Bhutan Council for School Examinations and Assessment

Pure Mathematics

Assessment Syllabus

Key Stage 5 (Classes XI and XII)

2026 -2030

Contact Us
Bhutan Council for School Examinations and Assessment
Kawajangsa, Thimphu
Post Box No. 156
Email: bcsea@bcsea.bt

Table of Contents

1. Why choose this syllabus?

In Bhutan, education is designed to foster seven essential competencies, balancing the preservation of cultural identity with readiness for global engagement. Mathematics plays a vital role in supporting the development of these competencies. Studying mathematics contributes significantly to achieving these competencies in the following ways.

- **Spirituality & Values:** Mathematics connects logic with ethics and mindfulness, helping students appreciate beauty, patterns, and universal truths. Examples such as the Knot of Infinity, auspicious dates, and the Golden Ratio show how mathematical ideas link to spirituality, responsibility, and ethical reasoning.
- **Language:** Mathematics is a universal language with its own grammar, vocabulary, and syntax. It bridges disciplines and cultures, from symmetry in Bhutanese art to calculus in hydropower, empowering students to innovate and communicate complex ideas.
- **Transversal Competencies:** Math fosters analytical, critical, and problem-solving skills used across sciences, business, arts, and global challenges, preparing students for lifelong learning and contribution to society.
- **Enterprising & Industrious:** By applying math to real-world contexts—like engineering, sustainable energy, and infrastructure—students build discipline, creativity, and entrepreneurial thinking while supporting Bhutan's development goals.
- **Sustainable Living:** Concepts like estimation, measurement, and statistics enable informed decisions about resource use and environmental stewardship.
- **Health & Wellbeing:** Structured reasoning, perseverance, and the beauty of patterns promote resilience, mindfulness, confidence, and emotional balance, enriching both academic and personal growth.
- **Digital Competence:** Integrating technology in math enhances reasoning, visualization, and communication. Tools such as coding, statistical software, and graphing utilities deepen understanding and prepare students for academic, professional, and everyday applications.

Key benefits

Bhutan Assessment prepares students for life, helping them develop an informed curiosity and a lasting passion for learning. Our Education gives students a clear path for educational success from age 6 to 19.

Mathematics helps learners to develop the following qualities:

- **Confidence:** using and sharing information and ideas, and applying mathematical techniques to solve problems. These skills enhance self-assurance and support learning in mathematics as well as in other subjects.
- **Responsibility:** acquiring and applying skills that prepare them for further academic studies and enable them to become numerate, informed members of society.
- **Reflection:** making connections across different areas of mathematics and thoughtfully considering the outcomes of mathematical problems and models.
- **Innovation:** approaching both familiar and unfamiliar problems in creative ways, choosing from a variety of mathematical and problem-solving strategies.
- **Engagement:** appreciating the beauty, patterns, and structure of mathematics, and recognizing its wide range of real-life applications.

Key Concept

Mathematics is grounded in four main strands: Numbers and Operations, Patterns and Algebra, Measurement and Geometry, and Data Management and Probability. These elements build essential skills such as number sense, calculation, generalization, modelling, spatial reasoning, and data interpretation. By linking abstract principles to practical applications—like design, engineering, and decision-making—they provide a coherent foundation that supports progression from basic learning to advanced topics such as matrices, calculus, and mathematical thinking.

Skills

Mathematics instruction aims to develop knowledge and equip learners with transferable skills for lifelong success. Through active, reflective, and collaborative learning, students grow in confidence and learn to apply mathematical understanding in diverse contexts.

Key Mathematical Skills

- **Abstract conceptualization:** Understand and work with symbolic and abstract ideas.
- **Fluency and accuracy:** Execute calculations and procedures with speed and precision.
- **Generalization:** Detect patterns and establish overarching rules.
- **Mathematical reasoning:** Form sound arguments, draw conclusions, and justify solutions.
- **Modelling:** Represent real-world situations mathematically and interpret results in context.
- **Problem solving:** Tackle new and complex challenges by selecting appropriate strategies.
- **Spatial understanding:** Visualize and analyse geometric forms, graphs, and transformations.
- **Statistical literacy:** Gather, interpret, and evaluate data effectively.
- **Technical communication:** Present ideas clearly through symbols, diagrams, graphs, and precise language.
- **Use of tools and technology:** Apply measurement instruments and digital tools accurately to support mathematical work.

Recognition and Support

National and International Recognition

BCSEA qualifications are designed to meet high academic standards and prepare learners for success both within Bhutan and globally. Our Mathematics curriculum equips students with skills and knowledge that are valued by universities and employers worldwide.

Students who complete mathematics syllabus can confidently pursue higher education locally or internationally, as our programmes align with global expectations for analytical thinking, problem-solving, and ethical decision-making. Graduates are well-prepared to continue studies in mathematics, or related fields, and are equally equipped for careers that demand practical and transferable skills.

Supporting Teachers

Effective education depends on the alignment of curriculum, teaching, learning, and assessment**.** BCSEA provides teachers with the guidance, resources, and professional development opportunities needed to deliver the mathematics curriculum effectively.

Teachers have access to:

- **Planning and preparation resources**: assessment framework, schemes of assessment, specimen papers, and teacher guides.
- **Learning and revision tools**: mark schemes, past papers, and exemplars to support students' understanding and performance.
- **Results analysis and reporting**: insights from assessments to inform teaching strategies and improve student outcomes.

Professional Development in Assessment

As an awarding body, BCSEA offers targeted professional development focused on assessment**.** This ensures teachers and examiners:

- Understand assessment objectives and criteria**.**
- Can accurately interpret and apply mark schemes**.**
- Are skilled in providing feedback that supports learner improvement**.**
- Stay up-to-date with changes in assessment standards and processes**.**

Through this approach, BCSEA ensures high-quality assessment, fairness, and reliability**,** supporting both learners and educators in achieving excellence.

2. Syllabus Overview

Aims

The aims describe the purposes of a course based on this syllabus.

The aims are to enable students to:

- build mathematical knowledge and skills in ways that foster confidence, satisfaction, and enjoyment.
- understand mathematical principles and appreciate mathematics as a logical, coherent discipline.
- develop a broad range of mathematical skills, particularly those that support real-life applications and connections with other subjects.
- strengthen their ability to analyse problems logically and systematically.
- recognise when and how situations can be represented mathematically, identify and interpret key elements, and choose appropriate methods for solving problems.
- use mathematics as a clear and effective means of communication, with emphasis on precise expression.
- gain the mathematical foundation needed for further studies in mathematics or related fields.

