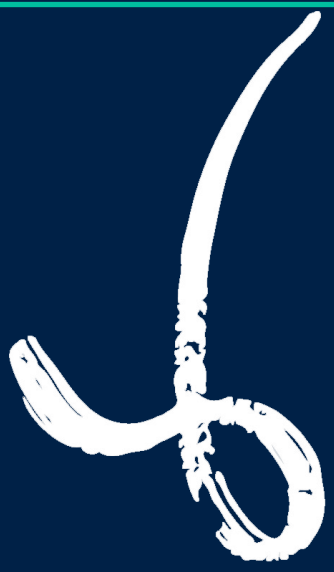
OXFORD AQA
INTERNATIONAL QUALIFICATIONS

International AS and A-level

Mathematics

(9760) Specification





For teaching from 2027 onwards

For International AS exams
May/June 2028 onwards

For International A-level exams
May/June 2029 onwards

For teaching and examination outside the United Kingdom

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Are you using the latest version of this specification?

- You will always find the most up-to-date version of this specification on our website at **oxfordaqa.com/9760**
- We will write to you if there are significant changes to the specification.

1 Introduction

1.1 Why choose OxfordAQA International AS and A-levels?

Our International qualifications enable schools that follow a British curriculum to benefit from the best education expertise in the United Kingdom (UK).

Our International AS and A-levels offer the same rigour and high quality as AS and A-levels in the UK and are relevant and appealing to students worldwide. They reflect a deep understanding of the needs of teachers and schools around the globe and are brought to you by Oxford University Press and AQA, the UK's leading awarding body.

Providing valid and reliable assessments, these qualifications are based on over 100 years of experience, academic research and international best practice. They have been independently validated as being to the same standard as the qualifications accredited by the UK examinations regulator, Ofqual. They reflect the latest changes to the British system, enabling students to progress to higher education with up-to-date qualifications.

You can find out about OxfordAQA at **oxfordaqa.com**

1.2 Why choose our International AS and A-level Mathematics?

We have worked closely with teachers to design our specification to inspire, challenge and motivate every student, no matter what their level of ability, while supporting you in developing creative and engaging lessons.

Maths is for everyone. It is diverse, engaging and essential in equipping students with the right skills to reach their future destination, whatever that may be. At OxfordAQA, we design qualifications and support to enable students to engage with, explore, enjoy and succeed in maths. By putting students at the heart of everything we do, our aim is to support teachers to shape what success in maths looks like for every student.

Our question papers are designed with students in mind. We're committed to ensuring that students are settled early in our exams and have the best possible opportunity to demonstrate their knowledge and understanding of maths, to ensure they achieve the results they deserve.

The specification takes an approach to the study of mathematics that is consistent across the topic areas. Our experienced team has produced question papers and mark schemes that allow you to get back to inspirational mathematics teaching and allow students of all abilities to achieve their best on every question.

You can find out about all our International AS and A-level Mathematics qualifications at **oxfordaqa.com/maths**

1.3 Recognition

OxfordAQA meet the needs of international students. They are an international alternative and comparable in standard to the Ofqual regulated qualifications offered in the UK. Our qualifications have been independently benchmarked by UK ENIC, the UK national agency for providing expert opinion on qualifications worldwide. They have confirmed they can be considered 'comparable to the overall GCE A-level and GCSE standard offered in the UK'.

To read their report and see the latest list of universities who have stated they accept these international qualifications, visit oxfordaqa.com/recognition

1.4 The Oxford International Programme learner attributes

In order to equip students with the skills they need for success both now and in the future, we have worked with Oxford University Press to create the Oxford International Programme. This combines the Oxford International Curriculum with OxfordAQA qualifications, creating an integrated offer for international schools, from Early Years to A-level.

At its core we have introduced the Oxford International Programme learner attributes – the skills and competencies that enable our students to thrive academically, socially and personally.

The learner attributes, alongside our focus on demonstrating higher order critical thinking skills, ensure that students are equipped to get the grades that will take them places, and build the skills they need to be successful when they get there.



1.5 Support and resources to help you teach

We know that support and resources are vital for your teaching and that you have limited time to find or develop good quality materials. That's why we've worked with experienced teachers to provide you with resources that will help you confidently plan, teach and prepare for exams.

Teaching resources

You will have access to:

- sample schemes of work to help you plan your course with confidence
- teacher guidance notes to give you the essential information you need to deliver the specification
- training courses to help you deliver our qualifications
- student textbooks that have been checked and approved by us
- engaging worksheets and activities developed by teachers, for teachers.

Preparing for exams

You will have access to the support you need to prepare for our exams, including:

- specimen papers and mark schemes
- exemplar student answers with examiner commentaries
- a searchable bank of past AQA exam questions mapped to these qualifications.

Analyse your students' results with Data Insights

After the first examination series, you can use this tool to see which questions were the most challenging, how the results compare to previous years and where your students need to improve. Data Insights, our free online results analysis tool, will help you see where to focus your teaching.

Information about results, including maintaining standards over time, grade boundaries and our post-results services, will be available on our website in preparation for the first examination series.

Help and support

Visit our website for information, guidance, support and resources at oxfordaqa.com/9760

You can contact the subject team directly at **info@oxfordaqa.com** or call us on +44 (0)161 696 5995 (option 1 and then 1 again)

Please note: We aim to respond to all email enquiries within two working days.

Our UK office hours are Monday to Friday, 8am – 5pm.

2 Specification at a glance

The titles of the qualifications are:

- OxfordAQA International Advanced Subsidiary Mathematics
- OxfordAQA International Advanced Level Mathematics.

These qualifications are modular. The full International A-level is intended to be taken over two years. The specification content for the International AS is half that of an International A-level. The International AS can be taken as a stand-alone qualification or can be used to count towards the International A-level. Students can take the International AS in the first year and then take the International A2 in the second year to complete the International A-level or they can take all the units together in the same examination series at the end of the course.

The International AS content will be 50% of the International A-level content and International AS assessments will contribute 50% of the total marks for the full International A-level qualification with the remaining 50% coming from the International A2 assessments.

Candidates may re-sit a unit any number of times within the shelf-life of the specification. The best result for each unit will count towards the final qualification. Exams will be available in October/November, January and May/June.

The guided learning hours (GLH) for an OxfordAQA International Advanced Subsidiary is 180.

The guided learning hours (GLH) for an OxfordAQA International Advanced Level is 360.

These figures are for guidance only and may vary according to local practice and the learner's prior experience of the subject.

2.1 Subject content

- Pure Mathematics 1 (page 11)
- Pure Mathematics 2 (page 15)
- Statistics 1 (page 20)
- Mechanics 1 (page 25)
- Pure Mathematics 3 (page 29)
- Pure Mathematics 4 (page 32)
- Statistics 2 (page 36)
- Mechanics 2 (page 41)

2.2 Assessments

Qualification title	International AS Mathematics	International A-level Mathematics
Total units	Three units - 2 compulsory and 1 option	Six units - 4 compulsory and 2 options
Compulsory units	Pure Mathematics 1 + Pure Mathematics 2	Pure Mathematics 1 + Pure Mathematics 2 + Pure Mathematics 3 + Pure Mathematics 4
Optional units	One of: Statistics 1 or Mechanics 1	Two of: Statistics 1* or Mechanics 1* or Statistics 2 or Mechanics 2

*For A-level certification, **at least one** of Statistics 1 or Mechanics 1 must be counted as the AS optional unit. Statistics 2 and Mechanics 2 cannot solely form the optional element of an A-level award.

The full list of entry combinations for the optional units in International A-level Mathematics is:

A-level optional unit combination	AS Optional unit	A2 Optional unit
1a	Statistics 1	Mechanics 1
1b	Mechanics 1	Statistics 1
2	Statistics 1	Statistics 2
3	Mechanics 1	Mechanics 2
4	Statistics 1	Mechanics 2
5	Mechanics 1	Statistics 2

Note: Combinations 1a and 1b always produce the exact same A-level result, so they are functionally identical routes to an A-level award.

Pure Mathematics 1
What's assessed Content from the Pure Mathematics 1 area of the specification
How it's assessed • Written exam: 1 hour 15 minutes • 60 marks • Calculator allowed • 33.3% of the International AS assessment • 16.7% of the International A-level assessment

Pure Mathematics 2
What's assessed Content from the Pure Mathematics 2 area of the specification
How it's assessed • Written exam: 1 hour 15 minutes • 60 marks • Calculator allowed • 33.3% of the International AS assessment • 16.7% of the International A-level assessment

Statistics 1

What's assessed

Content from the Statistics 1 area of the specification

How it's assessed

- Written exam: 1 hour 15 minutes
- 60 marks
- Calculator allowed
- 33.3% of the International AS assessment (does not count towards AS if used as an A2 optional unit)
- 16.7% of the International A-level assessment

Mechanics 1

What's assessed

Content from the Mechanics 1 area of the specification

How it's assessed

- Written exam: 1 hour 15 minutes
- 60 marks
- Calculator allowed
- 33.3% of the International AS assessment (does not count towards AS if used as an A2 optional unit)
- 16.7% of the International A-level assessment

Pure Mathematics 3

What's assessed

Content from the Pure Mathematics 3 area of the specification

How it's assessed

- Written exam: 1 hour 15 minutes
- 60 marks
- Calculator allowed
- 16.7% of the International A-level assessment

Pure Mathematics 4

What's assessed

Content from the Pure Mathematics 4 area of the specification

How it's assessed

- Written exam: 1 hour 15 minutes
- 60 marks
- Calculator allowed
- 16.7% of the International A-level assessment

Statistics 2

What's assessed

Content from the Statistics 2 area of the specification

How it's assessed

- Written exam: 1 hour 15 minutes
- 60 marks
- Calculator allowed
- 16.7% of the International A-level assessment

Mechanics 2

What's assessed

Content from the Mechanics 2 area of the specification

How it's assessed

- Written exam: 1 hour 15 minutes
- 60 marks
- Calculator allowed
- 16.7% of the International A-level assessment

