# MATHEMATICS OVERVIEW
# GRADES XI AND XII

**Delhi Board of School Education (DBSE)**

**Directorate of Education, Government of National Capital Territory of Delhi**

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## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| DBSE | Delhi Board of School Education |
| TA | Term-end Assessment |
| IA | Internal Assessment |
| IB | International Baccalaureate |
| MYP | Middle Years Programme |

# 1. Introduction

## 1.1. Importance of mathematics

Mathematics is the science and study of quality, structure, space, and change. Mathematicians seek out patterns, formulate new conjectures, and establish truth by rigorous deduction from appropriately chosen axioms and definitions.

Through abstraction and logical reasoning mathematics as a serious course of study evolved from counting, calculation, measurement, and the systematic study of the shapes and motions of physical objects. Practical mathematics has been a human activity for as far back as written records exist.

Today, mathematics is used throughout the world as an essential tool in many fields, including natural science, engineering, medicine, and the social sciences. Applied mathematics, the branch of mathematics concerned with application of mathematical knowledge to other fields, inspires and makes use of new mathematical discoveries and sometimes leads to the development of entirely new disciplines. Mathematicians also engage in pure mathematics, or mathematics for its own sake, without having any application in mind, although practical applications for what begins as pure mathematics are often discovered later.

## 1.2. Aims

The aims of all mathematics courses at Senior secondary level are to enable students to:

- enjoy mathematics, and develop an appreciation of the elegance and power of mathematics
- develop an understanding of the principles and nature of mathematics
- communicate clearly and confidently in a variety of contexts
- develop logical, critical and creative thinking, and patience and persistence in problem-solving
- employ and refine their powers of abstraction and generalization
- apply and transfer skills to alternative situations, to other areas of knowledge and to future developments
- appreciate how developments in technology and mathematics have influenced each other
- appreciate the moral, social and ethical implications arising from the work of mathematicians and the applications of mathematics
- appreciate the international dimension in mathematics through an awareness of the universality of mathematics and its multicultural and historical perspectives
- appreciate the contribution of mathematics to other disciplines, and as a particular “area of knowledge”

## 1.3. Objectives of mathematics education

The objectives of mathematics encompass the factual, conceptual, procedural and metacognitive dimensions of knowledge. These objectives relate directly to the mathematics assessment criteria.

In the DBSE mathematics senior secondary course, students will be expected to demonstrate the following:

**Objective A – Knowing and Understanding**

Students would have knowledge and understanding of –

- mathematical facts, concepts and terminology
- methodologies and techniques used in mathematics

**Objective B – Application**

Students would be able to apply mathematical –

- facts and concepts
- methodologies and techniques.

**Objective C – Higher Order Thinking Skills**

Students would be able to use –

- logical ability
- analytical ability
- synthesizing and evaluating ability in mathematics.

**Criteria D – Investigation skills**

Students would be able to use –

- investigation skills to solve authentic problems

# 2. Mathematics as a subject

## 2.1. Content areas in Mathematics

### 2.1.1 Sets, Functions and Relations

Models are depictions of real-life events using expressions, equations or graphs while a function is defined as a relation or expression involving one or more variables. Creating different representations of functions to model the relationships between variables, visually and symbolically as graphs, equations and tables represents different ways to communicate mathematical ideas.

### 2.1.2 Algebra

Algebra allows us to represent patterns, show equivalencies and make generalizations which enable us to model real-world situations. Algebra is an abstraction of numerical concepts and employs variables which allow us to solve mathematical problems.

### 2.1.3 Geometry and Trigonometry

Geometry and trigonometry allow us to quantify the physical world, enhancing our spatial awareness in two and three dimensions. This topic provides us with the tools for analysis, measurement and transformation of quantities, movements and relationships.

### 2.1.4 Calculus

Calculus describes rates of change between two variables and the accumulation of limiting areas. Understanding these rates of change and accumulations allow us to model, interpret and analyse real-world problems and situations. Calculus helps us to understand the behaviour of functions and allows us to interpret the features of their graphs.

### 2.1.5 Statistics and Probability

Statistics is concerned with the collection, analysis and interpretation of data and the theory of probability can be used to estimate parameters, discover empirical laws, test hypotheses and predict the occurrence of events. Statistical representations and measures allow us to represent data in many different forms to aid interpretation.