Content Overview

Assessment Component	Strand	Class XI	Class XII
Pure Mathematics 1	Measurement and geometry	1: Circular Measures	4: Trigonometry
		2: Trigonometry	5: Vectors
		3: Coordinate Geometry	
	Data Management and Probability	1: Representation of Data	3: Correlation and Regression
		2: Probability	4: Permutations and Combinations
			5: Probability
Pure Mathematics 2	Number and Operation	1: Logarithmic and Exponential functions	2: Matrices
			3: Complex Numbers
	Patterns and Algebra	1: Series	6: Algebra
		2: Quadratics	7: Differentiation
		3: Functions	8: Integration
		4: Differentiation	
		5: Integration	

Assessment Overview

Key Stage 5 Pure Mathematics Components:

Paper 1
Pure Mathematics 1 1 hour 45 minutes
70 marks
Pure Mathematics 1 subject content of Classes XI and XII
Approximately 25% from Class XI
10 MCQ and 8 to 10 structured questions
Written examination
Externally assessed
40% of the total marks

Paper 2
Pure Mathematics 2 1 hour 45 minutes
70 marks
Pure Mathematics 2 subject content of Classes XI and XII
Approximately 25% from Class XI
10 MCQ and 8 to 10 structured questions
Written Examination
Externally assessed
40% of the total marks

Coursework
School Based Assignment 1 year
40 marks
Assignment topics: Pure Mathematics subject content of Classes XI and XII
Internally assessed
Externally verified
20% to the total marks

Assessment Objectives

The assessment objectives (AOs) are:

AO1: Knowledge and Understanding

- Show understanding of relevant mathematical concepts, terminology and notation
- Recall accurately and use appropriate mathematical manipulative techniques

AO2: Application and communication

- Recognize the appropriate mathematical procedure for a given situation
- Apply appropriate combinations of mathematical skills and techniques in solving problems
- Present relevant mathematical work, and communicate corresponding conclusions, in a clear and logical way

Weighting for assessment objectives

The weightings allocated to each of the assessment objectives (AOs) are summarised below.

Assessment objective	Weighting in Key Stage 5 %
AO1 Knowledge and understanding	50
AO2 Application and communication	50
Total	**100**

Assessment objectives as a percentage of each component

Assessment objective	Weighting in components %		
	Paper 1	**Paper 2**	**Coursework**
AO1 Knowledge and understanding	50	50	50
AO2 Application and communication	50	50	50
Total	**100**	**100**	**100**

3. Subject content

This syllabus offers flexibility to design a course that is engaging, challenging, and relevant to your learners.

Where appropriate, teachers are responsible for selecting subject contexts, resources, and examples that support learners' understanding. These choices should be suitable for the learners' age, cultural background, and learning environment, and must align with school policies and local legal requirements.

The mathematical content for each component is detailed below.

Prior Knowledge

To successfully take up Key Stage 5 Mathematics, learners are expected to have completed Key Stage 4 Mathematics or an equivalent standard of study. This ensures they possess the foundational knowledge and skills necessary to engage with the more advanced concepts introduced at KS5.

Specifically, students should have a solid understanding of the following areas from KS4:

- **Strand A:** Students must be familiar with real numbers, rates, exponent laws, set theory, radicals, and matrices.
- **Strand B:** Students should understand polynomial expressions, linear equations and inequalities, sequences, linear functions and relations, solving systems of linear equations, solving nonlinear equations, and basic differentiation.
- **Strand C:** Students are expected to have studied circles, trigonometry, vectors in two dimensions, and the concepts of length and midpoint.
- **Strand D:** Students should have prior experience with collecting, displaying, and analysing data, as well as understanding basic probability.

Class XI Subject content

Pure Mathematics 1

Candidates should be able to:

C	Measurement and Geometry
C1	Circular Measure
C1.1	Understand the concept of a radian and apply relationship between radians and degrees
C1.2	Apply the formulae $s = r\theta$ and $A = \frac{1}{2}r^2\theta$ to solve problems related to arc length and sector area of a circle.
C2	Trigonometry
C2.1	Use the exact values of the sine, cosine, tangent and their reciprocals —secant, cosecant and cotangent — of standard $(0, 30°, 45°, 60° \; and \; 90°)$ and allied angles
C2.2	Graphically represent the six trigonometric functions and their transformations and identify the period and amplitude.
C2.3	Use the following identities to solve equations and simply expressions: ● $\frac{sin\theta}{cos\theta} \equiv tan\theta$ and $\frac{cos\theta}{sin\theta} \equiv cot\theta$ ● $sin^2\theta + cos^2\theta \equiv 1$ ● $sec^2\theta \equiv 1 + tan^2\theta$ and $cosec^2\theta \equiv 1 + cot^2\theta$

C2.4	Use the notations of inverse trigonometric relations $sin^{-1}x, cos^{-1}x, \ tan^{-1}x$ and use these relations to solve simple trigonometric equations lying in specified intervals.
C3	Coordinate Geometry, Straight Lines, Equation of a Circle
C3.1	Interpret and apply different forms of straight-line equations: ● slope-intercept form $(y = mx + c)$, ● point-slope form $(y - y_1) = m(x - x_1)$, and ● general form $ax + by + c = 0$.
C3.2	Find the equation of a straight line given sufficient information such as points, intercepts, slopes, parallelism, perpendicularity or midpoints.
C3.3	Interpret and convert between the equation of circle in different forms: Completed square form $(x-a)^2 + (y-b)^2 = r^2$ and general form $x^2 + y^2 + 2gx + 2fy + c = 0$
C3.4	Use algebraic methods to solve problems involving lines and circles including use of elementary geometrical properties of circles.
C3.5	Determine and interpret the intersection points between a line and a circle by solving their algebraic equations.
D	**Data Management and Probability**
D1	Representation of data, Central Tendencies, Dispersion (Variation) Cumulative Frequency Graphs
D1.1	Present raw statistical data using box-and-whisker plot, stem and leaf plot, histogram, cumulative frequency graphs and explain the advantages and disadvantages of each representation
D1.2	Determine central tendencies (mean, median and mode) of data for the following data types: ● Simple distribution ● Grouped discrete and grouped continuous frequency distributions
D1.3	Determine the measures of variation of both grouped and ungrouped data using various methods including ● Range ● Interquartile range ● Standard Deviation
D2	Probability
D2.1	Define basic probability terms (like random experiment, sample space, and events) and classify different types of events (such as mutually exclusive, complementary, or impossible events).
D2.2	Solve simple probability problems by drawing sample space diagrams, outcome charts or sets.
D2.3	Differentiate between dependent and independent events, and calculate probabilities using the addition (OR) rule and multiplication (AND) rule.