3 Subject content

3.1 Pure Mathematics 1

This topic assumes knowledge of OxfordAQA International GCSE Mathematics – Extension Tier

P1.1: Algebra

Content		Guidance
P1.1.1	Use and manipulation of surds	To include knowledge of simplification and rationalisation of the denominator of a fraction. For example: • $\sqrt{12}+2\sqrt{27}=8\sqrt{3}$ • $\frac{1}{\sqrt{2}-1}=1+\sqrt{2}$ • $\frac{2\sqrt{3}+\sqrt{2}}{3\sqrt{2}+\sqrt{3}}=\frac{\sqrt{6}}{3}$ To include knowledge of the term irrational.
P1.1.2	Laws of indices for all rational exponents	
P1.1.3	Quadratic functions and their graphs	To include knowledge of the vertex and line of symmetry of the graph.
P1.1.4	The discriminant of a quadratic equation	To include knowledge of the conditions for equal roots, for distinct real roots and for no real roots.
P1.1.5	Factorisation of quadratic polynomials	To include knowledge of factorising, for example: • $2x^2 + x - 6 = (2x - 3)(x + 2)$ • $2x^4 + 9x^2 + 4 = (2x^2 + 1)(x^2 + 4)$
P1.1.6	Completing the square	For example: • $x^2 + 6x - 1 = (x + 3)^2 - 10$ • $2x^2-6x+2=2\left(x-\frac{3}{2}\right)^2-\frac{5}{2}$
P1.1.7	Quadratic equations	To include knowledge of factorisation, the quadratic formula $\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ and completing the square.
P1.1.8	Simultaneous equations	Greatest level of difficulty to be one linear equation and one quadratic equation, solved analytically by substitution.
P1.1.9	Linear inequalities and quadratic inequalities	For example: $2x^2+x\geq 6$

Content		Guidance
P1.1.10	Algebraic manipulation of polynomials	To include knowledge of expanding brackets and collecting like terms.
P1.1.11	Algebraic division	To include knowledge and application to a quadratic or a cubic polynomial divided by a linear term of the form $(x - a)$ where a is an integer, including the terms divisor, quotient and remainder, where the greatest level of difficulty is indicated by $\frac{x^3 - 5x^2 + 7x - 3}{x - 2} = x^2 - 3x + 1 - \frac{1}{x - 2}$ Any method will be accepted, including: • by inspection • by equating coefficients • by algebraic long division To include knowledge of the term divisible.
P1.1.12	The Remainder Theorem and the Factor Theorem	To include knowledge of when a quadratic or cubic polynomial $\mathrm{p}(x)$ is divided by $(x - a)$, the remainder is $\mathrm{p}(a)$, and that when $\mathrm{p}(a) = 0$, then $(x - a)$ is a factor of $\mathrm{p}(x)$ Greatest level of difficulty as indicated by $x^3 - 5x^2 + 7x - 3$, a cubic, always with a factor $(x - a)$ where a is an integer, but to include the cases of three distinct linear factors, repeated linear factors or a quadratic factor which cannot be factorised in the real numbers.

P1.2: Coordinate geometry

Content		Guidance
P1.2.1	Equation of a straight line	To include knowledge of the forms $y - y_1 = m(x - x_1)$ $y = mx + c$, and $ax + by + c = 0$ To include problems that use gradients, mid-points and the distance between two points.
P1.2.2	Conditions for two straight lines to be parallel or perpendicular to each other	To include knowledge that the product of the gradients of two perpendicular lines is −1
P1.2.3	The intersection of a straight line and a curve	To include knowledge of algebraic methods and the geometrical interpretation of equal roots, distinct real roots or no real roots. To include knowledge of the terms intersect, intercept, meets and touches.

P1.3: Differentiation

Content		Guidance
P1.3.1	The first derivative	To include knowledge of the interpretation of the first derivative of $\mathrm{f}(x)$ as the gradient of the tangent to the graph of $y = \mathrm{f}(x)$ at a general point, the gradient of the tangent as a limit, and the interpretation as a rate of change. To include knowledge of the notations $\mathrm{f}'(x)$ and $\frac{\mathrm{d}y}{\mathrm{d}x}$ A general appreciation only of the derivative when interpreting it is required. Knowledge of differentiation from first principles will not be required.
P1.3.2	Differentiation of x^n where n is a rational number	To include knowledge of differentiation of sums and differences of terms of the form ax^n, terms that can be expressed as a single power, and polynomials For example: • $2x^2 - 5x^3$ • $x^{\frac{3}{2}} + \frac{3}{x^2}$ • $\frac{2}{\sqrt{x}} + 4x^3$
P1.3.3	Applications of differentiation	To include knowledge of applications with gradients, tangents and normals, maxima and minima and stationary points, increasing and decreasing functions, and practical problems where a function of a single variable has to be optimised. Knowledge of or application to points of inflection will not be required.
P1.3.4	The second derivative	To include knowledge of determining whether stationary points are maxima or minima.

P1.4: Integration

Content		Guidance
P1.4.1	Indefinite integration as the reverse of differentiation	
P1.4.2	Integration of x^n where n is a rational number not equal to −1	To include knowledge of integration of sums and differences of terms of the form ax^n, terms that can be expressed as a single power, and polynomials For example: • $2x^2 - 5x^3$ • $x^{\frac{3}{2}} + \frac{3}{x^2}$ • $\frac{2+x}{\sqrt{x}} = 2x^{-\frac{1}{2}} + x^{\frac{1}{2}}$
P1.4.3	Evaluation of definite integrals	To include knowledge of the interpretation of the definite integral as the area under a curve. To include knowledge of regions, and their areas, which are wholly above or wholly below the x-axis, including the knowledge that the definite integral can give a positive value or a negative value. To include knowledge of regions, and their areas, which are partially above and partially below the x-axis. To include knowledge of regions, and their areas, bounded by a straight line and a curve or bounded by two curves. To include knowledge of the terms shaded, region, finite, bounded and enclosed.

3.2 Pure Mathematics 2

This topic assumes knowledge of:

- OxfordAQA International GCSE Mathematics - Extension Tier
- Pure Mathematics 1

P2.1: Circles

Content		Guidance
P2.1.1	The equation of a circle	To include knowledge of the form $(x-a)^2+(y-b)^2=r^2$ To include knowledge of completing the square to find the centre and radius of a circle where the equation of the circle is, for example, given as $x^2+4x+y^2-6y-12=0$
P2.1.2	Coordinate geometry of the circle	To include knowledge of the following circle properties: • the angle in a semicircle is a right angle • the perpendicular from the centre to a chord bisects the chord • the tangent to a circle is perpendicular to the radius at its point of contact.
P2.1.3	The equations of tangents and normal to a circle at a given point	To include knowledge of the use of the coordinates of the centre and a point on the circle, or other appropriate points, to find relevant gradients. Knowledge or application of implicit differentiation will not be required.

P2.2: Graph techniques

Content		Guidance
P2.2.1	Simple transformations on the graph of $y = f(x)$ as represented by $y = f(ax)$ $y = af(x)$ and $y = f(x+a)+b$	To include knowledge of the terms reflection, translation, stretch parallel to the x-axis or y-axis, and scale factor. For example • $y = \sqrt{x}$ mapped onto $y = \sqrt{2x}$ • $y = 2^x$ mapped onto $y = 2^{x+3}$ • $y = 3^{-x}$ mapped onto $y = 3^x$ • $y = (x - 1)^2 + 3$ mapped onto $y = (x + 2)^2 + 1$ Translations may involve vectors such as $\begin{bmatrix} 3 \\ -2 \end{bmatrix}$ Knowledge of combinations of more than one type of transformation is not required. To include knowledge of the term map.
P2.2.2	Translation of circles	To include knowledge of how the equation of a circle is transformed by a translation.
P2.2.3	The trapezium rule	To include knowledge of the trapezium rule as a method for finding an approximate value for the area under a curve. To include knowledge of a graphical determination of whether the rule overestimates or underestimates the area, and improvement of an estimate by increasing the number of strips. To include knowledge of the terms strip and ordinate.
P2.2.4	Graphs of functions and the sketching of curves defined by simple equations	To include knowledge of linear, quadratic and cubic functions. To include knowledge of $f(x)$ notation, but only a very general idea of the concept of a function is required. Knowledge of the terms domain and range are not required.
P2.2.5	Geometrical interpretation of algebraic solution of equations	To include knowledge of the interpretation and use of intersection points of graphs of functions to solve equations and vice versa.

P2.3: Trigonometry

Content		Guidance
P2.3.1	The sine rule and the cosine rule	To include knowledge of the terms acute, right, obtuse and reflex.
P2.3.2	The area of a triangle	To include knowledge of the formula $\frac{1}{2}ab\sin C$
P2.3.3	Degree and radian measure	To include knowledge of the exact values of $\sin\theta$, $\cos\theta$ and $\tan\theta$ (where they exist) when the angle θ is $0°$, $30°$, $45°$, $60°$, $90°$ and $180°$, and their radian equivalents.
P2.3.4	Arc length, area of a sector and area of segment of a circle	To include knowledge of the formulae $s = r\theta$ and $A = \frac{1}{2}r^2\theta$ To include knowledge of the terms perimeter and vertices.
P2.3.5	Sine, cosine and tangent functions	To include knowledge of their graphs, symmetries and periodicity. Knowledge of the concept of odd and even functions is not required.
P2.3.6	The relationships $\tan\theta = \frac{\sin\theta}{\cos\theta}$ and $\sin^2\theta + \cos^2\theta = 1$	To include knowledge of their use in proving identities and their use in solving trigonometric equations in a given interval.
P2.3.7	Solving simple trigonometric equations	To include knowledge of solving equations in a given interval of degrees or radians. For example: • $\sin\theta = -0.4$ • $\sin(\theta - 20°) = 0.2$ • $2\sin\theta - \cos\theta = 0$ • $\cos(2\theta - 15°) = 0.5$ • $2\sin^2\theta + 5\cos\theta = 4$ • $3\tan^2 2\theta + \tan 2\theta - 8 = 0$ Knowledge of the compound angle formulae or the double-angle formulae will not be required.