Probability enables us to quantify the likelihood of events occurring and so evaluate risk. Both statistics and probability provide important representations which enable us to make predictions, valid comparisons and informed decisions. These fields have power and limitations and should be applied with care and critically. Probability theory allows us to make informed choices, to evaluate risk, and to make predictions about seemingly random events.

## 3. Curriculum overview for grades XI and XII

An academic year at DBSE consists of two terms. Grade XI and XII curriculum is clustered into units. These units are delivered in two terms of an academic year. Unit names, content, duration and the learning resources are provided in the subsequent sections.

### 3.1. Grade XI curriculum overview

Table 1: Unit names, content, duration and the learning resources in grade XI

| Grade XI | | | |
|---|---|---|---|
| **Term 1** | | | |
| **Unit** | **Content** | **Duration** | **Resources** |
| Linear Inequalities | • Linear inequalities.<br>• Algebraic solutions of linear inequalities in one variable and their representation on the number line.<br>• Graphical solution of linear inequalities in two variables.<br>• Graphical method of finding a solution of system of linear inequalities in two variables.<br>• Properties of roots<br>• Nature of roots<br>• Common roots<br>• Transformation of roots | 2 weeks | NCERT Books |
| Trigonometric Identities and Equations | • Positive and negative angles.<br>• Measuring angles in radians and in degrees and conversion from one measure to another.<br>• Definition of trigonometric functions with the help of unit circle.<br>• Truth of the identity sin2x + cos2x = 1, for all x.<br>• Signs of trigonometric functions.<br>• Domain and range of trigonometric functions and their graphs.<br>• Expressing sin (x±y) and cos (x±y) in terms of sinx, siny, cosx & cosy and their simple<br>• Applications<br>• Deducing identities | 4 weeks | NCERT Books |
| Sequences and series | • Properties of AP, GP, Insertion of AM's, GM's<br>• HP properties, Insertion of HMs, AM, GM & HM relations<br>• AGP, Method of Difference, Sigma n, $n^2$, $n^3$ based problems | 3 weeks | NCERT Books |

| | | | |
|---|---|---|---|
| Complex Numbers | • Need for complex numbers, especially$\sqrt{-1}$, to be motivated by inability to solve some of the quadratic equations.<br>• Algebraic properties of complex numbers.<br>• Argand plane.<br>• Statement of Fundamental Theorem of Algebra<br>• Solution of quadratic equations (with real coefficients) in the complex number system. | 4 weeks | NCERT Books |
| **Term 2** | | | |
| Permutations and Combinations | • Fundamental principle of counting.<br>• Factorial n. (n!)<br>• Permutations and combinations, formula for nPr and nCr, simple applications. | 2 weeks | NCERT Books |
| Binomial Expansion | • Binomial theorems general observation: general term, middle term, greatest binomial coefficient | 1 week | NCERT Books |
| Straight line | • Slope of a line and angle between two lines.<br>• Various forms of equations of a line: parallel to axis, point -slope form, slope-intercept form, two-point form, intercept form and normal form.<br>• General equation of a line. Distance of a point from a line. | 2 weeks | NCERT Books |
| Conic sections | • Sections of a cone: circles, ellipse, parabola, hyperbola.<br>• Standard equations and simple properties of parabola, ellipse and hyperbola.<br>• Standard equation of a circle. | 10 weeks | NCERT Books |

## 3.2. Grade XII curriculum overview

Table 2: Unit names, content, duration and the learning resources in grade XI

| Grade XII | | | |
|---|---|---|---|
| **Term 1** | | | |
| **Unit** | **Content** | **Duration** | **Resources** |
| Functions | • Types of relations: reflexive, symmetric, transitive and equivalence relations.<br>• One to one and onto functions. | 3 | NCERT Books |
| Inverse Trigonometry | • Definition, range, domain, principal value branch. | 4 | NCERT Books |
| Differential Calculus - 1 | • Continuity and differentiability, derivative of composite functions, chain rule, derivative of inverse trigonometric functions, derivative of implicit functions.<br>• Concept of exponential and logarithmic functions.<br>• Derivatives of logarithmic and exponential functions.<br>• Logarithmic differentiation, derivative of functions expressed in parametric forms. Second order derivatives. | 4 | NCERT Books |
| Differential Calculus - 2 | • Applications of derivatives: increasing/decreasing functions, tangents and normals, maxima and minima (first derivative test motivated geometrically, and second derivative test given as a provable tool).<br>• Simple problems (that illustrate basic principles and understanding of the subject as well as real-life situations). | 2 | NCERT Books |
| Integral Calculus - 1 | • Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts, Evaluation of simple integrals of the following types and problems based on them.<br>• Fundamental Theorem of Calculus (without proof).<br>• Basic properties of definite integrals and evaluation of definite integrals. | 2 | NCERT Books |
| Integral Calculus - 2 | • Applications in finding the area under simple curves, especially lines, parabolas; area of circles /ellipses (in standard form only) (the region should be clearly identifiable) | 1 | NCERT Books |