Pure Mathematics 2

Candidates should be able to:

A	Numbers and Operations
A1	Logarithmic and Exponential functions
A1.1	Establish connections between logarithms and indices and apply theorems and laws of logarithms to solve problems.
A1.2	Understand and interpret the inverse relationship between e^x and lnx, including their properties and graphical representations
A1.3	Solve exponential equations and inequalities by applying logarithmic methods. e.g. $3^{2x} = 2$; $3 \times 2^{3x-1} < 5$.
A1.4	Use logarithms to convert nonlinear relationships into linear form and determine unknown constants by interpreting the gradient (slope) and intercept of the resulting straight-line graph. e.g. $y = 2(3^x) \Rightarrow lny = ln2 + xln3$, which is linear in x and lny.
B	**Patterns and Algebra**
B1	Binomial Theorem, Sequences & Series
B1.1	Apply the binomial expansion for $(a+b)^n$, where n is a positive integer, and identify the term independent of x, the coefficient of a specific term, and the middle term in the expansion
B1.2	Recognize and differentiate between arithmetic and geometric series; determine the general (n^{th}) term and calculate the sum of the first n terms of each series
B1.3	Determine the sum to infinity of a geometric progression and understand the condition required for its convergence
B1.4	Use the concepts of arithmetic mean and geometric mean to determine unknown terms in arithmetic and geometric progressions
B2	Quadratics
B2.1	Solve quadratic equations and inequalities in one unknown through factorization, quadratic formula and completing squares
B2.2	Recognize and solve equations of x which are quadratic in some function of x e.g. i) $x^4 - 2x^2 + 1 = 0$, ii) $2x + 3\sqrt{x} - 5 = 0$
B2.3	Describe the nature of roots of a quadratic polynomial using the discriminant value
B2.4	Solve a pair of simultaneous equations, consisting of one linear and one quadratic equation, by the method of substitution
B3	Functions
B3.1	Understand the terms function, domain, range, one-one function, inverse function and composition of functions.
B3.2	Identify the domain and range of a simple algebraic function
B3.3	Find the composition of two given functions

B3.4	Establish whether simple algebraic functions are invertible — apply domain restrictions if needed — and compute its inverse.
B3.5	Illustrate in graphical terms the relation between a one-one function and its inverse
B3.6	Identify and apply transformations to the graph of y=f(x), of the form $y = f(x) + a$, $y = f(x + a)$, $y = af(x)$, and $y = f(ax)$
B4	Differentiation
B4.1	Use first principles (the definition of the derivative) to differentiate simple algebraic functions: $\frac{dy}{dx} = \frac{f(x+\delta x)-f(x)}{\delta x}$ as δx tends to 0.
B4.2	Use the notations f ′(x), f ″(x), $\frac{dy}{dx}, \frac{dy^2}{dx^2}$, and differentiate the algebraic functions of the form $y = x^n$ (for any rational exponent n), constant multiples, sums, and differences, and use the chain rule for composite functions.
B4.3	Apply the product rule and quotient rule to differentiate functions composed of products or quotients of simpler functions
B4.4	Apply differentiation to determine gradients of curves, equations of tangents and normals, the intervals where functions increase or decrease, and rates of change.
B5	Integration
B5.1	Apply the concept of integration as reverse differentiation to evaluate integrals involving $(ax + b)^n$, (n ≠ -1), including cases with constant multiples, sums, or differences of functions.
B5.2	Solve problems requiring evaluation of integration constants and finding the equation of functions from their derivatives.
B5.3	Evaluate definite integrals.

Class XII Subject content

Pure Mathematics 1

Candidates should be able to:

C	**Measurement and Geometry**
C4	Trigonometry
C4.1	Simplify expression, solve equations and find the exact evaluation of expressions with the use of ● The expansions of $sin(A \pm B), cos(A \pm B)$ and $tan(A \pm B)$ ● The formulae for $sin2A$, $cos2A$ and $tan2A$ ● The expression of $asin\theta + bcos\theta$ in the forms $Rsin(\theta \pm \alpha)$ and $Rcos(\theta \pm \alpha)$ e.g. 1. Simplify: $\cos\left(x - \frac{\pi}{6}\right) - 3\sin\left(x - \frac{\pi}{6}\right)$ 2. Solve: $3cos\theta + 2sin\theta = 1$.

C5	Vectors
C5.1	Use standard vector notations i.e. $\begin{pmatrix} x \\ y \end{pmatrix}, x\mathbf{i} + y\mathbf{j}, \begin{pmatrix} x \\ y \\ z \end{pmatrix}, x\mathbf{i} + y\mathbf{j} + z\mathbf{k}, \overrightarrow{AB}$.
C5.2	Perform addition, subtraction, and scalar multiplication of vectors algebraically and geometrically.
C5.3	Calculate the magnitude (length) of a vector in 2D and 3D and find unit vectors in the direction of a given vector.
C5.4	Understand and interpret the parametric equation of a line in the form $r = a + tb$, where t is a scalar parameter
C5.5	Determine whether two lines are parallel, intersect or are skew, and find the point of intersection of two lines when it exists
C5.6	Calculate the scalar product of two vectors, and use the concept in problems involving lines and points
D	**Data Management and Probability**
D3	Correlation and Regression
D3.1	Understand the concept of correlation coefficients, and calculate the correlation between two variables using Karl Pearson's product-moment method and Spearman's rank correlation method
D3.2	Interpret the value of the correlation coefficient based on the specific context of the data.
D3.3	Determine the equation of regression lines.
D3.4	Predict the value of an unknown variable using the concept of regression
D4	Permutation and Combination
D4.1	Understand the fundamental difference between permutations and combinations, and use them to solve simple problems on counting
D4.2	Solve counting problems involving non-circular arrangements and selections of distinct objects, including repetition and restrictions.
D5	Probability
D5.1	Solve probability problems using a combination of the addition and multiplication rules.
D5.2	Evaluate probabilities by using permutations or combinations involving the selection/arrangements of two or more things.
D5.3	Solve problems involving conditional probability in simple cases