P2.4: Exponentials and logarithms

Content		Guidance
P2.4.1	The function $f(x) = a^x$ where $a>0$	To include knowledge of the graph of $y = a^x$, its asymptote and the use of the laws of indices.
P2.4.2	Logarithms and the laws of logarithms	To include knowledge of the equivalence of $y = a^x$ and $x = \log_a y$ and the results: • $\log_a x + \log_a y = \log_a (xy)$ • $\log_a x - \log_a y = \log_a \left(\frac{x}{y}\right)$ • $k \log_a x = \log_a (x^k)$ • $\log_a a = 1$ • $\log_a 1 = 0$
P2.4.3	Solving equations of the form $a^x = b$	To include knowledge of the use of a calculator logarithm function to solve, for example, $3^x = 2$

P2.5: Sequences and series

Content		Guidance
P2.5.1	Sequences	To include knowledge of arithmetic sequences and geometric sequences and the terms common difference and common ratio. To include knowledge of sequences given by a formula for the n^{th} term. To include knowledge of sequences generated by a simple relation of the form $x_{n+1} = f(x_n)$ and their use in finding a limit L as $n \to \infty$ by setting $L = f(L)$ To include knowledge of the terms consecutive, successive, subsequent, converge and diverge.
P2.5.2	Series	To include knowledge of arithmetic series and the formula for the sum of the first n natural numbers. To include knowledge of geometric series and the sum of a finite geometric series. To include knowledge of the sum to infinity of a convergent geometric series, and the condition for convergence $-1 < r < 1$, which may be written as $\lvert r \rvert < 1$ To include knowledge of the notations $u_1 + u_2 + u_3 + \ldots$ and $\sum_{r=k}^{n} f(r)$ for the summation of a series.

Content		Guidance
P2.5.3	The binomial expansions of $(1 + x)^n$ and $(a + b)^n$ for positive integer n	To include knowledge of the notations $n!$, ${}^nC_r$, and $\binom{n}{r}$ Use of Pascal's triangle or formulae will be accepted. To include knowledge of the term ascending.

3.3 Statistics 1

This topic assumes knowledge of:

- OxfordAQA International GCSE Mathematics - Extension Tier
- Pure Mathematics 1

S1.1: Measures of central tendency and spread

Content		Guidance
S1.1.1	Measures of central tendency and spread	To include knowledge of the mean, mode, median and quartiles, range, interquartile range, variance, standard deviation for ungrouped and grouped data, and continuous and discrete data. To include knowledge of obtaining mean and standard deviation values from a calculator when raw data is given. To include knowledge of obtaining mean and standard deviation values using the relevant formulae when summarised data is given. To include knowledge of the appropriateness of using the different measures of central tendency and spread, including the terms valid, appropriate and misleading.

S1.2: Bivariate data

Content		Guidance
S1.2.1	Scatter diagrams	To include knowledge of dependent variables, independent variables and outliers.
S1.2.2	Correlation	To include knowledge of the informal interpretation of linear correlation, including positive correlation, negative correlation and no correlation, and that correlation does not imply causation.

Content		Guidance
S1.2.3	Least squares regression lines with one independent variable	To include knowledge of the equation of the least squares regression line with one independent variable, interpretation of values for the gradient and intercept in the context of the question, use of the least squares regression line for prediction within range of observed values of independent variable, drawing a least squares regression line on a scatter diagram, and an appreciation of the issues with extrapolation. To include knowledge of finding the gradient and intercept values of the equation of the least squares regression line using a calculator when raw data is given. To include knowledge of finding the gradient and intercept values of the equation of the least squares regression line using the relevant formulae when summarised data is given. To include knowledge of calculating the residual $\varepsilon_i = y_i - a - bx_i$, the use of residuals to check the plausibility of a model and to identify outliers, and an appreciation of the potentially large influence of outliers on the least squares regression line.

S1.3: Probability

Content		Guidance
S1.3.1	Elementary probability	To include knowledge of the concept of a random event and its probability. To include knowledge of assigning probabilities to events using relative frequencies or equally likely outcomes. To include knowledge of set notation. To include knowledge of the terms randomly, biased, unbiased, unique, model, assume and assumption.
S1.3.2	Addition law of probability and mutually exclusive events	To include knowledge of: • $\mathrm{P}(A \cup B) = \mathrm{P}(A) + \mathrm{P}(B) - \mathrm{P}(A \cap B)$ for two events only. • $\mathrm{P}(A \cup B) = \mathrm{P}(A) + \mathrm{P}(B)$ for two or more events only • $\mathrm{P}(A \cap B) = 0$ for mutually exclusive events $\mathrm{P}(A') = 1 - \mathrm{P}(A)$

Content		Guidance
S1.3.3	Multiplication law of probability, conditional probability and independent events	To include knowledge of: • $\mathrm{P}(A \cap B) = \mathrm{P}(A) \times \mathrm{P}(B \mid A) = \mathrm{P}(B) \times \mathrm{P}(A \mid B)$ for two or more events • $\mathrm{P}(A \cap B) = \mathrm{P}(A) \times \mathrm{P}(B)$ for independent events.
S1.3.4	Application of probability laws	To include knowledge of solving simple problems by the direct application of the probability laws, by counting equally likely outcomes, and the construction and use of frequency tables or relative frequency (probability) tables. Knowledge of tree diagrams or Venn diagrams is not required.

S1.4: Discrete random variables

Content		Guidance
S1.4.1	Discrete random variables	To include knowledge of the probability distributions of discrete random variables where the number of possible outcomes will be finite, including given in the form of a table or a probability distribution function.
S1.4.2	Mean, variance and standard deviation for discrete random variables	To include knowledge of: • $\mathrm{E}(X) = \sum x_i \mathrm{P}(X = x_i)$ • $\mathrm{E}(\mathrm{g}(\mathrm{X})) = \sum \mathrm{g}(\mathrm{x_i})\mathrm{P}(\mathrm{X} = \mathrm{x_i})$ • $\mathrm{E}(aX + b) = a\mathrm{E}(X) + b$ • $\mathrm{Var}(X) = \mathrm{E}\left((X - \mathrm{E}(X))^2\right)$ • $\mathrm{Var}(X) = \mathrm{E}(X^2) - \mathrm{E}(X)^2$ • $\mathrm{Var}(aX + b) = a^2\mathrm{Var}(X)$
S1.4.3	Mean, variance and standard deviation of a simple function of a discrete random variable	For example: • $\mathrm{E}(2X + 3)$, $\mathrm{E}(5X^2)$, $\mathrm{E}(10X^{-1})$, $\mathrm{E}(100X^{-1})$ • $\mathrm{Var}\,(3X)$, $\mathrm{Var}\,(4X - 5)$, $\mathrm{Var}\,(6X^{-1})$
S1.4.4	Mean and variance of the sum or difference of independent discrete random variables	To include knowledge of: • $\mathrm{E}(aX \pm bY) = a\mathrm{E}(X) \pm b\mathrm{E}(Y)$ • $\mathrm{Var}(aX \pm bY) = a^2\mathrm{Var}(X) + b^2\mathrm{Var}(Y)$ • $\mathrm{E}\left(\sum X_i\right) = \sum \mathrm{E}(X_i)$ • $\mathrm{Var}\left(\sum X_i\right) = \sum \mathrm{Var}(X_i)$

S1.5: The binomial distribution

Content		Guidance
S1.5.1	The binomial distribution	To include knowledge of the conditions for which the binomial distribution is an appropriate model, and the notation $X \sim \mathrm{B}(n, p)$
S1.5.2	Calculation of probabilities	To include knowledge of finding probabilities using the binomial distribution formula and the probability tables in the Examinations booklet. To include knowledge of the notations ${}^{n}C_{r}$ and $X \sim \mathrm{B}(n, p)$
S1.5.3	Mean, variance and standard deviation	To include knowledge of finding the mean, variance and standard deviation of a binomial distribution. Knowledge of the derivation of the mean and variance is not required.

S1.6: Hypothesis testing

Content		Guidance
S1.6.1	Populations and samples	To include knowledge of the terms population, sample, parameter and statistic, and the use of these terms in hypothesis testing. To include knowledge of the concept of a random sample. Knowledge of methods for obtaining random samples is not required.
S1.6.2	Null and alternative hypotheses	To include knowledge of the null hypothesis to be of the form that a parameter takes a specified value.
S1.6.3	The language of hypothesis tests	To include knowledge of the terms one-tailed test, two-tailed test, significance level, critical value, critical region, acceptance region and test statistic.
S1.6.4	The outcome of hypothesis tests in context	To include knowledge of giving the outcome of a hypothesis test in the context of the problem, including understanding and referring to the significance level of the test. To include knowledge of the language of 'Reject H_0' and 'Fail to reject H_0'
S1.6.5	Type **I** and Type **II** errors	To include knowledge of the concepts of • Type **I** errors (reject H_0 | H_0 true) • Type **II** errors (fail to reject H_0 | H_0 false)

Content		Guidance
S1.6.6	Tests for a population proportion	To include knowledge of using exact binomial probabilities to find the critical region(s) and the acceptance region(s). To include knowledge of finding the probability of a Type **I** error for this test. Knowledge of finding the probability of a Type **II** error for this test is not required.

3.4 Mechanics 1

This topic assumes knowledge of:

- OxfordAQA International GCSE Mathematics - Extension Tier
- Pure Mathematics 1

M1.1: Mathematical modelling

Content		Guidance
M1.1.1	Mathematical modelling	To include knowledge of using assumptions in simplifying reality and mathematical modelling, including the terms light, smooth, rough, particle, inextensible, rigid, rod, string, negligible, assume and model. To include knowledge of analysing, interpreting and evaluating mathematical models in context and commenting on the validity of mathematical models. To include the terms exert, slack, taut, rebound, bounce, slide, slip, hits, held, release, rest, stationary, horizontal, vertical, magnitude, disc, sphere, hinge, slope, incline, plane, instant, instantaneously.

