

ASSESSMENT FRAMEWORK AND MODEL QUESTION PAPER

MATHEMATICS

Grade XI

NATIONAL CURRICULUM
2022-23



50% MCQs & 50% Descriptive
INCLUSIVE SCHEME OF STUDIES 2024



FEDERAL BOARD OF
INTERMEDIATE AND
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ISLAMABAD



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**FEDERAL BOARD OF INTERMEDIATE AND
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H-8/4, ISLAMABAD



**ASSESSMENT FRAMEWORK
FOR
MATHEMATICS GRADE-XI
CURRICULUM 2022-23
SCHEME OF STUDIES 2024**

ACKNOWLEDGEMENT

It is a great honour that we, at the Federal Board of Intermediate and Secondary Education, have developed the Assessment Framework (AF) for the subject of Mathematics for Grade-XI. The primary objective of the AF is to optimize the current curriculum 2022-23. This comprehensive framework has been crafted meticulously by subject matter and assessment experts who conducted an in-depth review of all learning outcomes for Grade-XI Mathematics curriculum. They evaluated these outcomes in terms of their scope, cognitive level, and progression across the grade.

This significant undertaking was the result of a series of extensive meetings and collaborative efforts of the subject and assessment experts. Their dedication and expertise have been instrumental in bringing this framework to fruition.

The Assessment Framework will serve as a guiding document for students, teachers and paper setters. Students will receive clear directions for preparing themselves for the annual examination. Similarly, teachers will use it as a guide to understand what to teach in class and to prepare students for the final examinations accordingly. Similarly paper setters will also seek guidance from this document.

Following subject as well as assessment experts/committee members remained constantly engaged in the development of the AF:

1. Dr. Javed Iqbal, Principal, OPF Boys College, H-8, Islamabad
2. Dr. Khalid Mehmood, Area Education Officer, Nilore Sector, Islamabad
3. Dr. Muhammad Anwar, Assistant Professor, Islamabad Model College for Boys, G-10/4, Islamabad
4. Dr. Tahir Ullah, Assistant Professor, Islamabad Model College for Boys, G-10/4, Islamabad
5. Mr. Anwar ul Haq, Vice Principal, Bahria College, Naval Complex, E-8, Islamabad
6. Mrs. Zohra Yousaf, HOD Math, Army Public School & College, Hamza Camp Rawalpindi
7. Ms. Memona Tabbasam, Subject Experts, APSAC Secretariat Rawalpindi

The whole work was successfully accomplished under the able supervision and guidance of Dr. Ikram Ali Malik, Chairman, FBISE and due to the hard work and dedication of the staff of Research Section of FBISE, in particular, Syed Zulfiqar Shah, Deputy Secretary, Research and Academics who played a pivotal and leading role in finalizing the Assessment Framework.

MIRZA ALI
Director
FBISE, Islamabad

ASSESSMENT FRAMEWORK FOR MATHEMATICS GRADE-XI, CURRICULUM 2022-23

To ensure clarity and precision in assessment, the learning outcomes have been categorized into two distinct groups: formative and summative. This classification helps in effectively measuring student progress and understanding. Each Student learning outcome (SLO) has been carefully marked as either formative or summative within the newly developed Assessment Framework. SLOs of Summative Assessment Format will be part of the Final Examination while SLOs of Formative Assessment will although be part of the teaching-learning activity but they will **NOT** be part of Final Examinations. Estimated cognitive levels i.e Knowledge (K), Understanding (U) and Application (A) of all the SLOs have also been indicated. It may be noted that all the higher cognitive levels have been collectively accumulated in the cognitive level of 'Application'. In subjects involving Practicals (Lab work), it has been mentioned categorically whether an SLO is summative for theory or summative for Practical Based Assessment (PBA). If an SLO is summative for PBA, it means that Laboratory work is required in the teaching-learning activity and it will be part of the Practical Examination/ Practical Based Assessment.

