polynomials. The factor theorem.	Addition, subtraction, multiplication and division and the confident use of brackets and surds.
2. Partial fractions.	To include denominators such as $(ax+b)(cx+d)(ex+f)$, $(ax+b)(cx+d)^2$, and $(ax+b)(x^2+c^2)$.
3. Positive and negative rational indices.	
4. The general quadratic function in one variable, including solving of quadratic equations, completing the square, sketching graphs and finding maxima and minima.	
5. Arithmetic and geometric progressions and their sums to n terms. Sum to infinity of geometric series.	To include the Σ notation.
6. The use of the binomial expansion of $(1+x)^n$ when (*a*) n is a positive integer, and (*b*) n is rational and $\lvert x\rvert < 1$.	To include the notations $n!$, with $0! = 1$, and $\binom{n}{r}$.
7. The manipulation of simple algebraic inequalities. The modulus function.	To include solutions of inequations reducible to the form $f(x) > 0$, where $f(x)$ can be expressed in factors, and sketching the graph of $y = f(x)$ in these cases.
8. Plane cartesian coordinates.	Understanding of the relationship between a graph and the associated algebraic relation. In particular, ability to sketch curves such as $y = kx^n$ for integral and simple rational n, $ax + by = c$, $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$. Geometrical properties of the parabola, ellipse and hyperbola are not included in the common core.
9. Curves and equations in cartesian form.	Knowledge of the effect of simple transformations on the graph of $y = f(x)$ as represented by $y = a\,f(x)$, $y = f(x) + a$, $y = f(x - a)$, $y = f(ax)$. The relation of the equation of a graph to its symmetries.
10. Expression of the coordinates (or position vector) of a point on a curve in terms of a parameter.	
11. Definition of the six trigonometric functions for any angle, knowledge of their periodic properties and symmetries.	The graphs of sine, cosine and tangent.

12. Use of the sine and cosine formulae.

13. The angle between a line and a plane, between two planes, and between two skew lines in simple cases.

14. Circular measure, $s = r\theta$, $A = \frac{1}{2}r^2\theta$.

15. Knowledge and use of the formulae for $\sin(A \pm B)$, $\cos(A \pm B)$, $\tan(A \pm B)$, $\sin A \pm \sin B$ etc.
    Knowledge of identities such as $\sin^2 A + \cos^2 A = 1$, $1 + \tan^2 A = \sec^2 A$.
    Expression of $a\cos\theta + b\sin\theta$ in the form $r\cos(\theta \pm \alpha)$.

    Confidence in the application of these formulae in simple cases is expected. In particular the confident use of double angle formulae is expected.

16. General solution of simple trigonometric equations, including graphical interpretation.

17. The approximations $\sin x \approx x$, $\tan x \approx x$, $\cos x \approx 1 - \frac{1}{2}x^2$.

18. Vectors in two and three dimensions; algebraic operations of addition and multiplication by scalars, and their geometrical significance; the scalar product and its use for calculating the angle between two lines; position vectors; vector equation of a line in the form $\mathbf{r} = \mathbf{a} + t\mathbf{b}$.

    To include use of the unit vectors **i**, **j**, **k**.

19. Functions. The inverse of a one-one function.
    Composition of functions.
    Graphical illustration of the relationship between a function and its inverse.

20. The exponential and logarithmic functions and their simple properties.

    The definition $a^x = e^{x\ln a}$.

21. The idea of a limit and the derivative defined as a limit.
    The gradient of a tangent as the limit of the gradient of a chord.
    Differentiation of standard functions.

    The derivatives of x^n, $\sin x$, $\cos x$, $\tan x$, $\sin^{-1}x$, $\cos^{-1}x$, $\tan^{-1}x$, e^x, a^x, $\ln x$.

22. Differentiation of sum, product and quotient of functions, and of composite functions. Differentiation of simple functions defined implicitly or parametrically.

    Skill will be expected in the differentiation of functions generated from standard functions by these operations.

23. Applications of differentiation to gradients, tangents and normals, maxima and minima, curve sketching, connected rates of change, small increments and approximations.