M1.2: Kinematics in one dimension

Content		Guidance
M1.2.1	Kinematic quantities	To include knowledge of the quantities: distance, displacement, position, speed, average speed, velocity, average velocity, acceleration. To include knowledge of the difference between displacement and distance, and the difference between velocity and speed.
M1.2.2	Kinematic graphs	To include knowledge of sketching and interpreting kinematics graphs, and the use of gradients and areas under graphs to solve problems.

M1.3: Constant acceleration in one dimension

Content		Guidance
M1.3.1	The equations of constant acceleration	To include knowledge of the conditions under which the equations apply, and the equations • $s = ut + \frac{1}{2}at^2$ • $v = u + at$ • $v^2 = u^2 + 2as$ • $s = \frac{1}{2}(u + v)t$ • $s = vt - \frac{1}{2}at^2$ where s represents displacement, u represents initial velocity, v represents final velocity, a represents acceleration and t represents time.
M1.3.2	Vertical motion under gravity	To include knowledge of the equations of constant acceleration and their application to vertical motion. The magnitude of the acceleration due to gravity, g, will be taken as $9.8\ \text{m s}^{-2}$

M1.4: Variable acceleration in one dimension

Content		Guidance
M1.4.1	The relationships between displacement, velocity and acceleration	To include knowledge of calculus techniques and the results: • $v = \frac{\mathrm{d}s}{\mathrm{d}t}$ • $a = \frac{\mathrm{d}v}{\mathrm{d}t}$ and $a = \frac{\mathrm{d}^2s}{\mathrm{d}t^2}$ • $s = \int v\,\mathrm{d}t$ • $v = \int a\,\mathrm{d}t$

M1.5: Forces and Newton's laws of motion

Content		Guidance
M1.5.1	Newton's three laws of motion	To include knowledge of the use of the three laws in static problems, and dynamic problems restricted to cases of linear motion and constant mass. Newton's 1st Law: A body will continue with constant velocity unless acted upon by a resultant force. Newton's 2nd Law (for a body with constant mass): The magnitude of the resultant force acting on a body is equal to the mass of the body multiplied by the magnitude of the body's acceleration. Newton's 3rd Law: If one body exerts a force on a second body, the second body will exert a force on the first body that is equal in magnitude but opposite in direction.
M1.5.2	Force diagrams	To include knowledge of drawing force diagrams and identifying and naming the forces present.
M1.5.3	Mass and weight	To include knowledge of the difference between mass and weight, and the equation $W = mg$ The magnitude of the acceleration due to gravity, g, will be taken as 9.8 m s^{-2}
M1.5.4	Friction	To include knowledge of limiting friction, the coefficient of friction and the relationship $F \leq \mu R$, including deriving inequalities from the use of $F \leq \mu R$ To include knowledge of the terms frictional and 'on the point of slipping'.
M1.5.5	Common forces in problems	To include knowledge of tensions in strings and rods, thrusts in rods, (normal) reaction forces, resistance forces, friction, air resistance and drag.
M1.5.6	The resultant force	To include knowledge of finding the resultant force acting on a body, including resolving forces. To include knowledge of motion up or down an inclined plane, and the use of limiting friction $F = \mu R$
M1.5.7	Equilibrium of forces	To include knowledge that the resultant force on a body is zero if a body is in equilibrium, including resolving forces and finding unknown forces acting on, for example, a block on an inclined plane.

Content		Guidance
M1.5.8	Connected particles	To include knowledge of the motion of two particles connected by a light inextensible string passing over a smooth fixed peg or a smooth light pulley, when the forces on each particle are constant, and other connected particle problems, such as a car and trailer.

M1.6: Momentum, impulse and collisions in one dimension

Content		Guidance
M1.6.1	Momentum and the conservation of momentum	To include knowledge of the equation $p = mv$ and the terms collide, collision and coalesce. To include knowledge of the conservation of momentum restricted to collisions between two particles moving on a straight line. Knowledge of Newton's law of restitution is not required.
M1.6.2	Impulse	To include knowledge of impulse as the change in momentum.
M1.6.3	Collisions with fixed surfaces	To include knowledge of collisions between a particle which is moving on a line perpendicular to a fixed smooth surface, such as a wall.

M1.7: Work done and energy

Content		Guidance
M1.7.1	Work done by a constant force	To include knowledge of situations where forces only act in directions parallel to the direction of motion.
M1.7.2	Gravitational potential energy	To include knowledge of the equation $\text{Change in Gravitational Potential Energy} = mg\Delta h$ where Δh is the change in vertical height.
M1.7.3	Kinetic energy	To include knowledge of the equation $\text{Kinetic Energy} = \frac{1}{2}mv^2$
M1.7.4	The work–energy principle and the conservation of energy	To include knowledge of situations where energy transformations are restricted to transformations from one type to one another type. For example, loss in gravitational potential energy = increase in kinetic energy.

3.5 Pure Mathematics 3

This topic assumes knowledge of:

- OxfordAQA International GCSE Mathematics - Extension Tier
- Pure Mathematics 1
- Pure Mathematics 2

P3.1: Algebra and functions

Content		Guidance
P3.1.1	Functions	To include knowledge of the definition of a function, and the domain and range of a function. To include knowledge of relevant notations, for example: • $f(x)$ for functions • $x \geq 1$ or $x \in [1, \infty)$ for domains • $f(x) < -3$ or $f(x) \in (-\infty, -3)$ for ranges.
P3.1.2	Composition of functions	To include knowledge of the notation $fg(x) = f(g(x))$
P3.1.3	Inverse functions and their graphs	To include knowledge of the notation f^{-1} for the inverse of the function f To include knowledge of the graph of $y = f^{-1}(x)$ being a reflection of the graph of $y = f(x)$ in the line $y = x$
P3.1.4	The modulus function	To include knowledge of related graphs and the solution to inequalities of using them, such as solving $\|x + 2\| < 3\|x\|$ using solutions of $\|x + 2\| = 3\|x\|$
P3.1.5	Combinations of the transformations on the graph of $y = f(x)$ as represented by $y = f(ax)$, $y = af(x)$ and $y = f(x + a) + b$	To include knowledge of the terms reflection, translation, stretch parallel to the x-axis or y-axis, and scale factor. For example: • $y = e^x$ mapped onto $y = 2e^{-x}$ • $y = \ln(2x - 1)$ mapped onto $y = \ln x$ • $y = \sin 2x$ mapped onto $y = 3 + \sin(x - \pi)$ • $y = \sec x$ mapped onto $y = 4 + 3\sec 2x$

P3.2: Trigonometry

Content		Guidance
P3.2.1	The inverse trigonometric functions $\sin^{-1}$, $\cos^{-1}$ and $\tan^{-1}$	To include knowledge of their domains, their ranges and their graphs, including any asymptotes. To include knowledge of the graphs of $y = \sin^{-1} x$, $y = \cos^{-1} x$ and $y = \tan^{-1} x$ as being reflections of the relevant trigonometric graphs in the line $y = x$ Knowledge of the addition formulae for inverse trigonometric functions is not required.
P3.2.2	The reciprocal trigonometric functions sec, cosec and cot	To include knowledge of their domains, their ranges and their graphs, including any asymptotes, and their relationships to the cosine, sine and tangent functions.
P3.2.3	The relationships $\tan^2 x + 1 = \sec^2 x$ and $1 + \cot^2 \theta = \operatorname{cosec}^2 \theta$	To include knowledge of their use in proving identities and the solution of trigonometric equations in a given interval.

P3.3: Exponentials and logarithms

Content		Guidance
P3.3.1	The exponential function e^x	To include knowledge of its domain, its range and its graph, including any asymptotes. To include knowledge of understanding of e^x as the inverse function of $\ln x$
P3.3.2	The natural logarithm function $\ln x$	To include knowledge of its domain, its range and its graph, including any asymptotes. To include knowledge and understanding of $\ln x$ as the inverse function of e^x

P3.4: Calculus

Content		Guidance
P3.4.1	Differentiation of functions	To include knowledge of differentiating the functions e^x, $\ln x$, $\sin x$, $\cos x$, $\tan x$.
P3.4.2	The product rule for differentiation	
P3.4.3	The quotient rule for differentiation	
P3.4.4	The chain rule for differentiation	
P3.4.5	The relationship $\frac{dy}{dx} = \frac{1}{\left(\frac{dx}{dy}\right)}$	For example: A curve has equation $x = y^2 - 4y + 1$ Find the value of $\left.\frac{dy}{dx}\right\|_{y=1}$

Content		Guidance
P3.4.6	Integration of functions	To include knowledge of integrating the functions e^x, $\frac{1}{x}$, $\sin x$, $\cos x$ and their linear combinations.
P3.4.7	Integration by inspection or by substitution	To include knowledge of the method of substitution as being the reverse of the chain rule for differentiation, including the use of $\int \frac{f'(x)}{f(x)}\,dx = \ln\left\|f(x)\right\| + c$ where c is a constant of integration.
P3.4.8	Integration by parts	To include knowledge of this method as being the reverse of the product rule for differentiation.
P3.4.9	Volume of revolution	The axes of revolution/rotation will be restricted to the x-axis and y-axis.

P3.5: Numerical methods

Content		Guidance
P3.5.1	Simple location of roots of $f(x) = 0$	To include knowledge of considering the change of sign of $f(x)$ in an interval of x for which a root of $f(x) = 0$ lies and for which $f(x)$ is continuous.
P3.5.2	Recursive relationships of the form $x_{n+1} = g(x_n)$ to find approximate solutions of equations	To include knowledge of rearranging equations into the form $x = g(x)$, and staircase diagrams and cobweb diagrams to illustrate iterations and their use in considerations of convergence.
P3.5.3	Numerical integration	To include knowledge of the mid-ordinate rule and Simpson's Rule. To include knowledge of improvement of an estimate by increasing the number of steps. To include knowledge of geometrical interpretation of the mid-ordinate rule.