The Assessment Framework will act as a comprehensive guide for students, teachers and paper setters. Students will have clear instructions on how to prepare for the annual examinations. Teachers will use the framework to understand the curriculum and effectively prepare their students for the final examination. Additionally, paper setters will refer to this document for guidance in setting examination papers.

A model question paper has also been developed to provide a clear structure and format for upcoming examinations. The model question paper ensures consistency and fairness, offering students a comprehensive understanding of what to expect in their examinations. By aligning the paper with the Student Learning Outcomes (SLOs) of the curriculum, we ensured that the questions accurately reflect the skills and knowledge that students are expected to acquire.

A detailed Table of Specifications (ToS) has been created to ensure equitable coverage of cognitive levels and content domains in order to generate a balanced question paper. The ToS serves as drawing scale and action plan for the question paper, ensuring that all important areas of the curriculum are adequately and proportionately assessed.

FORMATIVE ASSESSMENT: AN ESSENTIAL COMPONENT OF EFFECTIVE LEARNING

Formative assessment is a pivotal element in the educational process, distinguished by its role in providing ongoing feedback to both students and educators. Unlike summative assessments, which evaluate student learning at the end of an instructional period, formative assessments are integrated into the learning process to monitor student understanding and guide instructional decisions.

The primary objective of formative assessment is to identify learning gaps and misunderstandings as they occur, enabling timely interventions. This dynamic approach allows teachers to adjust their teaching strategies to better meet the needs of their students. For instance, if a teacher notices through a quick quiz or class discussion that a significant portion of the class struggles with a particular concept, they can revisit that topic, providing additional explanations or alternative methods of instruction. This adaptability is crucial for fostering a deeper understanding of the material.

Formative assessments come in various forms, ranging from informal methods like classroom discussions, observations, and questioning, to more structured approaches such as quizzes, peer assessments, and self-reflections. These methods are not limited to paper-and-pencil tasks but can include digital tools that provide instant feedback. The versatility of formative assessments allows educators to cater to diverse learning styles and preferences, ensuring that all students are engaged and supported in their learning journey.

Formative assessment plays a significant role in creating a supportive classroom environment. It shifts the focus from merely achieving grades to understanding the learning process. This approach reduces the pressure on students, as they perceive assessments not as a final judgment of their abilities but as a part of their learning journey. Consequently, formative assessment can lead to increased student motivation and engagement.

In conclusion, formative assessment is a powerful tool that, when effectively implemented, can significantly enhance the learning experience. It provides invaluable insights for both teachers and students, promotes a growth-oriented learning environment, and supports the continuous development of essential skills. As education evolves, the role of formative assessment will undoubtedly continue to be central in fostering successful and meaningful learning experiences.

SUMMATIVE ASSESSMENT: EVALUATING LEARNING OUTCOMES IN THE FORM OF TERMINAL/FINAL EXAMINATION

Summative assessment is a fundamental component of the educational process, designed to evaluate student learning at the conclusion of an instructional period. Unlike formative assessment, which provides ongoing feedback during the learning process, summative assessment serves as a final measure of what students have learned. Typically administered at the end of a unit, course, or academic year. Summative assessment aims to determine the extent to which educational objectives have been achieved.

The primary purpose of summative assessment is to assess the overall effectiveness of instruction and learning. It provides a conclusive evaluation of student performance, often in the form of tests, final projects, or standardized exams. These assessments generate grades or scores that reflect a student's achievement in a given subject area over a specific period or time duration.

Summative assessment is often used to make critical decisions regarding student progression, certification, or placement in subsequent educational levels. Additionally, summative assessments provide valuable data that inform curriculum development and instructional strategies. By analyzing summative assessment results, educators can identify trends, strengths, and weaknesses within their instructional approaches, allowing for improvements in future teaching.

In conclusion, summative assessment plays a critical role in the educational process by providing a final evaluation of student learning. While it differs from formative assessment in its focus and application, it is an essential tool for measuring academic achievement. When balanced with formative assessments, summative assessments contribute to a well-rounded and effective approach to evaluating and supporting student learning.