| Term 2 | | | |
|---|---|---|---|
| Differential Equations | ● Definition, order and degree, general and particular solutions of a differential equation.<br>● Solution of differential equations by method of separation of variables, solutions of homogeneous differential equations of first order and first degree of the type: $dy/\ dx$ = $f$(y/x).<br>● Solutions of linear differential equation<br>of the type:<br>dy/dx + py = q, where p and q are functions of x or constant | 2 weeks | NCERT Books |
| Vectors | ● Vectors and scalars, magnitude and direction of a vector.<br>● Direction cosines and direction ratios of a vector.<br>● Types of vectors (equal, unit, zero, parallel and collinear vectors), position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio.<br>● Definition, Geometrical Interpretation, properties and application of scalar (dot) product of vectors, vector (cross) product of vectors. | 2 weeks | NCERT Books |
| Three-Dimensional Geometry | ● Direction cosines and direction ratios of a line joining two points.<br>● Cartesian equation and vector equation of a line, coplanar and skew lines, shortest distance between two lines.<br>● Cartesian and vector equation of a plane.<br>● Distance of a point from a plane. | 2 weeks | NCERT Books |
| Determinants & Matrices | ● Concept, notation, order, equality, types of matrices, zero and identity matrix, transpose of a matrix, symmetric and skew symmetric matrices. Operation on matrices: Addition and multiplication and multiplication with a scalar. Simple properties of addition, multiplication and scalar multiplication.<br>● Noncommutativity of multiplication of matrices, Invertible matrices; (Here all matrices will have real entries).<br>● Determinant of a square matrix (up to 3 x 3 matrices), minors, co-factors and | 3 weeks | NCERT Books |

| | | | |
|---|---|---|---|
| | applications of determinants in finding the area of a triangle. Adjoint and inverse of a square matrix. Solving system of linear equations in two or three variables (having unique solution) using inverse of a matrix. | | |
| Probability | • Conditional probability, multiplication theorem on probability, independent events, total probability,<br>• Bayes' theorem, Random variable and its probability distribution. | 4 weeks | NCERT Books |

## 4. Assessment overview

Criterion based assessments enable students to self-monitor and build self-belief as they can see the evidence of the progress they are making over time. Students can track their progress using level descriptors, they can clearly understand how their work can be improved over time.

The four core criteria assessed in Physical Education are:

1. Criterion A – Knowing and understanding
2. Criterion B – Applying
3. Criterion C – Higher Order Thinking Skills
4. Criterion D – Investigation skills (problem solving)

The assessment tasks and methods used in internal assessment are criterion related, student-centric and provide feedback for further enhancement of learning. There are two types of assessments used for reporting student performance.

- Internal assessments (IA) (20%)
- Term-end assessments (TA) (80%)