Pure Mathematics 2

Candidates should be able to:

A	Numbers and Operations
A2	Matrices
A2.1	Compute the transpose, determinants, adjoint and inverse of a matrix.
A2.2	Apply inverse of a matrix in solving systems of two or three linear equations
A2.3	Use the matrix method to check the consistency of a system of two or three linear equations to identify when the system has unique solution, no solution or infinite number of solutions; find the solutions when consistent.
A3	Complex Numbers
A3.1	Identify the real and imaginary parts of a complex number, and check the equality of two complex numbers
A3.2	Perform addition, subtraction, multiplication of two complex numbers expressed in the form $x + yi$
A3.3	Perform addition, subtraction, and multiplication of a complex number and its conjugate, and describe the geometrical effect of each operation in the complex plane
A3.4	Solve for complex solutions of a polynomial equation and understand that any non-real roots occur in conjugate pairs.
A3.5	Plot complex numbers in the complex plane using the Argand diagram
A3.6	Perform multiplication and division of complex numbers expressed in both polar and exponential forms
A3.7	Calculate the two square roots of complex numbers.
A3.8	Plot the loci corresponding to given complex equations and inequalities in the complex plane (Argand plane)
B	**Patterns and Algebra**
B6	Algebra, Polynomial division, Remainder and factor theorem, and Partial Fractions
B6.1	Comprehend the concept of absolute value functions, graphically represent linear absolute value equations of the form $y = \|ax + b\|$, and solve related equations and inequalities analytically.
B6.2	Perform division operations on polynomials (degree ≤4) by linear or quadratic divisors, and determine both the quotient polynomial and remainder term (including cases with zero remainder)
B6.3	Use remainder theorem and factor theorem to solve related problems.
B6.4	Use factor theorem to factorize polynomials of degree not exceeding degree 3

B6.5	Decompose proper rational functions into partial fractions corresponding to the following cases of denominator factorization: • $(ax + b)(cx + d)(ex + f)$ • $(ax + b)(cx + d)^2$ • $(ax + b)(cx^2 + d)$
B7	Differentiation
B7.1	Find the derivatives of $e^x, a^x, lnx, sin\,x, \cos x, tanx, \tan^{-1} x$, along with constant multiples, sums, differences, products, quotients and composites of these functions.
B7.2	Find the first derivative of functions defined implicitly or parametrically
B7.3	Find and classify stationary points (maxima, minima, or inflection points) and apply this analysis to sketch graphs.
B8	Integration
B8.1	Find integrals of functions of the following types: • e^{ax+b} • $\frac{1}{ax+b}$ • $sin(ax + b)$ • $cos(ax + b$ • $sec^2(ax + b)$ • $\frac{1}{x^2+a^2}$
B8.2	Apply trigonometric relationships to simplify and evaluate integrals of trigonometric functions. e.g. $\int \cos^2(2x)\,dx, \quad \int \sin^2(x)\,dx$
B8.3	Evaluate integrals of proper rational functions through partial fraction decomposition to the following cases of denominator factorizations: • $(ax + b)(cx + d)(ex + f)$ • $(ax + b)(cx + d)^2$ • $(ax + b)(cx^2 + d)$
B8.4	Apply substitution techniques to evaluate integrals including those of the form $\frac{kf'(x)}{f(x)}$.
B8.5	Evaluate integrals of products of functions using the integration by parts.
B8.6	Use definite integration to compute: • the area of a region bounded by a curve or lines with the axes, or between a curve and a line or between two curves. • the volume of revolution about one of the axes.

Grade descriptors

Grade descriptors are intended to illustrate the standards of achievement expected of candidates awarded particular grades. They provide a general indication of the performance required at Grades A, C and E. The descriptors are not mark schemes and should be interpreted in relation to the content of this syllabus, the assessment objectives, and the contexts in which tasks are set. They are designed to help teachers and examiners understand the level of performance typical of each grade, and to support benchmarking of candidate work.

Grade	AO1	AO2
A	Candidates demonstrate thorough knowledge and secure understanding of mathematical concepts, terminology, and notation. They recall and apply techniques accurately and fluently.	Candidates consistently identify suitable procedures, apply appropriate combinations of skills to solve both routine and complex problems, and present their work clearly and logically, with well-justified conclusions.
C	Candidates show a sound knowledge and understanding of mathematical concepts, terminology, and notation. They generally recall and apply techniques correctly, though occasional errors may occur.	Candidates can usually identify appropriate procedures in straightforward situations, apply skills to standard problems with some success, and present work that is mostly clear, with conclusions that are reasonably communicated.
E	Candidates demonstrate a basic knowledge and partial understanding of mathematical concepts, terminology, and notation. They recall some techniques but often with inaccuracies.	Candidates may recognise appropriate procedures in simple situations but struggle with unfamiliar problems or combining skills effectively. Their work is inconsistently presented, and conclusions are sometimes incomplete or unclear.

4. Details of the assessment

Paper 1 Pure Mathematics 1

Written paper, 1 hour 45 minutes, 70 marks.
All questions in the examination papers are compulsory.

Section A in this paper has 10 multiple-choice items of the four-choice type worth 10 marks each testing part of assessment objective AO1(knowledge and understanding) and part of assessment objective AO2 (applying) questions.
Section B in this paper has 8 to 10 structured questions worth 4 to 10 marks of various length and often contain several parts, labelled (a), (b), (c), which may have sub-parts (i), (ii), (iii), each testing assessment objectives AO1 and AO2 questions.

Assessment Objectives	Level	Marks Allocation %
AO1 Knowledge and Understanding	Knowledge	15% to 25%
	Understanding	25% to 35%
AO2 Application and communication	Applying	20% to 30%
	Analysing	10% to 20%
	Evaluating	5% to 15%

Questions are based on the Pure Mathematics 1 syllabus content of Classes XI and XII.
Approximately 25% of the marks are based on Class XI content.
Candidates must use the formulae given in the appendix. These are the only formulae accepted in candidate responses.