3.6 Pure Mathematics 4

This topic assumes knowledge of:

- OxfordAQA International GCSE Mathematics - Extension Tier
- Pure Mathematics 1
- Pure Mathematics 2
- Pure Mathematics 3

P4.1: Algebra and functions

Content		Guidance
P4.1.1	Rational functions	To include knowledge of simplification of rational expressions, such as factorising and cancelling, for example: $\frac{x^2-4x}{x^2-5x+4}=\frac{x(x-4)}{(x-4)(x-1)}=\frac{x}{x-1}$ To include use of the Factor Theorem and Remainder Theorem for divisors of the form $(ax+b)$ $\frac{2x^2}{(x+5)(x+3)}=2-\frac{4x-30}{(x+5)(x+3)}$
P4.1.2	Algebraic division	To include knowledge of simplification by inspection, by equating coefficients or by algebraic long division, for example: • $\frac{3x+4}{x-1}=3+\frac{7}{x-1}$ • $\frac{2x^3-3x^2-2x+2}{x-2}=2x^2+x+\frac{2}{x-2}$ • by using the given relationship $\frac{2x^2}{(x+5)(x+3)}=a+\frac{bx+c}{(x+5)(x+3)}$ To include knowledge of the terms divisor, quotient and remainder.

Content		Guidance
P4.1.3	Partial fractions	To include knowledge of forming partial fractions where denominators are not more complicated than repeated linear terms. Greatest level of difficulty as indicated by $\frac{3+2x^2}{(2x+1)(x-3)^2}$ Knowledge of irreducible quadratic factors in the denominator is not required.

P4.2: Coordinate geometry in the (x, y) plane

Content		Guidance
P4.2.1	Cartesian and parametric equations of curves	To include knowledge of conversion between the Cartesian form and the parametric form.

P4.3: Series expansions

Content		Guidance
P4.3.1	The binomial expansion of $(1+x)^n$ for rational n	To include knowledge of the values for which the expansion is valid. Greatest level of difficulty as indicated by $(2+3x)^{-2} = \frac{1}{4}\left(1+\frac{3x}{2}\right)^{-2}$ for $\lvert x\rvert < \frac{2}{3}$
P4.3.2	Series expansion of rational functions	To include knowledge of the use of partial fractions.

P4.4: Trigonometry

Content		Guidance
P4.4.1	The compound angle formulae for sin, cos and tan	To include knowledge of: • $\sin(\alpha \pm \beta) = \sin\alpha\cos\beta \pm \sin\beta\cos\alpha$ • $\cos(\alpha \pm \beta) = \cos\alpha\cos\beta \mp \sin\alpha\sin\beta$ • $\tan(\alpha \pm \beta) = \frac{\tan\alpha \pm \tan\beta}{1 \mp \tan\alpha\tan\beta}$ To include knowledge of harmonic form, expressing $a\cos\theta + b\sin\theta$ in the forms $R\sin(\theta \pm \alpha)$ or $R\cos(\theta \pm \alpha)$

Content		Guidance
P4.4.2	The double angle formulae for sin, cos and tan	To include knowledge of: • $\sin 2x = 2\sin x \cos x$ • $\cos 2x = \cos^2 x - \sin^2 x$ • $\cos 2x = 2\cos^2 x - 1$ • $\cos 2x = 1 - 2\sin^2 x$ • $\tan 2x = \frac{2\tan x}{1-\tan^2 x}$
P4.4.3	Trigonometric relationships	To include the use of trigonometric relationships in solving problems, for example: • $\sin 3x = \sin(2x + x) = \sin x(3 - 4\sin^2 x)$ • Prove that $\frac{\operatorname{cosec}\theta}{\operatorname{cosec}\theta - \sin\theta} = \sec^2\theta$ • $\int \cos^2 x \, dx \Rightarrow \int \left(\frac{1+\cos 2x}{2}\right) dx$
P4.4.4	Trigonometric equations	To include the use of trigonometric relationships to solve trigonometric equations in a given interval.
P4.4.5	Small-angle approximations for sin, cos and tan	To include knowledge of • $\sin x \approx x$ • $\cos x \approx 1 - \frac{x^2}{2}$ • $\tan x \approx x$ for small values of x in radians. To include knowledge of their use in series expansions.

P4.5: Calculus, differential equations and modelling

Content		Guidance
P4.5.1	Forming and solving first order differential equations with separable variables	To include knowledge of the separation of variables. To include knowledge of growth and decay, and applications to problems set in a simple context.
P4.5.2	Implicit differentiation and parametric differentiation	To include knowledge of finding $\frac{\mathrm{d}y}{\mathrm{d}x}$ for a curve defined implicitly or parametrically. Knowledge of finding the second derivative of curves defined implicitly or paramterically is not required.
P4.5.3	Tangents and normals for curves defined implicitly or paramterically	To include knowledge of finding equations of tangents and normals at a general point for curves defined parametrically.
P4.5.4	Integration using partial fractions	
P4.5.5	Exponential growth and decay	To include knowledge of the use of exponential functions in models which may be set in a simple context.

P4.6: Vectors

Content		Guidance
P4.6.1	Vectors in two and three dimensions	To include knowledge of the notation for column vectors.
P4.6.2	Magnitude of a vector	To include knowledge of finding the distance between two points.
P4.6.3	Algebraic operations for vectors	To include knowledge of vector addition, multiplication of a vector by a scalar, and their geometrical interpretations. To include knowledge of parallel vectors and the result $\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA}$
P4.6.4	Vector equations of lines	To include knowledge of the equation of a line in the vector forms $\mathbf{r} = \mathbf{a} + \lambda\mathbf{d}$ and $\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \\ a_3 \end{bmatrix} + \lambda \begin{bmatrix} d_1 \\ d_2 \\ d_3 \end{bmatrix}$ To include knowledge of the intersection of two straight lines in two and three dimensions, parallel lines, and skew lines in three dimensions.
P4.6.5	The scalar product	To include knowledge of determining whether two vectors are perpendicular. To include knowledge of its use for calculating the angle between two lines or two vectors. To include knowledge of finding the coordinates of the foot of the perpendicular from a point to a line and hence the perpendicular distance from a point to a line.

3.7 Statistics 2

This topic assumes knowledge of:

- OxfordAQA International GCSE Mathematics - Extension Tier
- Pure Mathematics 1
- Pure Mathematics 2
- Pure Mathematics 3
- Statistics 1

S2.1: The Poisson distribution

Content		Guidance
S2.1.1	The Poisson distribution	To include knowledge of the conditions for which the Poisson distribution is an appropriate model, and the notation $X \sim \text{Po}(\lambda)$
S2.1.2	The Poisson distribution as a limiting form of the binomial distribution	To include knowledge of the conditions of large n and small p with $np = \lambda$ for the appropriate use of the Poisson distribution to approximate the binomial distribution.
S2.1.3	Calculation of probabilities	To include knowledge of finding probabilities using the Poisson distribution formula and the probability tables in the Examinations booklet.
S2.1.4	Mean, variance and standard deviation	To include knowledge of finding the mean, variance and standard deviation of a Poisson distribution, including deducing the formulae from the mean and the variance of a binomial distribution. Knowledge of derivations of the mean and variance is not required.
S2.1.5	Distribution of sum of independent Poisson random variables	Knowledge of the proof of this result is not required.

S2.2: Continuous random variables

Content		Guidance
S2.2.1	Comparing discrete random variables and continuous random variables	To include knowledge of similarities and differences between discrete random variables and continuous random variables
S2.2.2	Probability density functions, cumulative distribution functions and their relationship	To include knowledge of piecewise functions, both continuous and discontinuous, and the relationships: • $\text{F}(x) = \int_{-\infty}^{x} \text{f}(t)\,\text{d}t$ • $\text{f}(x) = \frac{\text{d}}{\text{d}x}\text{F}(x)$

Content		Guidance
S2.2.3	Probability of an observation lying in a specified interval	To include knowledge of: • $\mathrm{P}(a < X < b) = \int_a^b \mathrm{f}(x)\mathrm{d}x$ • $\int_{-\infty}^{\infty} \mathrm{f}(x)\mathrm{d}x = 1$ • $\mathrm{P}(X = a) = 0$
S2.2.4	Mean, variance and standard deviation	To include knowledge of finding the mean, variance and standard deviation for continuous random variables, including: • $\mathrm{E}(X) = \int_{-\infty}^{\infty} x\,\mathrm{f}(x)\mathrm{d}x$ • $\mathrm{E}(\mathrm{g}(\mathrm{X})) = \int_{-\infty}^{\infty} \mathrm{g}(\mathrm{x})\mathrm{f}(\mathrm{x})\mathrm{dx}$ • $\mathrm{E}(aX + b) = a\mathrm{E}(X) + b$ • $\mathrm{Var}(X) = \mathrm{E}\left((X - \mathrm{E}(X))^2\right)$ • $\mathrm{Var}(X) = \mathrm{E}(X^2) - \mathrm{E}(X)^2$ • $\mathrm{Var}(aX + b) = a^2\mathrm{Var}(X)$
S2.2.5	Mean, variance and standard deviation of a simple function of a continuous random variable	For example: • $\mathrm{E}(2X + 3)$, $\mathrm{E}(5X^2)$, $\mathrm{E}(10X^{-1})$, $\mathrm{E}(100X^{-1})$ • $\mathrm{Var}\,(3X)$, $\mathrm{Var}\,(4X - 5)$, $\mathrm{Var}\,(6X^{-1})$
S2.2.6	Mean and variance of the sum or difference of independent continuous random variables	To include knowledge of: • $\mathrm{E}(aX \pm bY) = a\mathrm{E}(X) \pm b\mathrm{E}(Y)$ • $\mathrm{Var}(aX \pm bY) = a^2\mathrm{Var}(X) + b^2\mathrm{Var}(Y)$ • $\mathrm{E}\left(\sum X_i\right) = \sum \mathrm{E}(X_i)$ • $\mathrm{Var}\left(\sum X_i\right) = \sum \mathrm{Var}(X_i)$

Content		Guidance
S2.2.7	The continuous uniform distribution	To include knowledge of the conditions for which the continuous uniform distribution is an appropriate model, the notation $X \sim \mathrm{U}(a, b)$ and the probability density function $\mathrm{f}(x) = \begin{cases} \frac{1}{b-a} & \text{for } a \le x \le b \\ 0 & \text{otherwise} \end{cases}$ To include knowledge of calculating probabilities using the continuous uniform distribution. To include knowledge of the mean, variance and standard deviation of the continuous uniform distribution, and their derivations. To include knowledge of the cumulative distribution function for the continuous uniform distribution.