24. Integration as the inverse of differentiation. Integration of standard functions.
The integrals of x^n, $1/x$, e^x, $\sin x$, $\cos x$, $1/(1 + x^2)$, $1/\sqrt{(1 - x^2)}$.

25. Simple techniques of integration, including integration by substitution and by parts.
The relationship with corresponding techniques of differentiation should be understood.

26. The evaluation of definite integrals with fixed limits.

27. The idea of area under a curve as the limit of a sum of areas of rectangles. Simple applications of integration to plane areas and volumes of revolution.

Section B

SYLLABUS	NOTES
1. Simple problems on arrangements and selections.	The terms 'permutation' and 'combination' should be understood.
2. The method of induction.	Problems set may involve the summation of finite series.
3. Expansions of functions in power series.	Maclaurin's series should be known but derivation of the general term and general conditions for convergence are not required. Conditions for convergence of the standard series e^x, $\sin x$, $\cos x$, $\ln(1 + x)$ should be known.
4. Numerical integration, the trapezium rule.	Simple graphical consideration of the sign of the error in the trapezium rule is required. Simpson's rule is not included.

PAPER 2

Paper 2 will be set on Section C of the syllabus. Candidates will be expected to have studied two of the three options in Section C but may choose questions freely from all three options except that no more than four may be chosen from any one option.

Section C

Option (a): Particle Mechanics

SYLLABUS	NOTES
1. Forces treated as vectors, composition and resolution of forces on a particle. Triangle and polygon of forces. Equilibrium of particles under coplanar forces. Friction.	Proofs of fundamental theorems are not required. Problems set will, in general, require clear force diagrams and use of equations obtained by resolving, but graphical solutions may be permitted in appropriate cases.
2. Kinematics of a particle moving in a straight line. x-t graphs. v-t graphs. Constant acceleration formulae.	
Newton's laws of motion. Dynamics of a particle moving in a straight line under forces expressed as functions of time or velocity or distance.	Candidates are expected to know the forms $\frac{\mathrm{d}^2x}{\mathrm{d}t^2}$, $\frac{\mathrm{d}v}{\mathrm{d}t}$, $v\frac{\mathrm{d}v}{\mathrm{d}x}$ for acceleration. Problems set will require only the solution of first order differential equations with separable variables.
3. Simple cases of motion of two connected particles.	Problems set may involve a single fixed smooth light pulley.
4. Elastic strings and springs, Hooke's Law.	
5. Kinetic and potential energy, work, power. Principle of conservation of energy.	Gravitational and elastic potential energy. An ability to apply, in appropriate circumstances, the principle 'Kinetic Energy + Potential Energy is constant' is expected.
Momentum and impulse; simple examples of conservation of momentum for particles moving in a straight line.	Knowledge of the coefficient of restitution is not required.
6. Simple cases of motion of a projectile.	Simple problems involving the cartesian parametric equations (parameter t) or the (x, y) equation of the path of a projectile may be set. Knowledge of the properties of a parabola is not required. Knowledge of the range on an inclined plane is not required.
7. Uniform circular motion.	Proof that acceleration has magnitude v^2/r (or $r\omega^2$) and is directed towards the centre is not required.

Option (b): Probability and Statistics

Candidates will be expected to be familiar with the tabulation and representation of statistical data; mean, median and mode; cumulative frequency graph (ogive); percentiles; variance and standard deviation. Knowledge of the various types of diagrams for continuous or discrete variables, either grouped or ungrouped, is expected.