Paper 2 Pure Mathematics 2

Written paper, 1hour 45 minutes, 70 marks.
All questions in the examination papers are compulsory.

Section A in this paper has 10 multiple-choice items of the four-choice type worth 10 marks each testing part of assessment objective AO1(knowledge and understanding) and part of assessment objective AO2 (applying) questions.

Section B in this paper has 8 to 10 structured questions worth 4 to 10 marks of various length and often contain several parts, labelled (a), (b), (c), which may have sub-parts (i), (ii), (iii), each testing assessment objectives AO1 and AO2 questions.

Assessmnet Objectives	Level	Marks Allocation %
AO1 Knowledge and Understanding	Knowledge	15% to 25%
	Understanding	25% to 35%
AO2 Application and communication	Applying	20% to 30%
	Analysing	10% to 20%
	Evaluating	5% to 15%

Questions are based on the Pure Mathematics 2 syllabus content of Classes XI and XII.
Approximately 25% of the marks are based on Class XI content.
Candidates must use the formulae given in the appendix. These are the only formulae accepted in candidate responses.

Coursework

School based assignment, 1 year, 40 marks.
Internally assessed and externally verified.

Coursework component 3 tests assessment objectives AO1 and AO2. Candidates submit one coursework assignment over two years period based on content of class XI or XII.

BCSEA coursework is designed to allow assessment of candidates' ability to use and apply mathematics in practical, real-life tasks and within mathematics itself. The coursework component has been developed to translate the requirements of the curriculum into good classroom practice for candidates across the whole ability range and to provide opportunities for candidates to use information technology where appropriate.

Further details about types of coursework task, mark schemes and guidance around administration will be provided before the first year of assessment

Examination information

Structure of the question paper
All questions in the examination papers are compulsory. An approximate number of questions for each paper is given in the Assessment overview of this syllabus. Questions are of varied lengths and often contain several parts, labelled (a), (b), (c), which may have sub-parts (i), (ii), (iii), as needed. Some questions might require candidates to sketch graphs or diagrams, or draw accurate graphs.

Answer space
Candidates answer on the question paper. All working should be shown neatly and clearly in the spaces provided for each question. If additional space is required, candidates should use the blank page at the end of the question paper, where the question number or numbers must be clearly shown.

Additional materials for examinations
Candidates are expected to have the following equipment in examinations:
- a scientific calculator (see the following section)
- a list of formulae is supplied in examinations for the use of candidates. A copy of the list of formulae is given for reference in his syllabus.

Calculators
It is expected that candidates will have a calculator with standard 'scientific' functions available for use in all the examinations. Computers, graphical calculators and calculators capable of symbolic algebraic manipulation or symbolic differentiation or integration are not permitted. The General Regulations concerning the use of calculators are contained in the Operational Guidelines for Examination and Assessment (OGEA) available from www.bcsea.bt.
Candidates are expected to show all necessary working; no marks will be given for unsupported answers from a calculator.

Degrees of accuracy
Candidates should present numerical answers to three significant figures unless a different level of accuracy is specified in the question. To earn accuracy marks, candidates should avoid rounding figures until they have their final answer.

Command words

Command words and their meanings help candidates know what is expected from them in the exam. The table below includes command words used in the assessment for this syllabus. The use of the command word will relate to the subject context.

Command word	What it means
Apply	Use a theorem, law, or method to solve problems.
Calculate	Perform numerical computations.
Classify	Categorize mathematical objects based on properties (e.g., maxima, minima, inflection points).
Comment	Give a brief mathematical explanation or observation.
Compare	Examine the relationship between two quantities or probabilities.
Construct	Create a mathematical object (e.g., graph, diagram, equation) using given conditions.
Convert (nonlinear to linear)	Transform an equation using logarithms to make it linear.
Decompose	Break down a mathematical expression into simpler parts (e.g., partial fractions).
Describe	Explain a property or behavior (e.g., nature of roots using discriminant).
Determine	Find or calculate a specific value or property.
Differentiate	Find the derivative of a function.
Draw	Represent a diagram or graph accurately using given information.
Evaluate	Compute the value of an expression or integral.
Expand	Write out $(a+b)^n$ & $(a-b)^n$as a sum of terms (binomial expansion).
Explain	Give clear reasoning or justification using mathematical concepts.
Factorize	Express a polynomial as a product of simpler polynomials.
Find	Compute or locate a mathematical object (e.g., inverse function, stationary points).
Identify	Recognize and name a mathematical property or function.
Illustrate	Represent a concept graphically or visually.
Integrate	Find the antiderivative of a function.
Interpret	Explain or give meaning to a mathematical relationship or graphical representation.
Predict	Estimate an unknown value using a mathematical model (e.g., regression).
Prove	Show a statement is true (e.g. right-hand side is equal to left-hand side)
Represent	Express data or functions in a different form (e.g., stem-and-leaf plot, histogram).
Simplify	Reduce an expression to a more compact form using identities.
Show	Provide structured evidence that leads to a given result
Sketch	Draw a rough graph representing a function or relationship.
Solve	Find the solution(s) to an equation, inequality, or problem.
State	Give the answer or fact without working.
Test	Check whether a statement or solution satisfies given conditions.
Use	Employ a mathematical tool or concept in a given situation.
Verify	Confirm the truth of a result by showing it is correct mathematically.

Symbols and conventions learners should recognise

Symbol	Definition
∩	intersection, the common elements among sets
i	imaginary number
θ	theta, the representation of an angle
| x |	modulus x or absolute value of x, the magnitude of x, or the distance of x from zero
≠	not equal to
$\frac{dy}{dx}$ or $f'(x)$	Derivative of y with respect to x, which means the slope of the tangent to the curve at a given point.
$<, >, \leq, \geq$	Inequality symbols - which are less than, greater than, less than or equal to, and greater than or equal to signs.