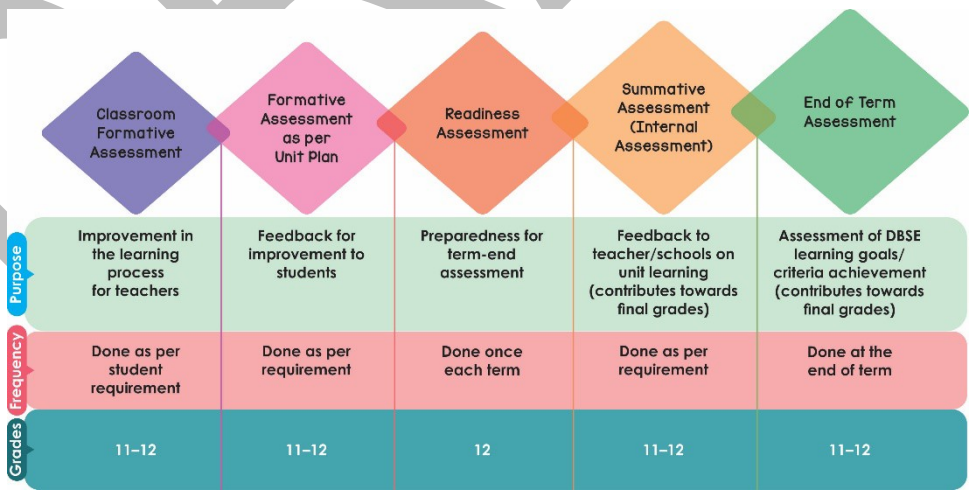
The assessment tasks and methods used in internal assessments provide opportunities for students to show their academic achievements in multiple ways and provide feedback for further enhancement of learning. External assessment tasks are based on curriculum objectives defined for mathematics.

DBSE assessments used for reporting for grades 11 & 12 can be school-led and/or board-led. School-led assessments are based on an item pool provided by DBSE and Board-led assessments are developed and administered by DBSE. In grade 12, DBSE monitor internal assessments and readiness assessments. Term-end assessments are conducted by DBSE.

### 4.1. Assessment structure

Global best practices suggest a multifaceted assessment structure. That is, students should be assessed in multiple ways and at multiple times without increasing the workload of teachers or students, to the extent possible. A schematic representation of the DBSE assessment structure is presented below:

Figure 1: Assessments in DBSE



## 4.2. Assessment calendar

The assessment calendar for internal and external assessments for academic year 2022-23 for grade 11 and 12 assessments is given below.

Table 3: Grade XI assessment calendar

| Chapter | Duration | | Assessment | Criteria Assessed | Assessment Strategies |
|---|---|---|---|---|---|
| 1 | 04 Jul 2022 | 16 Jul 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | • Student Portfolio<br>• Viva, and<br>• Performance or Demonstration of task/skill<br>• Quiz<br>• Competency based test |
| 2 | 18 Jul 2022 | 13 Aug 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | |
| 3 | 16 Aug 2022 | 3 Sep 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | |
| 4 | 5 Sep 2022 | 30 Sep 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | |
| **10 – 24 October 2022** | | | **Term-end 1** | **All 4 Criteria** | **Competency based assessment** |
| 5 | 01 Nov 2022 | 11 Nov 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | • Student Portfolio<br>• Viva, and<br>• Performance or Demonstration of task/skill<br>• Quiz<br>• Competency based test |
| 6 | 14 Nov 2022 | 19 Nov 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | |
| 7 | 21 Nov 2022 | 3 Dec 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding | |

| | | | | | |
|---|---|---|---|---|---|
| | | | | B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | |
| 8 | 5 Dec 2022 | 20 Feb 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | |
| **1 - 20 March 2023** | | | **Term-end 2** | **All 4 Criteria** | **Competency based assessment** |

Table 4:: Grade XII assessment calendar

| Chapter | Duration | | Assessment | Criteria Assessed | Assessment Strategies |
|---|---|---|---|---|---|
| 1 | 04 Apr 2022 | 7 May 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | • Student Portfolio<br>• Viva, and<br>• Performance or Demonstration of task/skill<br>• Quiz<br>• Competency based test |
| 2 | 9 May 2022 | 3 Jun 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | |
| 3 | 4 Jul 2022 | 30 Jul 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | |
| 4 | 1 Aug 2022 | 12 Aug 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | |
| 5 | 16 Aug 2022 | 31 Aug 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | |

| | | | | | |
|---|---|---|---|---|---|
| 6 | 1 Sep 2022 | 9 Sep 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | |
| | | | Readiness Assessment | **All 4 Criteria** | Competency based assessment |
| **10 – 24 October 2022** | | | **Term-end 1** | **All 4 Criteria** | **Competency based assessment** |
| 7 | 01 Nov 2022 | 11 Nov 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | |
| 8 | 14 Nov 2022 | 26 Nov 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | |
| 9 | 28 Nov 2022 | 10 Dec 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | |
| 10 | 12 Dec 2022 | 31 Dec 2022 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | |
| 11 | 16 Jan 2023 | 10 Feb 2023 | Internal Assessment | A. Criteria A - Knowing and Understanding<br>B. Criteria B - Applying<br>C. Criteria C - Higher Order Thinking Skills<br>D. Criteria D- Investigation skills (Problem Solving) | • Student Portfolio<br>• Viva, and<br>• Performance or Demonstration of task/skill<br>• Quiz<br>• Competency based test |
| | | | Readiness Assessment | All 4 Criteria | Competency based assessment |
| **1 - 20 March 2023** | | | **Term-end 2** | **All 4 Criteria** | **Competency based assessment** |