SYLLABUS	NOTES
1. Theoretical and empirical interpretations of probability; the basic probability laws including $P(A \cup B) = P(A) + P(B) - P(A \cap B)$; mutually exclusive events; conditional probability; independent events; $P(A \cap B) = P(A)P(B\|A)$; $= P(B)P(A\|B)$.	Problems will involve simple applications of the basic laws, but not the general form of Bayes' theorem. Tree diagrams, Venn diagrams and/or Karnaugh maps may be used but none of these methods will be specifically required in problems set.
2. Probability distributions for discrete random variables, expectation, variance. Uniform, binomial and Poisson distributions; their means and variances (without proofs). The Poisson distribution as an approximation to the binomial distribution (without proof).	Simple examples may be set in which the distribution has to be found. Knowledge and use of $E(aX + b) = aE(X) + b$, $\mathrm{Var}(X) = E(X^2) - [E(X)]^2$, $\mathrm{Var}(aX + b) = a^2 \mathrm{Var}(X)$, is required.
3. Probability distributions for continuous random variables; probability density function, f; expectation, variance; cumulative distribution function, F; uniform (rectangular) distribution; the normal distribution excluding detailed analytical treatment; use of tables; the normal distribution as an approximation to the binomial distribution (without proof).	Problems may be set in which $f(x)$ or $F(x)$ are given or have to be found. Candidates are expected to be able to interpret the graphs of $f(x)$ and $F(x)$, to know the relationship $f(x) = F'(x)$ and to calculate expectations, medians, modes, and variances of simple functions of X. No detailed knowledge of bivariate distributions is required but the following results (without proof) should be known: $E(aX + bY) = aE(X) + bE(Y)$; $\mathrm{Var}(aX + bY) = a^2 \mathrm{Var}(X) + b^2 \mathrm{Var}(Y)$ for independent variables X, Y; if X, Y are independent normal variables, then $aX + bY$ is a normal variable.
4. General ideas of sampling methods and distributions; approximate normality of the distribution of sample mean (the central limit theorem, without proof). Estimation of population parameters from a sample; unbiasedness; confidence limits for population proportion and for the mean from large samples.	Sampling of attributes is included. Detailed knowledge of particular sampling methods is not expected, but candidates may be asked to comment on or answer simple probability questions on a given method of sampling. Use of $E(\bar{X}) = \mu$, $\mathrm{Var}(\bar{X}) = \sigma^2/n$. Candidates are expected to know that an unbiased estimate of the population variance from a sample of size n is $\frac{1}{n-1}\Sigma(x - \bar{x})^2$.
5. Hypothesis testing: null and alternative hypotheses; one-tailed and two-tailed tests; tests of significance of a sample mean and of a sample proportion.	Samples will be large or from normal distributions of known variance. The t-distribution is not required.

Option (c): Pure Mathematics

SYLLABUS	NOTES
1. Polar coordinates; sketching simple curves (for $0 \leqslant \theta < 2\pi$ or $-\pi < \theta \leqslant \pi$ or a subset of either of these); area of a sector.	Conversion from cartesian to polar form (or vice versa) in simple cases is included. The convention $r \geqslant 0$ will be used.
2. Complex numbers: algebraic and trigonometric forms; modulus and argument; complex conjugate; sum, product and quotient of two complex numbers. Representation of complex numbers in an Argand diagram; simple loci.	The terms 'real part' and 'imaginary part' should be known. The relation $zz^* = \|z\|^2$ should be known.
De Moivre's theorem for an integral exponent (without proof); use of the relation $e^{i\theta} = \cos\theta + i\sin\theta$; simple applications.	Applications involving the expression of $\sin^n\theta$ or $\cos^n\theta$ in terms of sines and cosines are included for $n = 2, 3$ only.
3. Curve sketching for equations of the form $y = f(x)$, $y^2 = f(x)$.	The ability to sketch curves such as those given by $y = x^2(1-x)$, $y^2 = x^2(1-x)$, $y = \dfrac{x}{x^2-1}$, $y = \left\|\dfrac{x-1}{x-2}\right\|$ is expected. Determination of asymptotes parallel to the axes is required.
4. The location of the roots of an equation by simple graphical or numerical methods. The idea of a sequence of approximations converging to a root of an equation; use of linear interpolation; the Newton-Raphson method.	A geometrical approach to the Newton-Raphson method is sufficient. No formal proofs or considerations of convergence are required but an appreciation that a process may fail to converge is required.
5. Solution of first order differential equations by separating the variables; the reduction of a given differential equation to one of this type by means of a given simple substitution.	No particular knowledge of scientific, economic or other laws will be assumed, but the mathematical formulation of given information may be required. The ability to sketch members of a family of solution curves is required.
Solution of second order (or first order) differential equations of the form $a\dfrac{d^2y}{dx^2} + b\dfrac{dy}{dx} + cy = f(x)$.	Knowledge of the terms complementary function and particular integral is required. Examples will be restricted to cases where $f(x)$ is of the form $px + q$ or pe^{qx}.
6. Vectors in three dimensions: unit vectors, the expression $a_1\mathbf{i} + a_2\mathbf{j} + a_3\mathbf{k}$ for a vector $\mathbf{a}$ in terms of cartesian components; use of the scalar product $\mathbf{a.b}$ in both the forms $\|\mathbf{a}\|\,\|\mathbf{b}\|\cos\theta$ and $a_1b_1 + a_2b_2 + a_3b_3$. Geometrical applications of scalar products; the equation of a plane in the form $\mathbf{r.n} = p$.	$\mathbf{i}, \mathbf{j}, \mathbf{k}$ will denote an orthogonal right-handed set of unit vectors. The properties (i) $\mathbf{a}.(\lambda\mathbf{b}) = \lambda(\mathbf{a.b})$, (ii) $\mathbf{a.b} = \mathbf{b.a}$, (iii) $\mathbf{a}.(\mathbf{b} + \mathbf{c}) = \mathbf{a.b} + \mathbf{a.c}$ may be assumed.