S2.3: The exponential distribution

Content		Guidance
S2.3.1	The exponential distribution	To include knowledge of the conditions for which the exponential distribution is an appropriate model, the notation $X \sim \mathrm{Exp}(\lambda)$ and the memoryless nature of the distribution. To include knowledge that the time between successive Poisson events has an exponential distribution.
S2.3.2	Calculation of probabilities	To include knowledge of using the cumulative distribution function or of integrating the probability density function.
S2.3.3	Mean, variance and standard deviation	To include knowledge of finding the mean, variance and standard deviation of an exponential distribution. Knowledge of derivations of the mean and variance is not required.

S2.4: The normal distribution

Content		Guidance
S2.4.1	The normal distribution	To include knowledge of the properties of the normal distribution, including shape, symmetry and area properties. To include knowledge that approximately two-thirds of observations lie within $\mu \pm \sigma$

Content		Guidance
S2.4.2	Calculation of probabilities	To include knowledge of the transformation to the standardised normal distribution and use of tables in the Examinations booklet. Knowledge of interpolation is not required.
S2.4.3	Mean, variance and standard deviation	To include knowledge of finding the mean, variance and standard deviation of a normal distribution by using the table of percentage points in the Examinations booklet.
S2.4.4	Distribution of sum of independent normal random variables	Knowledge of the proof is not required.

S2.5: Estimation

Content		Guidance
S2.5.1	Unbiased estimators of a population mean and variance	To include knowledge of $\bar{X}$ and S^2 respectively.
S2.5.2	Sampling distribution of the mean of a random sample from a normal distribution	To include knowledge of the standard error of the sample mean $\frac{\sigma}{\sqrt{n}}$ and its estimator $\frac{S}{\sqrt{n}}$, where σ^2 is the population variance and S^2 is the unbiased estimator for the population variance.
S2.5.3	Normal distribution as an approximation to the sampling distribution of the mean of a large sample from any distribution	To include knowledge and application of the Central Limit Theorem.

S2.6: Hypothesis testing

Content		Guidance
S2.6.1	Tests for the population mean of a Poisson distribution	To include knowledge of using exact Poisson probabilities to find critical regions and acceptance regions. To include knowledge of finding the probability of a Type I error for this test. Knowledge of finding the probability of a Type II error for this test is not required.
S2.6.2	Tests for the population mean of a normal distribution with known variance	To include knowledge of using a *z*-statistic and finding the critical value for the test. To include knowledge of finding the probability of a Type I error for this test. Knowledge of finding the probability of a Type II error for this test is not required.

Content		Guidance
S2.6.3	Tests for the population mean of a distribution using a normal approximation	To include knowledge of its use with large samples only, with known and unknown variances, using a z-statistic, and finding the critical value for the test. To include knowledge of finding the probability of a Type I error for this test. Knowledge of finding the probability of a Type II error for this test is not required.
S2.6.4	Tests for the population mean of a normal distribution with unknown variance	To include knowledge of using a t-statistic and finding the critical value for the test. To include knowledge of finding the probability of a Type I error for this test. Knowledge of finding the probability of a Type II error for this test is not required.

3.8 Mechanics 2

This topic assumes knowledge of:

- OxfordAQA International GCSE Mathematics - Extension Tier
- Pure Mathematics 1
- Pure Mathematics 2
- Pure Mathematics 3
- Mechanics 1

M2.1: Kinematics in one, two and three dimensions

Content		Guidance
M2.1.1	Kinematic quantities	To include knowledge of the displacement, position, distance, velocity, speed and acceleration in one, two or three dimensions.
M2.1.2	The relationships between position, velocity and acceleration	To include knowledge of calculus techniques to solve problems in one, two or three dimensions, involving constant or variable acceleration. To include representing vectors in two or three dimensions using column vectors or the perpendicular unit vectors **i**, **j** and **k**. To include knowledge of vector techniques, including those from Pure Mathematics 4 such as the modulus and scalar product.

M2.2: Centre of mass and moments

Content		Guidance
M2.2.1	Centre of mass	To include knowledge of the centre of mass being the point in a body through which the entire weight of the body appears to act. To include knowledge of where the centre of mass is located for a uniform body, such as a block. Knowledge of finding the location of the centre of mass through calculation is not required.
M2.2.2	Moments	To include knowledge of finding the moment of a force about a given point.

Content		Guidance
M2.2.3	Equilibrium of a rigid body	To include knowledge of determining the forces acting on a rigid body when in equilibrium, and that when a rigid body is in equilibrium, the resultant force and the resultant moment are both zero. To include knowledge of situations such as those where all forces are parallel, such as on a horizontal beam, or where the forces act in two dimensions, such as on a ladder leaning against a wall.
M2.2.4	Sliding and toppling	To include knowledge of the conditions for toppling and the conditions for sliding. To include knowledge of determining how equilibrium will be broken in situations, such as a force applied to a body on a horizontal surface or on an inclined plane with an increasing slope. To include knowledge of deriving inequalities that must be satisfied for equilibrium.

M2.3: Newton's laws of motion and variable acceleration

Content		Guidance
M2.3.1	Newton's laws of motion and variable acceleration	To include knowledge of situations involving one, two or three dimensions, the use of calculus techniques and the use of vector techniques, including those from Pure Mathematics 4 such as the modulus and scalar product.

M2.4: Projectile motion

Content		Guidance
M2.4.1	Motion under gravity in two dimensions	To include knowledge of the formulae $x = (u\cos\alpha)t$ and $y = (u\sin\alpha)t - \frac{1}{2}gt^2$ where α is the angle of projection. To include knowledge of problems where the initial velocity is parallel to the horizontal, above the horizontal and below the horizontal. To include knowledge of problems where the initial vertical displacement of the projectile is above horizontal ground. Knowledge of problems involving inclined planes and resistance is not required.

M2.5: Work done and energy

Content		Guidance
M2.5.1	Work done by a constant force	To include knowledge of situations where forces may or may not act in the direction of motion, and the formula $W = Fs\cos\theta$
M2.5.2	The work–energy principle and the conservation of energy	To include knowledge of situations where energy transformations are from one or more types to one or more types. For example: loss in gravitational potential energy = increase in kinetic energy + work done against friction
M2.5.3	Power	To include knowledge of power as the rate at which a force does work, and the relationship $P = Fv$

M2.6: Uniform circular motion

Content		Guidance
M2.6.1	Motion in a circle with constant speed	To include knowledge of situations involving horizontal circles or situations such as a satellite describing a circular orbit, where the gravitational force acting on the satellite is towards the centre of the circle.
M2.6.2	Angular speed	To include knowledge of angular speed in radians per second, including converting its value to and from other units, such as revolutions per minute, and the time period of the motion.
M2.6.3	The resultant force and the relationships $v = r\omega$, $a = r\omega^2$ and $a = \frac{v^2}{r}$	To include knowledge of the resultant force for a body undergoing uniform circular motion, including the direction in which it acts.
M2.6.4	Vectors in uniform circular motion	To include knowledge of position, velocity and acceleration, and their use in uniform circular motion, such as proving that motion is circular by showing that a body maintains a constant distance from a given point as it moves. To include vector techniques, including those from Pure Mathematics 4 such as the modulus and scalar product.
M2.6.5	The conical pendulum	To include knowledge of resolving forces, and the use of one or more strings and/or one or more rods.
M2.6.6	Banked tracks	To include knowledge of resolving forces and the terms 'on the point of sliding' up or down the banked track.

4 Scheme of assessment

Find mark schemes, and specimen papers for new courses, on our website at oxfordaqa.com/9760

These qualifications are modular. The full International A-level is intended to be taken over two years. The specification content for the International AS is half that of an International A-level.

The International AS can be taken as a stand-alone qualification or it can count towards the International A-level. To complete the International A-level, students can take the International AS in their first year and the International A2 in their second year or they can take all the units together in the same examination series at the end of the two year course.

The International AS content will be 50% of the International A-level content. International AS assessments contribute 50% of the total marks for the full International A-level qualification. The remaining 50% comes from the International A2 assessments.

The specification provides an opportunity for students to produce extended responses either in words or using open-ended calculations.

The specification content will be split across units and will include some synoptic assessment. This allows students to draw together different areas of knowledge from across the full course of study.

All materials are available in English only.

4.1 Availability of assessment units and certification

Exams and certification for this specification are available as follows:

Examination series	Availability of units		Availability of certification	
	P1, P2, S1, M1	P3, P4, S2, M2	International AS	International A-level
June 2028	✓		✓	
October/November 2028	✓		✓	
January 2029	✓		✓	
June 2029	✓	✓	✓	✓
October/November 2029	✓	✓	✓	✓
January 2030	✓	✓	✓	✓
June 2030	✓	✓	✓	✓

4.2 Aims

Courses based on this specification should encourage students to:

- develop their understanding of mathematics and mathematical processes in a way that promotes confidence and fosters enjoyment
- develop abilities to reason logically and to recognise incorrect reasoning, to generalise and to construct mathematical proofs
- extend their range of mathematical skills and techniques and use them in more difficult unstructured problems
- develop an understanding of coherence and progression in mathematics and how different areas of mathematics can be connected
- recognise how a situation may be represented mathematically and understand the relationship between 'real world' problems and standard and other mathematical models and how these can be refined and improved
- use mathematics as an effective means of communication
- read and comprehend mathematical arguments and articles concerning applications of mathematics
- acquire the skills needed to use technology such as calculators and computers effectively yet be aware of any limitations of using these
- develop an awareness of the relevance of mathematics to other fields of study, to the world of work and to society in general.