List of formulae

Class XI

Strand A: Numbers and Operations

If $y = a^x$, where $a > 0$, $a \neq 1$, and $x > 0$, then $x = \log_a y$

$\log_a a = 1; \qquad \log_a 1 = 0; \qquad \log_a a^x = x; \qquad a^{\log_a x} = x$

$\log_a (xy) = \log_a x + \log y; \qquad \log_a \left(\frac{x}{y}\right) = \log_a x - \log_a y; \qquad \log_a (x)^m = m \log_a x$

$\log_a \left(\frac{1}{x}\right) = -\log_a x$

If $y = \mathrm{e}^x$ then $x = \ln y$

Strand B: Patterns and Algebra

$$(a+b)^n = \binom{n}{0}a^n + \binom{n}{1}a^{n-1}b^1 + \binom{n}{2}a^{n-2}b^2 + \ldots + \binom{n}{r}a^{n-r}b^r + \ldots + \binom{n}{n}b^n$$

$$\binom{n}{r} = \frac{n\times(n-1)\times(n-2)\times\cdots\times(n-r+1)}{r\times(r-1)\times(r-2)\times\cdots\times 3\times 2\times 1}$$

$$\binom{n}{r} = \frac{n!}{r!(n-r)!};\ \binom{n}{0} = 1;\ \binom{n}{1} = n;\ \binom{n}{n} = 1$$

nth term $= a + (n-1)d$

$$S_n = \frac{n}{2}(a+l) \text{ or } S_n = \frac{n}{2}[2a+(n-1)d]$$

nth term $= S_n - S_{n-1}$

nth term $= ar^{n-1}$

$$S_n = \frac{a(1-r^n)}{1-r} \text{ or } S_n = \frac{a(r^n-1)}{r-1}$$

$$S_\infty = \frac{a}{1-r}, \text{ where } |r| < 1.$$

$$\frac{d}{dx}(x^n) = nx^{n-1};\ \frac{d}{dx}(ax+b)^n = an(ax+b)^{n-1}$$

$$\frac{d}{dx}[kf(x)] = k\frac{d}{dx}[f(x)];\ \frac{d}{dx}[f(x)\pm g(x)] = \frac{d}{dx}f(x) \pm \frac{d}{dx}g(x)$$

$$\frac{dy}{dx} = \frac{dy}{du}\times\frac{du}{dx}$$

$$\frac{d}{dx}(uv) = u\frac{du}{dx} + v\frac{dv}{dx};\ \frac{d}{dx}\left(\frac{u}{v}\right) = v\frac{du}{dx} - u\frac{dv}{dx}$$

If the value of $\frac{dy}{dx}$ at point (x_1, y_1) is m then

The equation of tangent at that point is $y - y_1 = m(x - x_1)$

The equation of the normal at that point is $y - y_1 = -\frac{1}{m}(x - x_1)$

$$\int x^n dx = \frac{1}{n+1}x^{n+1} + c, \text{ where } c \text{ is constant and } n \neq -1.$$

$$\int kf(x)dx = k\int f(x)dx, \text{where } k \text{ is a constant.}$$

$$\int [f(x)\pm g(x)]dx = \int f(x)dx \pm \int g(x)dx$$

$$\int (ax+b)^n dx = \frac{1}{a(n+1)}(ax+b)^{n+1} + c$$

$x^2 + 2dx = (x+d)^2 - d^2$ and $x^2 - 2dx = (x-d)^2 - d^2$

$x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

For $f(x) = ax^2 + bx + c$ written in the form $f(x) = a(x-h)^2 + k$,

Line of symmetry: $x = h = \dfrac{-b}{2a}$

If $a > 0$, there is minimum point at (h,k)

If $a < 0$, there is a maximum point at (h,k)

The discriminant of $ax^2 + bx + c = 0$ is $b^2 - 4ac$.

Strand C: Measurement and Geometry

Arc length = $r\theta$

Area of section = $\dfrac{1}{2}r^2\theta$

$\tan\theta \equiv \dfrac{\sin\theta}{\cos\theta}$; $\cot\theta = \dfrac{\cos\theta}{\sin\theta}$

$\sin^2\theta + \cos^2\theta \equiv 1$

$\sec^2\theta - \tan^2\theta \equiv 1$

$\cos ec^2\theta - \cot^2\theta \equiv 1$

Midpoint of two points: $\left(\dfrac{x_1 + x_2}{2}, \dfrac{y_1 + y_2}{2}\right)$

Distance between two points: $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Gradient of a line: $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

Equation of lines:

$y = mx + c$

$y - y_1 = m(x - x_1)$

Equation of circle:

$(x-a)^2 + (y-b)^2 = r^2$, Centre: (a,b), Radius: r

$x^2 + y^2 + 2gx + 2fy + c = 0$, Centre: $(-g,-f)$, Radius: $\sqrt{g^2 + f^2 - c}$

Strand D: Data and Probability

$\bar{x} = \frac{\sum x}{n}$; $\bar{x} = \frac{\sum fx}{\sum f}$; $\bar{x} = \frac{\sum (x-b)}{n} + b$; $\bar{x} = \frac{\sum f(x-b)}{\sum f} + b$

$\bar{x} = \frac{1}{a}\left[\frac{\sum ax - b}{n} + b\right]$; $\bar{x} = \frac{1}{a}\left[\frac{\sum f(ax-b)}{\sum f} + b\right]$

$\text{IQR} = Q_3 - Q_1$;

$Q_1 = \left(\frac{n}{4}\right)^{th}$ or $\left(\frac{\sum f}{4}\right)^{th}$ value; $Q_2 = \left(\frac{n}{2}\right)^{th}$ or $\left(\frac{\sum f}{2}\right)^{th}$ value; $Q_3 = \left(\frac{3n}{4}\right)^{th}$ or $\left(\frac{3\sum f}{4}\right)^{th}$ value

$\text{Var}\,(x) = \frac{\sum (x-\bar{x})^2}{n}$ or $\frac{\sum x^2}{n} - \bar{x}^2$ or $\frac{\sum (x-b)^2}{n} - \left(\frac{\sum (x-b)}{n}\right)^2$

or $\frac{1}{a^2}\left[\frac{\sum (ax-b)^2}{n} - \left(\frac{\sum (ax-b)}{n}\right)^2\right]$