The cartesian equations of lines and planes are also required. Problems set may involve:
(i) the length of a projection,
(ii) the angle between two vectors,
(iii) the length of the perpendicular from a point to a line or from a point to a plane,
(iv) the angle between two planes.

MATHEMATICAL NOTATION

The list which follows summarizes the notation used in the Syndicate's Mathematics examinations. Although primarily directed towards Advanced level, the list also applies, where relevant, to examinations at all other levels, i.e. GCSE, AS, Certificate in Additional Mathematics.

Mathematical Notation

1. *Set Notation*

$\in$	is an element of
$\notin$	is not an element of
$\{x_1, x_2, \ldots\}$	the set with elements $x_1, x_2, \ldots$
$\{x: \ldots\}$	the set of all x such that …
$\mathrm{n}(A)$	the number of elements in set A
$\varnothing$	the empty set
$\mathcal{E}$	universal set
A'	the complement of the set A
$\mathbb{N}$	the set of positive integers and zero, $\{0, 1, 2, 3, \ldots\}$
$\mathbb{Z}$	the set of integers, $\{0, \pm 1, \pm 2, \pm 3, \ldots\}$
$\mathbb{Z}^+$	the set of positive integers, $\{1, 2, 3, \ldots\}$
$\mathbb{Z}_n$	the set of integers modulo n, $\{0, 1, 2, \ldots, n-1\}$
$\mathbb{Q}$	the set of rational numbers
$\mathbb{Q}^+$	the set of positive rational numbers, $\{x \in \mathbb{Q} : x > 0\}$
$\mathbb{Q}_0^+$	the set of positive rational numbers and zero, $\{x \in \mathbb{Q} : x \geqslant 0\}$
$\mathbb{R}$	the set of real numbers
$\mathbb{R}^+$	the set of positive real numbers, $\{x \in \mathbb{R} : x > 0\}$
$\mathbb{R}_0^+$	the set of positive real numbers and zero, $\{x \in \mathbb{R} : x \geqslant 0\}$
$\mathbb{R}^n$	the real n tuples
$\mathbb{C}$	the set of complex numbers
$\subseteq$	is a subset of
$\subset$	is a proper subset of
$\nsubseteq$	is not a subset of
$\not\subset$	is not a proper subset of
$\cup$	union
$\cap$	intersection
$[a, b]$	the closed interval $\{x \in \mathbb{R} : a \leqslant x \leqslant b\}$
$[a, b)$	the interval $\{x \in \mathbb{R} : a \leqslant x < b\}$
$(a, b]$	the interval $\{x \in \mathbb{R} : a < x \leqslant b\}$
(a, b)	the open interval $\{x \in \mathbb{R} : a < x < b\}$
yRx	y is related to x by the relation R
$y \sim x$	y is equivalent to x, in the context of some equivalence relation