National Curriculum of Pakistan 2022-23

Assessment Framework

MATHEMATICS Grade-XI (HSSC-I)

Details of Content Area/ Domain/SLOs

Content Area/ Domain	Topics	SLO Code / Description	Form of Assessment	Cognitive Level (Knowledge, Understanding, Application)	Remarks on SLOs	Number of Periods required (1 period = 40 minutes)
Domain A: Numbers and Algebra	Complex Numbers	[SLO: M-11-A-01]: Recall complex number represented by an expression of the form $a + bi$ or of the form $a + bi$ where a and b are real numbers and $i = \sqrt{-1}$.	Formative	K	Question(s) will not be asked in the annual examination; however, it will be part of regular teaching practice.	14
		[SLO: M-11-A-02]: Recognize $a + bi$ as a real part of $a + bi$ and bi as an imaginary part of $a + bi$.	Formative	U	Question(s) will not be asked in the annual examination; however, it will be part of regular teaching practice.	
		[SLO: M-11-A-03]: Know the condition for equality of complex numbers.	Formative	K	Question(s) will not be asked in the annual examination; however, it will be part of regular teaching practice.	
		[SLO: M-11-A-04]: Carryout basic operations on complex numbers.	Formative	U	Question(s) will not be asked in the annual examination; however, it	

					will be part of regular teaching practice.	
		[SLO: M-11-A-05]: Define _____ as the complex conjugate of _____	Formative	K	Question(s) will not be asked in the annual examination; however, it will be part of regular teaching practice.	
		[SLO: M-11-A-06]: Define _____ as the absolute value or modulus of a complex number _____.	Formative	K	Question(s) will not be asked in the annual examination; however, it will be part of regular teaching practice.	
		[SLO: M-11-A-07]: Solve the simultaneous linear equations with complex coefficients. For example, _____	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-08]: Write the polynomial _____ as a product of linear factors. For example, _____	Summative	K	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-09]: Solve quadratic equation of the form _____ by completing squares, where _____, _____ are real numbers and _____ a complex number. For example, _____ Solve _____	Summative	K	Question(s) will be asked in the annual examination.	

		[SLO: M-11-A-10]: Explain the polar coordinates system.	Formative	U	Question(s) will not be asked in the annual examination; however, it will be part of regular teaching practice.	
		[SLO: M-11-A-11]: Describe the polar representation of a complex number.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-12]: Apply the operations with complex numbers in polar representation.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-13]: Demonstrate simple equations and in-equations involving complex numbers in polar form.	Summative	A	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-14]: Apply concepts of complex numbers to real world problems (such as cryptography, wave phenomena, calculate voltage, current, circuits, the velocity and pressure of the fluid).	Summative	A	Question(s) will be asked in the annual examination.	
	Matrices & Determinants	[SLO: M-11-A-15]: Apply matrix operations (addition / subtraction and multiplication of matrices) with real and complex entries.	Formative	K	Question(s) will not be asked in the annual examination; however, it will be part of regular teaching practice.	21
		[SLO: M-11-A-16]: Evaluate determinant of matrices by using cofactors and properties of determinants.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-17]: Use row operations to find the inverse and the rank of a matrix.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-18]: Explain a consistent and inconsistent system of linear equations and demonstrate through examples.	Summative	U	Question(s) will be asked in the annual examination.	

		[SLO: M-11-A-19]: Solve a system of 3 by 3 non homogeneous linear equations by using matrix inversion method and Cramer's Rule.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-20]: Solve a system of three homogeneous linear equations in three unknowns using the Gaussian elimination method.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-21]: Apply the concepts of matrices to real world problems such as (graphic design, data encryption, seismic analysis, cryptography, transformation of geometric shapes, social network analysis).	Summative	A	Question(s) will be asked in the annual examination.	
	Sequences and Series	[SLO: M-11-A-22]: Solve problems by analyzing arithmetic sequences and series up to n terms.	Summative	U	Question(s) will be asked in the annual examination.	21
		[SLO: M-11-A-23]: Solve problems by analyzing geometric sequences and series up to n terms.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-24]: Identify a sequence as arithmetic or geometric sequence up to n terms.	Formative	U	Question(s) will not be asked in the annual examination; however, it will be part of regular teaching practice.	
		[SLO: M-11-A-25]: Solve problems by analyzing harmonic sequences and series up to n terms.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-26]: Find the sum of: • first natural numbers , • squares of first natural numbers , • cubes of first natural numbers .	Formative	K	Question(s) will not be asked in the annual examination; however, it will be part of regular teaching practice.	