## 4.3. Assessment levels and grades

The assessment criteria directly relate to the objectives of the mathematics curriculum and carry equal weightage. The student achievement levels will be reported as a number grade as described in the grade descriptions.

The grade descriptions are based on assessment criteria levels. The level descriptors of an assessment criterion depict clear progression of improvement of skills and competencies for a learning period.

All the assessment tasks used to report students' achievements are based on task specific, hierarchical, and qualitatively defined rubrics. The categories used in rubrics represent increasing quality or sophistication of response to a task. They provide a basis for evaluating and recording students' responses to an assessment task. A rubric makes assessment expectations transparent.

In order to show the degree of competence in each criterion, fine grained descriptions of various levels are used. These descriptions indicate the progression of achievement in each criterion.

Table 5: Objective A: Knowing and Understanding

| Achievement Level | Level Descriptor |
|---|---|
| 0 | No evidence |
| 1-2 | **Student is able to:**<br>● demonstrate limited knowledge and understanding of definitions, rules and formal systems in mathematics<br>● apply algorithms in simple tasks |
| 3-4 | **Student is able to:**<br>● demonstrate satisfactory knowledge and understanding of definitions, rules and formal systems in mathematics<br>● apply algorithms and compute in simple tasks |
| 5-6 | **Student is able to:**<br>● demonstrate broad knowledge and comprehensive understanding of definitions, rules and formal systems in mathematics<br>● apply algorithms and compute in routine and non-routine tasks |
| 7-8 | **Student is able to:**<br>● demonstrate a thorough knowledge and comprehensive understanding of definitions, rules and formal systems in mathematics<br>● apply algorithms and computational reasoning |

Table 6: Objective B: Applying

| Achievement Level | Level Descriptor |
|---|---|
| **0** | No evidence |
| **1-2** | **Student is able to:**<br>● use mathematical processes infrequently, even when attempting routine tasks<br>● utilise some definitions, rules and formal systems in mathematics to a limited extent |
| **3-4** | **Student is able to:**<br>● utilise definitions, rules and formal systems in mathematics to a satisfactory level<br>● use simple mathematical processes in routine tasks |
| **5-6** | **Student is able to:**<br>● utilise definitions, rules and formal systems as well as employ algorithms and computational thinking<br>● use complex mathematical processes in routine tasks<br>● demonstrates some ability to integrate knowledge, understanding and skills from different areas of the course |
| **7-8** | **Student is able to:**<br>● utilise definitions, rules and formal systems as well as employ algorithms and computational thinking<br>● use complex mathematical processes in routine and non – routine tasks<br>● demonstrate the ability to integrate knowledge, understanding and skills from different areas of the course |

Table 7: Objective C: HOTS

| Achievement Level | Level Descriptor |
|---|---|
| **0** | No evidence |
| **1-2** | **Student is able to:**<br>● identify patterns<br>● show limited understanding of the significance of results<br>● communicate some mathematics, but often uses inappropriate techniques, notation or terminology |
| **3-4** | **Student is able to:**<br>● show some ability to recognize patterns and structures;<br>● show limited understanding of the significance of results and attempt to draw some conclusions<br>● communicate mathematics adequately, using some appropriate techniques, notation and terminology |
| **5-6** | **Student is able to:**<br>● recognize patterns and structures, and make some generalizations;<br>● understand and explain the significance and validity of results, and draw relevant conclusions;<br>● communicate mathematics in a clear and effective manner, using correct techniques, notation and terminology |
| **7-8** | **Student is able to:**<br>● make generalizations and justify conclusions<br>● understand and explain the significance and validity of results, and draw full and relevant conclusions<br>● communicate mathematics in a clear, effective and concise manner, using correct techniques, notation and terminology |