2. *Miscellaneous Symbols*

$=$	is equal to
$\neq$	is not equal to
$\equiv$	is identical to or is congruent to
$\approx$	is approximately equal to
$\cong$	is isomorphic to
$\propto$	is proportional to
$<;\ \ll$	is less than; is much less than
$\leqslant,\ \ngtr$	is less than or equal to or is not greater than
$>;\ \gg$	is greater than; is much greater than
$\geqslant,\ \nless$	is greater than or equal to or is not less than
∞	infinity

3. *Operations*

$a + b$	a plus b
$a - b$	a minus b
$a \times b$, ab, $a.b$	a multiplied by b
$a \div b$, $\frac{a}{b}$, a/b	a divided by b
$a : b$	the ratio of a to b
$\sum_{i=1}^{n} a_i$	$a_1 + a_2 + \cdots + a_n$
$\sqrt{a}$	the positive square root of the real number a
$\|a\|$	the modulus of the real number a
$n!$	n factorial for $n \in \mathbb{N}$ $(0! = 1)$
$\binom{n}{r}$	the binomial coefficient $\frac{n!}{r!(n-r)!}$, for $n, r \in \mathbb{N}, 0 \leqslant r \leqslant n$ $\frac{n(n-1)\cdots(n-r+1)}{r!}$, for $n \in \mathbb{Q}, r \in \mathbb{N}$

4. *Functions*

f	function f
f(x)	the value of the function f at x
$\mathrm{f} : A \to B$	f is a function under which each element of set A has an image in set B
$\mathrm{f} : x \mapsto y$	the function f maps the element x to the element y
f^{-1}	the inverse of the function f
$\mathrm{g} \circ \mathrm{f}$, gf	the composite function of f and g which is defined by $(\mathrm{g} \circ \mathrm{f})(x)$ or $\mathrm{gf}(x) = \mathrm{g}(\mathrm{f}(x))$
$\lim_{x \to a} \mathrm{f}(x)$	the limit of $\mathrm{f}(x)$ as x tends to a
Δx, δx	an increment of x
$\frac{\mathrm{d}y}{\mathrm{d}x}$	the derivative of y with respect to x
$\frac{\mathrm{d}^n y}{\mathrm{d}x^n}$	the nth derivative of y with respect to x
$\mathrm{f}'(x)$, $\mathrm{f}''(x)$, …, $\mathrm{f}^{(n)}(x)$	the first, second, …, nth derivatives of $\mathrm{f}(x)$ with respect to x
$\int y \mathrm{d}x$	indefinite integral of y with respect to x
$\int_a^b y \mathrm{d}x$	the definite integral of y with respect to x for values of x between a and b
$\frac{\partial y}{\partial x}$	the partial derivative of y with respect to x
$\dot{x}$, $\ddot{x}$, …	the first, second, … derivatives of x with respect to time.

5. *Exponential and Logarithmic Functions*

e	base of natural logarithms
e^x, $\exp x$	exponential function of x
$\log_a x$	logarithm to the base a of x
$\ln x$	natural logarithm of x
$\lg x$	logarithm of x to base 10

6. *Circular and Hyperbolic Functions and Relations*

sin, cos, tan, cosec, sec, cot	the circular functions
$\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$, cosec^{-1}, $\sec^{-1}$, $\cot^{-1}$	the inverse circular relations
sinh, cosh, tanh, cosech, sech, coth	the hyperbolic functions
$\sinh^{-1}$, $\cosh^{-1}$, $\tanh^{-1}$, cosech^{-1}, sech^{-1}, $\coth^{-1}$	the inverse hyperbolic relations