		[SLO: M-11-A-27]: Recognize the arithmetic geometric sequence, determine its general term, find sum to n terms and sum to infinite number of terms, using sigma notation.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-28]: Identify leasing of motor vehicles, down payment, motor vehicle insurance, processing charges, repayment in monthly instalments.	Formative	K	Question(s) will not be asked in the annual examination; however, it will be part of regular teaching practice.	
		[SLO: M-11-A-29]: Solve problems related to leasing of motor vehicle under different conditions.	Summative	A	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-30]: Apply concepts from sequence and series to real world problems (such as simple interest on loan, investment, depreciation, Investment planning on compound interest, projectile motion, gaming strategy, health care management, web page design, traffic modelling).	Summative	A	Question(s) will be asked in the annual examination.	
	Mathematical Induction and Binomial Theorem	[SLO: M-11-A-31]: Describe a mathematical argument, identify the base case, induction of hypothesis and a precise conclusion.	Formative	K	Question(s) will not be asked in the annual examination; however, it will be part of regular teaching practice.	28
		[SLO: M-11-A-32]: Apply the principle of Mathematical Induction to prove statements, identities, divisibility of numbers and summation formulae.	Summative	A	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-33]: Evaluate and justify conclusions, communicating a position clearly in an appropriate mathematical form in daily life.	Summative	A	Question(s) will be asked in the annual examination.	

		[SLO: M-11-A-34]: State and apply the Binomial Theorem to expand expressions of the form $(a + b)^n$ where n is a positive integer.	Summative	K	Question(s) will be asked in the annual examination.
		[SLO: M-11-A-35]: Describe Binomial Theorem as expansion of binomial powers restricted to the set of natural numbers.	Summative	U	Question(s) will be asked in the annual examination.
		[SLO: M-11-A-36]: Calculate binomial coefficients using Pascal's triangle.	Formative	K	Question(s) will not be asked in the annual examination; however, it will be part of regular teaching practice.
		[SLO: M-11-A-37]: Expand using the Binomial Theorem, and use appropriate techniques to simplify the expression.	Summative	U	Question(s) will be asked in the annual examination.
		[SLO: M-11-A-38]: Find an approximate value using the Binomial Theorem.	Summative	A	Question(s) will be asked in the annual examination.
		[SLO: M-11-A-39]: Use Binomial Theorem to find the remainder when a number to some large exponent is divided by a number.	Summative	A	Question(s) will be asked in the annual examination.
		[SLO: M-11-A-40]: Use Binomial Theorem to find the last digit of a number, test the divisibility by a number and compare two large numbers.	Summative	A	Question(s) will be asked in the annual examination.
		[SLO: M-11-A-41]: Apply concepts of Mathematical Induction and Binomial Theorem to real world problems such as (Puzzles, Domino Effects, Pascal's Triangle, Economic Forecasting, Rankings, Variable Subletting).	Summative	A	Question(s) will be asked in the annual examination.

