MATHEMATICAL NOTATION

The list which follows summarises the notation used in Cambridge's Mathematics examinations. Although primarily directed towards A-Level, the list also applies, where relevant, to examinations at all other levels.

1. Set Notation

∈	is an element of
¢	is not an element of
$\{x_1, x_2, \ldots\}$	the set with elements x_1, x_2, \ldots
{ <i>x</i> :}	the set of all x such that
n(A)	the number of elements in set A
Ø	the empty set
8	universal set
A'	the complement of the set <i>A</i>
Z	the set of integers, $\{0, \pm 1, \pm 2, \pm 3, \ldots\}$
ℤ+	the set of positive integers, {1, 2, 3, …}
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, $\{x \in \mathbb{Q} : x \ge 0\}$
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, $\{x \in \mathbb{R} : x \ge 0\}$
\mathbb{R}^n	the real <i>n</i> tuples
\mathbb{C}	the set of complex numbers
⊆	is a subset of
С	is a proper subset of
⊈	is not a subset of
¢	is not a proper subset of
U	union
\cap	intersection
[<i>a</i> , <i>b</i>]	the closed interval $\{x \in \mathbb{R} : a \leq x \leq b\}$
[<i>a</i> , <i>b</i>)	the interval { $x \in \mathbb{R}$: $a \leq x \leq b$ }
(<i>a</i> , <i>b</i>]	the interval $\{x \in \mathbb{R} : a \le x \le b\}$
(<i>a</i> , <i>b</i>)	the open interval { $x \in \mathbb{R}$: $a < x < b$ }

2. Miscellaneous Symbols

=	is equal to
≠	is not equal to
≡	is identical to or is congruent to
~	is approximately equal to
x	is proportional to
<	is less than
≼;≯	is less than or equal to; is not greater than
>	is greater than
≥ ; ≮	is greater than or equal to; 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
$\sum_{i=1}^{n} a_i$	$a_1 + a_2 + \ldots + a_n$
\sqrt{a}	the positive square root of the real number a
a	the modulus of the real number a
<i>n</i> !	<i>n</i> factorial for $n \in \mathbb{Z}^+ \cup \{0\}$, (0! = 1)
$\binom{n}{r}$	the binomial coefficient $\frac{n!}{r!(n-r)!}$, for $n, r \in \mathbb{Z}^+ \cup \{0\}, 0 \leq r \leq n$
	$rac{n(n-1)(n-r+1)}{r!}$, for $n \in \mathbb{Q}, r \in \mathbb{Z}^+ \cup \{0\}$

4. Functions

f	function f
$\mathbf{f}(x)$	the value of the function f at x
f: $A \rightarrow B$	f is a function under which each element of set A has an image in set B
f: $x \mapsto y$	the function f maps the element x to the element y
f^{-1}	the inverse of the function f
g o f, gf	the composite function of f and g which is defined by $(g \circ f)(x)$ or $gf(x) = g(f(x))$
$\lim_{x \to a} f(x)$	the limit of $f(x)$ as x tends to a
Δx ; δx	an increment of x
$\frac{\mathrm{d}y}{\mathrm{d}x}$	the derivative of <i>y</i> with respect to <i>x</i>
$\frac{\mathrm{d}^n y}{\mathrm{d} x^n}$	the <i>n</i> th derivative of <i>y</i> with respect to <i>x</i>
$f'(x), f''(x),, f^{(n)}(x)$	the first, second, <i>n</i> th derivatives of $f(x)$ with respect to x
$\int y dx$	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
<i>x</i> , <i>x</i> ,	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 Functions and Relations

sin, cos, tan, cosec, sec, cot	the circular functions
\sin^{-1} , \cos^{-1} , \tan^{-1} \csc^{-1} , \sec^{-1} , \cot^{-1}	the inverse circular functions

7. Complex Numbers

i	square root of –1	
Ζ	a complex number, <i>z</i>	= x + iy

 $= r(\cos\theta + i\sin\theta), r \in \mathbb{R}_0^+$

 $= r \mathrm{e}^{\mathrm{i}\theta}, r \in \mathbb{R}_0^+$

Re z	the real part of z, $\operatorname{Re}(x + iy) = x$
Im z	the imaginary part of z, $\text{Im}(x + iy) = y$
z	the modulus of z, $ x + iy = \sqrt{x^2 + y^2}$, $ r(\cos\theta + i\sin\theta) = r$
arg z	the argument of z, $\arg(r(\cos \theta + i \sin \theta)) = \theta$, $-\pi < \theta \leq \pi$
Z*	the complex conjugate of z , $(x + iy)^* = x - iy$

8. Matrices

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

9. Vectors

a	the vector a
\overrightarrow{AB}	the vector represented in magnitude and direction by the directed line segment AB
â	a unit vector in the direction of the vector ${f a}$
i, j, k	unit vectors in the directions of the cartesian coordinate axes
a	the magnitude of a
\overrightarrow{AB}	the magnitude of \overrightarrow{AB}
a.b	the scalar product of a and b
a×b	the vector product of \mathbf{a} and \mathbf{b}

$A, B, C,$ etc.events $A \cup B$ union of events A and B $A \cap B$ intersection of the event A and B $P(A)$ probability of the event A A' complement of the event A, the event 'not A' $P(A B)$ probability of the event A given the event B $X, Y, R,$ etc.random variables $x, y, r,$ etc.value of the random variables X, Y, R, etc. $x_1, x_2,$ observations $f_1, f_2,$ frequencies with which the observations, x_1, x_2 occur $p(x)$ the value of the probability function $P(X = x)$ of the discrete random variable X p_1, ρ_2 probabilities of the values $x_1, x_2,$ of the discrete random variable X $F(x), G(x)$ the value of the probability function $p(X = x)$ of the random variable X $E(X)$ expectation of the random variable X $E(X)$ expectation of the random variable X $E[g(X)]$ expectation of the random variable X $B(n, p)$ binominal distribution, parameters n and p $Po(\mu)$ Poisson distribution, mean μ $N(t, \sigma^2)$ normal distribution, mean μ and variance σ^2 ρ population standard deviation \overline{X} sample mean σ^2 population standard deviation \overline{x} $s^2 = \frac{1}{n-1} \sum (x - \overline{x})^2$ ϕ orcresponding cumulative distribution function ϕ N(0, 1) ϕ linear product-moment correlation coefficient for a sample	10. Probability ar	nd Statistics
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ho linear product-moment correlation coefficient for a population	ϕ	
	Φ	corresponding cumulative distribution function
	ρ	linear product-moment correlation coefficient for a population
	r	linear product-moment correlation coefficient for a sample