4.3 Assessment Objectives

The exams will measure how students have achieved the following assessment objectives:

- AO1: Recall and select knowledge of mathematical facts, concepts, models and techniques required to solve problems in a variety of contexts.
- AO2: Construct rigorous mathematical arguments and proofs through use of precise statements, mathematical manipulation, logical deduction, modelling assumptions and justifications to solve structured and unstructured problems, and to deduce, interpret and communicate results.

Quality of Written Communication (QWC)

Students must:

- ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Questions in the papers for this specification do not include specific marks for QWC. However, poor written communication may lead to lower marks due to lack of clarity in answers.

4.3.1 Assessment Objective weightings for International AS Mathematics

Assessment Objectives (AOs)	Unit weightings (approx %)			Overall weighting of AOs (approx %)
	Pure 1	Pure 2	Unit S1 or M1	
AO1	13.3 - 16.7	13.3 - 16.7	13.3 - 16.7	40 - 50
AO2	16.7 - 20	16.7 - 20	16.7 - 20	50 - 60
Overall weighting of units (%)	33.3	33.3	33.3	100

4.3.2 Assessment Objective weightings for International A-level Mathematics

Assessment Objectives (AOs)	Unit weightings (approx %)						Overall weighting of AOs (approx %)
	Pure 1	Pure 2	Unit S1 or M1	Pure 3	Pure 4	Unit S1 or M1 or S2 or M2	
AO1	6.7 - 8.4	6.7 - 8.4	6.7 - 8.4	6.7 - 8.4	6.7 - 8.4	6.7 - 8.4	40 - 50
AO2	8.4 - 10	8.4 - 10	8.4 - 10	8.4 - 10	8.4 - 10	8.4 - 10	50 - 60
Overall weighting of units (%)	16.7	16.7	16.7	16.7	16.7	16.7	100

4.4 Assessment weightings

The raw marks awarded on each unit will be transferred to a uniform mark scale (UMS) to meet the weighting of the units and to ensure comparability between units sat in different exam series. Students' final grades will be calculated by adding together the uniform marks for all units. The maximum raw and uniform marks are shown in the table below.

Unit	Maximum raw mark	Percentage weighting A-level (AS)	Maximum uniform mark
Pure 1	60	16.7 (33.3)	80
Pure 2	60	16.7 (33.3)	80
Statistics 1	60	16.7 (33.3)	80
Mechanics 1	60	16.7 (33.3)	80
Pure 3	60	16.7	80
Pure 4	60	16.7	80
Statistics 2	60	16.7	80
Mechanics 2	60	16.7	80

Qualification	Maximum raw mark	Percentage weighting A-level (AS)	Maximum uniform mark
International AS	-	50 (100)	240
International A-level	-	100	480

For more detail on UMS, see Section 5.3.

5 General administration

We are committed to delivering assessments of the highest quality and have developed practices and procedures to support this aim. To ensure all students have a fair experience, we have worked with other awarding bodies in England to develop best practice for maintaining the integrity of exams. This is published through the Joint Council for Qualifications (JCQ). We will maintain the same high standard through their use for OxfordAQA Exams.

More information on all aspects of administration is available at **oxfordaqa.com/exams-administration**

For any immediate enquiries please contact info@oxfordaqa.com

Please note: We aim to respond to all email enquiries within two working days.

Our UK office hours are Monday to Friday, 8am – 5pm local time.

5.1 Entries and codes

You should use the following subject award entry codes:

Qualification title	OxfordAQA Exams entry code
OxfordAQA International Advanced Subsidiary Mathematics	9761
OxfordAQA International Advanced Level Mathematics	9762

Please check the current version of the Entry Codes book and the latest information about making entries on **oxfordaqa.com/exams-administration**

You should use the following unit entry codes:

Unit Pure 1	MT1P1
Unit Pure 2	MT2P2
Unit Statistics 1	MT3S1
Unit Mechanics 1	MT4M1
Unit Pure 3	MT5P3
Unit Pure 4	MT6P4
Unit Statistics 2	MT7S2
Unit Mechanics 2	MT8M2

A unit entry will not trigger certification. You will also need to make an entry for the overall subject award in the series that certification is required.

Exams will be available in October/November, January and May/June.

5.2 Overlaps with other qualifications

There is overlapping content in the International AS and A-level specifications. This helps you teach the International AS and A-level together.

5.3 Awarding grades and reporting results

The International AS qualification will be graded on a five-point scale: A, B, C, D and E.

The International A-level qualification will be graded on a six-point scale: A*, A, B, C, D and E.

Students who fail to reach the minimum standard for grade E will be recorded as U (unclassified) and will not receive a qualification certificate.

We will publish the minimum raw mark needed for each grade in each unit when we issue students' results. We will report a student's unit results to schools in terms of uniform marks and unit grades and we will report qualification results in terms of uniform marks and grades.

The relationship between uniform marks and grades is shown in the table below.

	Uniform mark range per unit and per qualification							
Grade	Pure 1	Pure 2	Option S1 or M1	International AS Mathematics	Unit 3	Unit 4	Option S1 or M1 or S2 or M2	International A-level Mathematics
Maximum uniform mark	80	80	80	240	80	80	80	480
A*								*See note below
A	64 - 80	64 - 80	64 - 80	192 - 240	64 - 80	64 - 80	64 - 80	384 - 480
B	56 - 63	56 - 63	56 - 63	168 – 191	56 - 63	56 - 63	56 - 63	336 - 383
C	48 - 55	48 - 55	48 - 55	144 - 167	48 - 55	48 - 55	48 - 55	288 - 335
D	40 - 47	40 - 47	40 - 47	120 - 143	40 - 47	40 - 47	40 - 47	240 - 287
E	32 - 39	32 - 39	32 - 39	96 - 119	32 - 39	32 - 39	32 - 39	192 - 239

* For the award of grade A*, a student must achieve grade A in the full International A-level qualification and a minimum of 144 uniform marks in the aggregate of units Pure 3 and Pure 4.

5.4 Re-sits

Unit results remain available to count towards certification, whether or not they have already been used, provided the specification remains valid. Students can re-sit units as many times as they like, as long as they're within the shelf-life of the specification. The best result from each unit will count towards the final qualification grade. Students who wish to repeat a qualification may do so by re-sitting one or more units.

To be awarded a new subject grade, the appropriate subject award entry, as well as the unit entry/entries, must be submitted.

5.5 Previous learning and prerequisites

There are no previous learning requirements. Any requirements for entry to a course based on this specification are at the discretion of schools.

5.6 Access to assessment: equality and inclusion

Our general qualifications are designed to prepare students for a wide range of occupations and further study whilst assessing a wide range of competences.

The subject criteria have been assessed to ensure they test specific competences. The skills or knowledge required do not disadvantage particular groups of students.

Exam access arrangements are available for students with disabilities and special educational needs.

We comply with the *UK Equality Act 2010* to make reasonable adjustments to remove or lessen any disadvantage that affects a disabled student. Information about access arrangements is issued to schools when they become OxfordAQA centres.

5.7 Working with OxfordAQA for the first time

You will need to apply to become an OxfordAQA centre to offer our specifications to your students. Find out how at oxfordaqa.com/centreapprovals

5.8 Private candidates

Centres may accept private candidates for examined units/components only with the prior agreement of OxfordAQA. If you are an approved OxfordAQA centre and wish to accept private candidates, please contact OxfordAQA at: info@oxfordaqa.com

Private candidates may also enter for examined only units/components via the British Council; please contact your local British Council office for details.

6 Appendix: Mathematical notation

The tables below set out the notation used by the International AS and A-level Mathematics and Further Mathematics specifications. Students will be expected to understand this notation without need for further explanation.

Mathematics students will not be expected to understand notation that relates only to Further Mathematics content. Further Mathematics students will be expected to understand all notations in the tables.

Students studying for AS Mathematics or AS Further Mathematics will be expected to understand notation that relates to AS content; they will not be expected to understand notation that relates only to A-level content.

6.1 Set Notation

Reference	Notation	Guidance
1.1	$\in$	is an element of
1.2	$\notin$	is not an element of
1.3	$\forall$	for all
1.4	$\{x_1, x_2, ...\}$	the set with elements $x_1, x_2, ...$
1.5	$\{x : ...\}$	the set of all x such that ...
1.6	$\mathbb{N}$	the set of natural numbers {1, 2, 3, ...}
1.7	$\mathbb{Z}$	the set of integers {..., -2, -1, 0, 1, 2, ...}
1.8	$\mathbb{R}$	the set of real numbers
1.9	$\mathbb{Q}$	the set of rational numbers
1.10	$\mathbb{C}$	the set of complex numbers (Further Mathematics only)
1.11	$\cup$	union
1.12	$\cap$	intersection
1.13	(x, y)	the ordered pair x, y
1.14	$[a, b]$	the closed interval $\{x \in \mathbb{R} : a \leq x \leq b\}$
1.15	$[a, b)$	the interval $\{x \in \mathbb{R} : a \leq x < b\}$
1.16	$(a, b]$	the interval $\{x \in \mathbb{R} : a < x \leq b\}$
1.17	(a, b)	the open interval $\{x \in \mathbb{R} : a < x < b\}$

6.2 Relational and logical notation

Reference	Notation	Guidance
2.1	$=$	is equal to
2.2	$\neq$	is not equal to
2.3	$\equiv$	is identical to
2.4	$\approx$	is approximately equal to
2.5	$\propto$	is proportional to
2.6	$<$	is less than
2.7	$\leq$	is less than or equal to
2.8	$>$	is greater than
2.9	$\geq$	is greater than or equal to
2.10	$\Rightarrow$	implies
2.11	$\Leftarrow$	is implied by
2.12	$\Leftrightarrow$	implies and is implied by

6.3 Miscellaneous notation

Reference	Notation	Guidance
3.1	∞	infinity
3.2	$\therefore$	therefore
3.3	$\because$	because
3.4	S_n	sum of the first n terms of a sequence
3.5	S_∞	sum to infinity of a series