	Division of polynomial	[SLO: M-11-A-42]: Divide a polynomial of degree up to 4 by a linear and quadratic polynomial to identify quotient and remainder.	Summative	U	Question(s) will be asked in the annual examination.	14
		[SLO: M-11-A-43]: Demonstrate and apply Remainder Theorem.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-44]: Analyze and apply Factor Theorem to factorize a cubic polynomial.	Summative	A	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-45]: Apply concepts of Remainder and Factor Theorems to real world problems (such as polynomial regression, signal processing, and coding theory).	Summative	A	Question(s) will be asked in the annual examination.	
Domain B: Geometry	Vectors in Space	[SLO: M-11-B-01]: Recognize rectangular coordinate system in space.	Formative	K	Question(s) will not be asked in the annual examination; however, it will be part of regular teaching practice.	28
		[SLO: M-11-B-02]: Define unit vectors and Recognize components of a vector.	Formative	K	Question(s) will not be asked in the annual examination; however, it will be part of regular teaching practice.	
		[SLO: M-11-B-03]: Find the magnitude of a vector.	Formative	K	Question(s) will not be asked in the annual examination; however, it will be part of regular teaching practice.	
		[SLO: M-11-B-04]: Repeat all fundamental mathematical operations for vectors in space which, in the plane, have already been discussed.	Formative	K	Question(s) will not be asked in the annual examination; however, it will be part of regular	

					teaching practice.	
		[SLO: M-11-B-05]: Demonstrate and prove properties of Vector Addition • The Commutative Law, • The Associative Law, • Null vector as an identity vector, • as additive inverse vector of .	Formative	K	Question(s) will not be asked in the annual examination; however, it will be part of regular teaching practice.	
		[SLO: M-11-B-06]: Explain Dot or Scalar Product of two vectors and give its geometrical interpretation.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-B-07]: Express dot product in terms of components.	Summative	K	Question(s) will be asked in the annual examination.	
		[SLO: M-11-B-08]: Find the condition for orthogonality of two vectors.	Summative	K	Question(s) will be asked in the annual examination.	
		[SLO: M-11-B-09]: Use dot product to find the angle between two vectors.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-B-10]: Find the projection of a vector along another vector.	Summative	K	Question(s) will be asked in the annual examination.	
		[SLO: M-11-B-11]: Find the work done by a constant force in moving an object along a given vector.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-B-12]: Solve daily life problems based on vectors. Cross or Vector Product.	Summative	A	Question(s) will be asked in the annual examination.	
		[SLO: M-11-B-13]: Explain the cross or vector product of two vectors and give its geometrical interpretation.	Summative	U	Question(s) will be asked in the annual examination.	

		[SLO: M-11-B-14]: Apply a cross product to find the angle between two vectors.	Summative	A	Question(s) will be asked in the annual examination.
		[SLO: M-11-B-15]: Solve situations in daily life based on Cross or dot Vector Product.	Summative	A	Question(s) will be asked in the annual examination.
		[SLO: M-11-B-16]: Describe scalar triple product of vectors.	Summative	U	Question(s) will be asked in the annual examination.
		[SLO: M-11-B-17]: Express Scalar Triple Product of vectors in terms of components (determinant form).	Summative	K	Question(s) will be asked in the annual examination.
		[SLO: M-11-B-18]: Prove that • • Prove that dot and cross are inter-changeable in scalar triple product.	Summative	K	Question(s) will be asked in the annual examination.
		[SLO: M-11-B-19]: Find the volume of a • parallelepiped, • tetrahedron, determined by three given vectors.	Summative	K	Question(s) will be asked in the annual examination.
		[SLO: M-11-B-20]: Define coplanar vectors and find the condition for planarity of three vectors.	Summative	K	Question(s) will be asked in the annual examination.
		[SLO: M-11-B-21]: Apply concepts of vectors in space to real world problems such as (design and execute optimal navigation paths in transportation and logistics, graphing complex 3D motion, vector operations in engineering and computer graphics, practical proficiency for work, flux, and circulation).	Summative	A	Question(s) will be asked in the annual examination.