$\text{Var}\,(x) = \frac{\sum f(x-\bar{x})^2}{\sum f}$ or $\frac{\sum fx^2}{\sum f} - \bar{x}^2$ or $\frac{\sum f(x-b)^2}{\sum f} - \left(\frac{\sum f(x-b)}{\sum f}\right)^2$

or $\frac{1}{a^2}\left[\frac{\sum f(ax-b)^2}{\sum f} - \left(\frac{\sum f(ax-b)}{\sum f}\right)^2\right]$

$\text{SD}(X) = \sqrt{\frac{\sum (x-\bar{x})^2}{n}}$ or $\sqrt{\frac{\sum x^2}{n} - \bar{x}^2}$

$\text{SD}(X) = \sqrt{\frac{\sum f(x-\bar{x})^2}{\sum f}}$ or $\sqrt{\frac{\sum fx^2}{\sum f} - \bar{x}^2}$

Combined mean of x and y is $\frac{\sum x + \sum y}{n_x + n_y}$

Combined varience of x and y is $\frac{\sum x^2 + \sum y^2}{n_x + n_y} = \left(\frac{\sum x + \sum y}{n_x + n_y}\right)^2$

$P(A) + P(\text{not } A) = 1$ or $P(A) + P(A') = 1$

$P(A \text{ or } B) = P(A \cup B) = P(A) + P(B),$ when $A \cap B = \phi$

$P(A \cup B) = P(A) + P(B) - P(A \cap B),$ when $A \cap B \neq \phi$

$P(A \text{ or } B \text{ or } C \text{ or...}) = P(A) + P(B) + P(C) + ...$ when $A \cap B \cap C \cap ... = \phi$

If A, B, C, ... are independent events, then

$P(A \text{ and } B) = P(A \cap B) = P(A) \times P(B)$

$P(A \cap B \cap C...) = P(A) \times P(B) \times P(C) \times ...$

Class XII

Strand A: Numbers and Operations

$(a \pm b)^2 = a^2 \pm 2ab + b^2$

$a^2 - b^2 = (a+b)(a-b)$

$a^3 \pm b^3 = (a \pm b)(a^2 \mp ab + b^2)$

$(a \pm b)^3 = a^3 \pm 3a^2b + 3ab^2 \pm b^3$

If $ax^2 + bx + c = 0,\ x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$C_{ij} = (-1)^{i+j} M_{ij}$

$A^{-1} = \dfrac{1}{|A|} adj.A$

$X = A^{-1}B$

For $z_1 = a + b\text{i}$ and $z_2 = c + d\text{i}$:

$z_1 \pm z_2 = (a \pm c) + (b \pm d)\text{i}$

For $z = x + y\text{i}$

$|z| = r = \sqrt{x^2 + y^2}$; $\quad |z_1 z_2| = r_1 r_2 = |z_1||z_2|$; $\quad \left|\dfrac{z_1}{z_2}\right| = \dfrac{r_1}{r_2} = \dfrac{|z_1|}{|z_2|}$;

$\arg(z)$: $\tan\theta = \dfrac{b}{a} \Rightarrow \theta = \tan^{-1}\left|\dfrac{b}{a}\right|$; $\quad \arg\left(\dfrac{z_1}{z_2}\right) = \theta_1 - \theta_2 = \arg z_1 - \arg z_2$

Polar forms:

Modular-argument form: $(\cos\theta + i\sin\theta)$

Exponential form: $r\text{e}^{i\theta}$

Cube roots of one: $z = 1,\ z = \dfrac{-1 + \text{i}\sqrt{3}}{2}, z = \dfrac{-1 - \text{i}\sqrt{3}}{2}$

Strand B: Patterns and Algebra

$y = x^n,\ y' = nx^{n-1}$

$y = cf(x),\ y' = cf'(x)$

If $y = uv,\ \frac{dy}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$

If $y = \frac{u}{v},\ \frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$

$\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$

$\frac{d}{dx}(\sin x) = \cos x$

$\frac{d}{dx}(\cos x) = -\sin x$

$\frac{d}{dx}(\tan x) = \sec^2 x$

$\frac{d}{dx}(\log_a x) = \frac{1}{x \log_e a}$

$\frac{d}{dx}(\log_e x) = \frac{1}{x}$

$\frac{d}{dx}(a^x) = a^x \log_e a$

$\frac{d}{dx} e^x = e^x$

$\int x^n dx = \frac{x^{n+1}}{n+1} + c$

$\int (ax+b)^n dx = \frac{(ax+b)^{n+1}}{a(n+1)} + c$

$\int \sin x dx = -\cos x + c$

$\int \cos x dx = \sin x + c$

$\int \sec^2 x dx = \tan x + c$

$\int \frac{1}{x} dx = \log|x| + c$

$\int e^x dx = e^x + c$

$\int a^x dx = \frac{a^x}{\log_e a} + c$

$\int \frac{1}{1+x^2} dx = \tan^{-1} x + c$

$\int uv dx = x\int v dx - \int \left\{ \frac{du}{dx} \int v dx \right\} dx$

$1 + 2 + 3 + ... + (n-1) = \frac{1}{2} n(n-1)$

$1^2 + 2^2 + ... + (n-1)^2 = \frac{1}{6} n(n-1)(2n-1)$

$1^3 + 2^3 + 3^3 + ... + (n-1)^3 = \left[\frac{n(n-1)}{2} \right]^2$

$\int_a^b f(x)dx = \underset{h \to 0}{\text{Lim}}\, h\left[\sum_{r=0}^{n-1} f(a+rh) \right]$

$A = \int_a^b y dx,\ V = \pi \int_a^b y^2 dx$

Volume of Cone: $\frac{1}{3}\pi r^2 h$

Volume of Sphere: $\frac{4}{3}\pi r^3$

Volume of Cylinder: $\pi r^2 h$

Volume of Prism: $Base\ Area \times height$

S. Area of Cone: $\pi rl + \pi r^2$

S. Area of Sphere: $4\pi r^2$

S. Area of closed Cylinder: $2\pi rh + 2\pi r^2$

Area of sector: $\frac{1}{2} r^2 \theta$

For a polynomial $\mathrm{P}(x)$:

If $\mathrm{P}(c)=0$ then $x-c$ is a factor of $\mathrm{P}(x)$; If $\mathrm{P}\left(\frac{b}{a}\right)=0$ then $ax-b$ is a factor of $\mathrm{P}(x)$.