6.4 Operations

Reference	Notation	Guidance
4.1	$a + b$	a plus b
4.2	$a - b$	a minus b
4.3	$a \times b$, ab	a multiplied by b
4.4	$a \div b$, $\frac{a}{b}$	a divided by b
4.5	a^b	a to the power of b
4.6	$\sum_{i=1}^{n} u_i$	$u_1 + u_2 + \ldots + u_n$

4.7	$\prod_{i=1}^{n} u_i$	$u_1 \times u_2 \times \ldots \times u_n$
4.8	$\sqrt{a}$	the principal square root of a
4.9	$\sqrt[n]{a}$	the principal nth root of a
4.10	$\lvert a \rvert$	the modulus of a
4.11	$n!$	the factorial of n
4.12	$\binom{n}{r}$, ${}^{n}\mathrm{C}_{r}$	the binomial coefficient

6.5 Functions, limits and calculus

Reference	Notation	Guidance
5.1	$\mathrm{f}(x)$	the function f evaluated at x
5.2	f^{-1}	the inverse of the function f
5.3	gf	the composite function of f and g, $\mathrm{gf}(x) = \mathrm{g}(\mathrm{f}(x))$
5.4	$\lim_{x \to a} \mathrm{f}(x)$	the limit of $\mathrm{f}(x)$ as x tends to a
5.5	Δx, δx	an increment of x
5.6	$\frac{\mathrm{d}y}{\mathrm{d}x}$	the first derivative of y with respect to x
5.7	$\left.\frac{\mathrm{d}y}{\mathrm{d}x}\right\rvert_{x=a}$	the first derivative of y with respect to x evaluated at $x = a$
5.8	$\frac{\mathrm{d}^2 y}{\mathrm{d}x^2}$	the second derivative of y with respect to x
5.9	$\frac{\mathrm{d}^n y}{\mathrm{d}x^n}$	the nth derivative of y with respect to x
5.10	$\left.\frac{\mathrm{d}^n y}{\mathrm{d}x^n}\right\rvert_{x=a}$	the nth derivative of y with respect to x evaluated at $x = a$
5.11	$\mathrm{f}'(x)$	the first derivative of $\mathrm{f}(x)$ with respect to x
5.12	$\mathrm{f}''(x)$	the second derivative of $\mathrm{f}(x)$ with respect to x
5.13	$\mathrm{f}^{(n)}(x)$	the nth derivative of $\mathrm{f}(x)$ with respect to x
5.14	$\dot{x}$	the first derivative of x with respect to t
5.15	$\ddot{x}$	the second derivative of x with respect to t

5.16	$\int y\,\mathrm{d}x$	the indefinite integral of y with respect to x
5.17	$\int_a^b y\,\mathrm{d}x$	the definite integral of y with respect to x between the limits of $x = a$ and $x = b$

6.6 Exponentials and logarithms

Reference	Notation	Guidance
6.1	e	the base of natural logarithms
6.2	$\mathrm{e}^x, \exp(x)$	the exponential function of x
6.3	$\ln x$	the natural logarithm of x
6.4	$\log_a x$	the logarithm to the base a of x

6.7 Trigonometric functions

Reference	Notation	Guidance
7.1	sin, cos, tan	the functions: sine, cosine and tangent
7.2	$\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$	the inverse functions: inverse sine, inverse cosine and inverse tangent
7.3	cosec, sec, cot	the reciprocal functions: cosecant, secant and cotangent
7.4	cosec^{-1}, $\sec^{-1}$, $\cot^{-1}$	the inverse reciprocal functions: inverse cosecant, inverse secant and inverse cotangent (Further Mathematics only)
7.5	°	degrees
7.6	rad	radians

6.8 Hyperbolic functions (Further Mathematics only)

Reference	Notation	Guidance
8.1	sinh, cosh, tanh	the functions: hyperbolic sine, hyperbolic cosine and hyperbolic tangent
8.2	$\sinh^{-1}$, $\cosh^{-1}$, $\tanh^{-1}$	the inverse functions: inverse hyperbolic sine, inverse hyperbolic cosine and inverse hyperbolic tangent
8.3	cosech, sech, coth	the reciprocal functions: hyperbolic cosecant, hyperbolic secant and hyperbolic cotangent
8.4	cosech^{-1}, sech^{-1}, $\coth^{-1}$	the inverse reciprocal functions: inverse hyperbolic cosecant, inverse hyperbolic secant and inverse hyperbolic cotangent

6.9 Complex numbers (Further Mathematics only)

Reference	Notation	Guidance
9.1	i	the imaginary unit, $\sqrt{-1}$
9.2	z	a complex number
9.3	z^*	the complex conjugate of z
9.4	$x + \mathrm{i}y$	a complex number (in Cartesian form) with real part x and imaginary part y
9.5	$r(\cos\theta + \mathrm{i}\sin\theta)$	a complex number (in modulus-argument form) with modulus r and argument θ
9.6	$re^{\mathrm{i}\theta}$	a complex number (in exponential form) with modulus r and argument θ
9.7	$\lvert z\rvert$	the modulus of z
9.8	$\arg(z)$	the principal argument of z, $\arg(z) = \theta$ where $-\pi < \theta \leq \pi$
9.9	$\mathrm{Re}(z)$	the real part of z
9.10	$\mathrm{Im}(z)$	the imaginary part of z

6.10 Matrices (Further Mathematics only)

Reference	Notation	Guidance
10.1	$\mathbf{0}$	the zero matrix
10.2	$\mathbf{I}$	the identity matrix
10.3	$\mathbf{M}$	a matrix $\mathbf{M}$
10.4	$\mathbf{M}^{-1}$	the inverse of the matrix $\mathbf{M}$
10.5	$\mathbf{M}^{\mathrm{T}}$	the transpose of the matrix $\mathbf{M}$
10.6	$\det(\mathbf{M})$	the determinant of the matrix $\mathbf{M}$

6.11 Vectors (Further Mathematics only)

Reference	Notation	Guidance
11.1	$\mathbf{a}$	a vector $\mathbf{a}$
11.2	$\overrightarrow{AB}$	a vector representing the line segment AB
11.3	$\mathbf{i}, \mathbf{j}, \mathbf{k}$	the perpendicular unit vectors in the directions of the Cartesian coordinate axes
11.4	$\lvert\mathbf{a}\rvert$	the magnitude of vector $\mathbf{a}$
11.5	$\begin{bmatrix} a \\ b \end{bmatrix}$	a 2-dimensional column vector
11.6	$\begin{bmatrix} a \\ b \\ c \end{bmatrix}$	a 3-dimensional column vector
11.7	$\mathbf{a} \cdot \mathbf{b}$	the scalar product of $\mathbf{a}$ and $\mathbf{b}$
11.8	$\mathbf{a} \times \mathbf{b}$	the vector product of $\mathbf{a}$ and $\mathbf{b}$ (Further Mathematics only)

6.12 Probability and statistics

Reference	Notation	Guidance
12.1	A etc	the event A
12.2	$A \cup B$	the union of event A and event B
12.3	$A \cap B$	the intersection of event A and event B
12.4	$\mathrm{P}(A)$	the probability of event A occurring
12.5	A'	the complement of event A
12.6	$\mathrm{P}(A \mid B)$	the probability of event A occurring given event B has occurred
12.7	X, Y etc	random variables
12.8	x, y etc	values of the random variables X, Y etc
12.9	$x_1, x_2, \ldots$	values of observations
12.10	$\mathrm{P}(X = x)$	the probability function of the discrete random variable X

12.11	E (X)	the expectation of the random variable X
12.12	Var (X)	the variance of the random variable X
12.13	$\mathrm{Cov}(X, Y)$	the covariance of X and Y (Further Mathematics only)
12.14	~	has the distribution
12.15	B(n,p)	binomial distribution with parameters n and p, where n is the number of trials and p is the probability of a success in a trial
12.16	$\mathrm{N}(\mu, \sigma^2)$	normal distribution with mean μ and variance σ^2
12.17	$Z \sim \mathrm{N}(0, 1)$	the standard normal distribution
12.18	$\mathrm{Po}(\lambda)$	Poisson distribution with parameter λ, where λ is the mean and variance
12.19	$\mathrm{Exp}(\lambda)$	exponential distribution with parameter λ, where $\frac{1}{\lambda}$ is the mean and standard deviation
12.20	$\mathrm{U}(a, b)$	continuous uniform distribution between a and b
12.21	$\mathrm{DU}(a,b)$	discrete uniform distribution on the integers a to b (Further Mathematics only)
12.22	$\mathrm{Geo}(p)$	geometric distribution with parameter p, the probability of success on a single trial. (Further Mathematics only)
12.23	$\mathrm{NB}(r, p)$	negative binomial distribution where r is the required number of successes and p is the probability of a success on a single trial. (Further Mathematics only)
12.24	μ	population mean
12.25	σ^2	population variance
12.26	σ	population standard deviation
12.27	$\bar{x}$	sample mean, unbiased estimate for the population mean
12.28	s^2	sample variance, unbiased estimate for the population variance
12.29	s, S	sample standard deviation
12.30	H_0	null hypothesis
12.31	H_1	alternative hypothesis
12.32	r	product moment correlation coefficient for a sample (Further Mathematics only)

12.33	ρ	product moment correlation coefficient for a population (Further Mathematics only)
12.34	r_s	Spearman's rank correlation coefficient for a sample (Further Mathematics only)
12.35	ρ_s	Spearman's rank correlation coefficient for a population (Further Mathematics only)

6.13 Mechanics

Reference	Notation	Guidance
13.1	t	time
13.2	$\mathbf{r}$	position
13.3	s, $\mathbf{s}$	displacement
13.4	u, $\mathbf{u}$	initial velocity
13.5	v, $\mathbf{v}$	velocity or final velocity
13.6	a, $\mathbf{a}$	acceleration
13.7	g	acceleration due to gravity
13.8	μ	coefficient of friction
13.9	e	coefficient of restitution (Further Mathematics only)

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