Table 8: Objective D: Investigating skills (Problem Solving Skills)

| Achievement Level | Level Descriptor |
|---|---|
| 0 | No evidence |
| 1-2 | **Student is able to:**<br>● identify and describe the mathematical aspects of a real-world problem situation including identifying the significant variables.<br>● develop mathematical diagrams, graphs, constructions and extract mathematical information from them<br>● state the mathematical result |
| 3-4 | **Student is able to:**<br>● simplify or decompose a situation or problem in order to make it amenable to mathematical analysis<br>● use computational model by manipulate numbers, graphical and statistical data and information, algebraic expressions and equations, and geometric representations<br>● explain the mathematical result |
| 5-6 | **Student is able to:**<br>● recognise aspects of a problem that correspond with known problems or mathematical concepts, facts or procedures<br>● demonstrate evidence of understanding of a computational model by articulating a solution, showing and/or summarising and presenting intermediate mathematical results<br>● interpret a mathematical result back into the real-world context in order to explain the meaning of the results |
| 7-8 | **Student is able to:**<br>● translate a problem into a standard mathematical representation or algorithm<br>● analyse similarities and differences between a computational model and the mathematical problem that it is modelling<br>● interpret a mathematical result back into the real-world context in order to explain the meaning of the results and explain the feasibility and possible limitations of the solution |

Table 9: Description of grade points

| Grade | Grade Description |
|---|---|
| 7 | Demonstrates a thorough knowledge and comprehensive understanding of the syllabus; successfully constructs and applies mathematical arguments at a sophisticated level in a wide variety of contexts; successfully uses problem solving techniques in challenging situations; recognizes patterns and structures, makes generalizations and justifies conclusions; understands and explains the significance and validity of results, and draws full and relevant conclusions; communicates mathematics in a clear, effective and concise manner, using correct techniques, notation and terminology; demonstrates the ability to integrate knowledge, understanding and skills from different areas of the course; uses technology correctly in challenging situations – makes efficient use of calculator's functionality when required. |
| 6 | Demonstrates a broad knowledge and comprehensive understanding of the syllabus; successfully constructs and applies mathematical arguments in a variety of contexts; uses problem solving techniques in challenging situations; recognizes patterns and structures, and makes some generalizations; understands and explains the significance and validity of results, and draws relevant conclusions; communicates mathematics in a clear and effective manner, using correct techniques, notation and terminology; demonstrates some ability to integrate knowledge, understanding and skills from different areas of the course; uses technology correctly in routine situations – makes efficient use of calculator's functionality when required |
| 5 | Demonstrates a broad knowledge and good understanding of the syllabus; applies mathematical arguments in performing routine tasks; successfully uses problem solving techniques in routine situations; successfully carries out mathematical processes in a variety of contexts, and recognizes patterns and structures; understands the significance of results and draws some conclusions; communicates mathematics effectively, using appropriate techniques, notation and terminology; demonstrates an awareness of the links between different areas of the course; makes use of calculator's functionality when required (this use may occasionally be inefficient). |
| 4 | Demonstrates a satisfactory knowledge of the syllabus; applies mathematical arguments in performing some routine tasks; uses problem solving techniques in routine situations; successfully carries out mathematical processes in straightforward contexts; shows some ability to recognize patterns and structures; has limited understanding of the significance of results and attempts to draw some conclusions; communicates mathematics adequately, using some appropriate techniques, notation and terminology; makes some use of calculator's functionality, but perhaps not always when required (this use may occasionally be inefficient). |
| 3 | Demonstrates partial knowledge of the syllabus and limited understanding of mathematical arguments in performing some routine tasks; attempts to carry out mathematical processes in straightforward contexts; makes an attempt to use problem solving techniques in routine situations; communicates some appropriate techniques, notation or terminology; occasionally uses calculator's functionality, but often inefficiently – does not always use it when required and may use an inefficient analytic approach. |
| 2 | Demonstrates limited knowledge of the syllabus; attempts to carry out mathematical processes at a basic level; communicates some mathematics, but often uses inappropriate techniques, notation or terminology. |
| 1 | Demonstrates minimal knowledge of the syllabus; demonstrates little or no ability to use mathematical processes, even when attempting routine tasks; communicates only minimal mathematics and consistently uses inappropriate techniques, notation or terminology; is unable to make effective use of technology. |