If $\mathrm{P}(x)$ is divided by $x-c$, the remainder is $\mathrm{P}(c)$; If $\mathrm{P}(x)$ is divided by $ax-b$, the remainder is $\mathrm{P}\left(\frac{b}{a}\right)$.

Strand C: Measurement and Geometry

$\sin(A\pm B)=\sin A\cos B\pm\cos A\sin B$

$\cos(A\pm B)=\cos A\cos B\mp\sin A\sin B$

$\tan(A\pm B)=\dfrac{\tan A\pm\tan B}{1\mp\tan A\tan B}$

$\cot(A\pm B)=\dfrac{\cot A\cot B\mp 1}{\cot B\pm\cot A}$

$\sin 2A=2\sin A\cos A;\quad \sin A=2\sin\dfrac{A}{2}\cos\dfrac{A}{2}$

$\cos 2A=\cos^2 A-\sin^2 A;\quad \cos A=\cos^2\dfrac{A}{2}-\sin^2\dfrac{A}{2}$

$=1-2\sin^2 A;\quad =1-2\sin^2\dfrac{A}{2}$

$=2\cos^2 A-1;\quad =2\cos^2\dfrac{A}{2}-1$

$\tan 2A=\dfrac{2\tan A}{1-\tan^2 A};\quad \tan A=\dfrac{2\tan\dfrac{A}{2}}{1-\tan^2\dfrac{A}{2}}$

$a\sin\theta\pm b\cos\theta=R\sin(\theta\pm\alpha)$ and $a\cos\theta\pm b\sin\theta=R\cos(\theta\mp\alpha)$,

where $R=\sqrt{a^2+b^2}$, $\tan\alpha=\dfrac{b}{a}$ and $0^o<\alpha<90^o$.

$\overrightarrow{AB}+\overrightarrow{BC}=\overrightarrow{AC}$

$\overrightarrow{CA}=-\overrightarrow{AC}$

$\mathbf{a}\cdot\mathbf{b}=|\mathbf{a}||\mathbf{b}|\cos\theta$

$\mathbf{a}\cdot\mathbf{b}=a_1b_1+a_2b_2+a_3b_3$

$\mathbf{r}=\mathbf{a}+t\mathbf{b}$

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{n\sum x^2 - \left(\sum x\right)^2}\sqrt{n\sum y^2 - \left(\sum y\right)^2}} \text{ or } \frac{\sum\left(x-\bar{x}\right)\left(y-\bar{y}\right)}{\sqrt{\sum\left(x-\bar{x}\right)^2\sum\left(y-\bar{y}\right)^2}}$$

$$r = 1 - \frac{6\left(\sum D^2 + \text{correction factors}\right)}{n(n^2-1)}, \text{ where correction factor: } \frac{1}{12}\left(m^3 - m\right) + ...$$

$$r = \pm\sqrt{b_{yx}b_{xy}}$$

$$b_{yx} = r\frac{\sigma_y}{\sigma_x} = \frac{n\sum xy - \sum x\sum y}{n\sum x^2 - \left(\sum x\right)^2}; \qquad b_{xy} = r\frac{\sigma_x}{\sigma_y} = \frac{n\sum xy - \sum x\sum y}{n\sum y^2 - \left(\sum y\right)^2}$$

$$y - \bar{y} = b_{yx}\left(x - \bar{x}\right);\ x - \bar{x} = b_{xy}\left(y - \bar{y}\right)$$

For n distinct objects, there are:

$${}^nP_n = n! = n(n-1)(n-2)...(3)(2)(1), \text{ for all } n \text{ objects.}$$

$${}^nP_r = \frac{n!}{(n-r)!} \text{ permutations of } r \text{ objects.}$$

$$\frac{n!}{p!\times q!\times r!\times ...} \text{ permutations in which there are } p, q, r, ... \text{ of each type.}$$

$${}^nC_r = \frac{n!}{r!(n-r)!} \text{combinations of } r \text{ objects.}$$

$$P(A\cup B) = P(A) + P(B) - P(A\cap B)$$

$$P(B/A) = \frac{P(A\cap B)}{P(A)},\ P(A) \neq 0$$

$$P(A/B) = \frac{P(A\cap B)}{P(B)},\ P(B) \neq 0$$

$$P(A)\times P(B\mid A) = P(B)\times P(A\mid B)$$

$$P(A) + P(\bar{A}) = 1$$

5. What else you need to know

This section provides key information about the syllabus and administrative processes. It is intended to help teachers, candidates, and schools understand how to manage entries, assessments, and access arrangements effectively. More information is available on the BCSEA portal (www.bcsea.bt) and through official guidance documents.

Before you start

Previous study

Learners beginning this course are recommended to have completed prior study in mathematics equivalent to the Bhutan Certificate of Secondary Education (BCSE).

Guided learning hours

The course is designed to require approximately 140 guided learning hours for class XI and 140 guided learning hours for Class XII.

Combining with other syllabuses

Candidates may take this syllabus alongside other BCSEA syllabuses, except where syllabuses have the same name and key stage.

Making entries

Schools are responsible for submitting candidate entries. Schools should ensure candidates are entered for the correct syllabus components. Entry instructions are available in the Operation Guidelines for Examination and Assessment (OGEA) available at www.bcsea.bt.

Retakes

Candidates may retake strand Mathematics components as required.

Language

This syllabus and all assessment materials are available in English only.

Accessibility and equality

Syllabus and assessment design

- BCSEA aims to avoid discrimination and maximise inclusivity for all candidates, including those with special educational needs and disabilities (SEN), religion, gender, or other protected characteristics**.**
- Materials are designed to be accessible, using clear language and design principles.

Access arrangements

- BCSEA provides access arrangements to minimise barriers for candidates with SEN, disability, illness, or injury.
- Arrangements should reflect a candidate's normal way of working**.** Approval must ensure that adjustments are reasonable, cost-effective, and do not compromise assessment integrity.
- schools should confirm access arrangements at the start of the course. For special arrangements not included in standard lists as per OGEA, contact BCSEA for guidance.
- Candidates unable to access all components may receive an award based on completed components.

After the exam

Grading and reporting

- Grades A – E, with 'A' as highest and 'E' as lowest.
- **Ungraded:** Candidates not meeting the lowest grade standard are reported as **Ungraded** (U).