7. *Complex Numbers*

i	square root of -1
z	a complex number, $z = x + \mathrm{i}y$ $= r(\cos\theta + \mathrm{i}\sin\theta),\ r \in \mathbb{R}_0^+$ $= r\mathrm{e}^{\mathrm{i}\theta},\ r \in \mathbb{R}_0^+$
$\mathrm{Re}\,z$	the real part of z, $\mathrm{Re}(x + \mathrm{i}y) = x$
$\mathrm{Im}\,z$	the imaginary part of z, $\mathrm{Im}(x + \mathrm{i}y) = y$
$\lvert z \rvert$	the modulus of z, $\lvert x + \mathrm{i}y \rvert = \sqrt{(x^2 + y^2)}$, $\lvert r(\cos\theta + \mathrm{i}\sin\theta) \rvert = r$
$\arg z$	the argument of z, $\arg(r(\cos\theta + \mathrm{i}\sin\theta)) = \theta$, $-\pi < \theta \leqslant \pi$
z^*	the complex conjugate of z, $(x + \mathrm{i}y)^* = x - \mathrm{i}y$

8. *Matrices*

$\mathbf{M}$	a matrix $\mathbf{M}$
$\mathbf{M}^{-1}$	the inverse of the square matrix $\mathbf{M}$
$\mathbf{M}^{\mathrm{T}}$	the transpose of the matrix $\mathbf{M}$
$\det \mathbf{M}$	the determinant of the square matrix $\mathbf{M}$

9. *Vectors*

$\mathbf{a}$	the vector $\mathbf{a}$
$\overrightarrow{AB}$	the vector represented in magnitude and direction by the directed line segment AB
$\hat{\mathbf{a}}$	a unit vector in the direction of the vector $\mathbf{a}$
$\mathbf{i}, \mathbf{j}, \mathbf{k}$	unit vectors in the directions of the cartesian coordinate axes
$\lvert \mathbf{a} \rvert$	the magnitude of $\mathbf{a}$
$\lvert \overrightarrow{AB} \rvert$	the magnitude of $\overrightarrow{AB}$
$\mathbf{a} \cdot \mathbf{b}$	the scalar product of $\mathbf{a}$ and $\mathbf{b}$
$\mathbf{a} \times \mathbf{b}$	the vector product of $\mathbf{a}$ and $\mathbf{b}$

10. *Probability and Statistics*

A, B, C, etc.	events
$A \cup B$	union of the events A and B
$A \cap B$	intersection of the events A and B
$\mathrm{P}(A)$	probability of the event A
A'	complement of the event A, the event 'not A'
$\mathrm{P}(A \mid B)$	probability of the event A given the event B
X, Y, R, etc.	random variables
x, y, r, etc.	values of the random variables X, Y, R, etc.
$x_1, x_2, \ldots$	observations
$f_1, f_2, \ldots$	frequencies with which the observations $x_1, x_2, \ldots$ occur
$\mathrm{p}(x)$	the value of the probability function $\mathrm{P}(X = x)$ of the discrete random variable X
$p_1, p_2, \ldots$	probabilities of the values $x_1, x_2, \ldots$ of the discrete random variable X.
$\mathrm{f}(x), \mathrm{g}(x), \ldots$	the value of the probability density function of the continuous random variable X
$\mathrm{F}(x), \mathrm{G}(x), \ldots$	the value of the (cumulative) distribution function $\mathrm{P}(X \leqslant x)$ of the random variable X
$\mathrm{E}(X)$	expectation of the random variable X
$\mathrm{E}[\mathrm{g}(X)]$	expectation of $\mathrm{g}(X)$
$\mathrm{Var}\,(X)$	variance of the random variable X
$\mathrm{G}(t)$	the value of the probability generating function for a random variable which takes integer values
$\mathrm{B}(n, p)$	binomial distribution, parameters n and p
$\mathrm{N}(\mu, \sigma^2)$	normal distribution, mean μ and variance σ^2
μ	population mean
σ^2	population variance
σ	population standard deviation
$\bar{x}$	sample mean
s^2	unbiased estimate of population variance from a sample, $s^2 = \dfrac{1}{n-1}\Sigma(x - \bar{x})^2$

ϕ	probability density function of the standardised normal variable with distribution N (0, 1)
Φ	corresponding cumulative distribution function
ρ	linear product-moment correlation coefficient for a population
r	linear product-moment correlation coefficient for a sample
$\mathrm{Cov}(X, Y)$	covariance of X and Y