	Fundamental Law of Trigonometry	[SLO: M-11-B-22]: Establish fundamental law of trigonometry.	Summative	U	Question(s) will be asked in the annual examination.	14
		[SLO: M-11-B-23]: Apply fundamental law and its deductions to derive: Trigonometric ratios of allied angles, double angle, half angle and triple angle identities.	Summative	A	Question(s) will be asked in the annual examination.	
		[SLO: M-11-B-24]: Express the product (of sines and cosines) as sums or differences (of sines and cosines).	Summative	K	Question(s) will be asked in the annual examination.	
	Trigonometric Functions	[SLO: M-11-B-25]: Find the domain and range of the trigonometric functions.	Summative	U	Question(s) will be asked in the annual examination.	21
		[SLO: M-11-B-26]: Discuss even, odd functions and the periodicity of trigonometric functions.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-B-27]: Find the maximum and minimum value of a given function of the type: • $y = a \sin(bx + c) + d$, • $y = a \cos(bx + c) + d$, • $y = a \tan(bx + c) + d$, • the reciprocals of above, where a, b, c, d are real numbers.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-B-28]: Graph and analyze the trigonometric functions sine, cosine, and tangent to solve problems.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-B-29]: Explain the properties of graphs of $y = \sin^{-1}x$ and $y = \cos^{-1}x$.	Summative	U	Question(s) will be asked in the annual examination.	

		[SLO: M-11-B-30]: Apply the concepts of trigonometric functions, identities, graphs, periodicity, even & odd functions and extreme values to real world problems such as distance, elevation, and direction of tall structures, navigation and mapping, lengths of irregular shapes, graphs to visualize and predict patterns in data, frequency and periodic length of Ferris wheel, forces on a see-saw or lever, the ideal angle for solar panel placement.	Summative	A	Question(s) will be asked in the annual examination.	
Domain C: Information Handling	Permutation and Combination	[SLO: M-11-C -01]: Explain and solve problems that involve the fundamental counting principle.	Summative	U	Question(s) will be asked in the annual examination.	14
		[SLO: M-11-C -02]: Explain and Solve problems that involve permutations.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-C -03]: Explain and Solve problems that involve combinations.	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-C -04]: Apply the concepts of permutation and combination to real world problems such as cryptography, estimating the odds of winning a lottery, calculating the number of possible DNA sequences or protein structures, choosing different sets of songs for certain occasions.	Summative	A	Question(s) will be asked in the annual examination.	

FINAL CONCEPTUAL PATTERN OF HSSC-I & II

Mathematics

Total Marks: 100 Marks (Theory Paper)

Components	Detail
Marks Allocated to MCQs	48 marks
Total MCQs	64
Marks per MCQ	0.75
Objective Portion – MCQs (48 Marks)	Section-A (MCQs) 40 straight MCQs ($56 \times 0.75 = 30 \text{ marks}$) 24 MCQs with (6-stimulus/situations/scenario) ($24 \times 0.75 = 18 \text{ marks}$)
Subjective Portion – SRQs & ERQs Structure (52 Marks)	Section-B (SRQs) Section B having 7 questions. Each question has internal choice. Each question having 4 marks. ($7 \times 4 = 28 \text{ marks}$) Section –C (ERQs) Section C having 3 questions. Each question has internal choice. Each question having 8 marks. ($3 \times 8 = 24 \text{ marks}$)
Subjective Portion Structure	7 straight SRQs (with no sub parts) 2 straight ERQs (with no sub parts) 1 straight ERQs (with sub parts)

Important Note:

- i) Summative SLOs of NCP Mathematics 2022-23 for grades XI or XII will only be included.
- ii) Ensure balanced domain coverage using the Table of Specifications (ToS).

Mathematics HSSC-I

To be filled-in by the Candidate

PAPER VERSION

(A)

(B)

(C)

(D)

(E)

CORRECTLY FILLED



WRONG METHOD



Time Allowed: 1:40 Hours

Total Marks: 48

Candidate Sign. _____

Invigilator Sign. _____

Question Booklet No. _____

Roll No. _____

FILL ONLY ONE BUBBLE FOR EACH CORRECT ANSWER. USE BLACK BALL POINT/MARKER

1	(A)	(B)	(C)	(D)	17	(A)	(B)	(C)	(D)	33	(A)	(B)	(C)	(D)	49	(A)	(B)	(C)	(D)
2	(A)	(B)	(C)	(D)	18	(A)	(B)	(C)	(D)	34	(A)	(B)	(C)	(D)	50	(A)	(B)	(C)	(D)
3	(A)	(B)	(C)	(D)	19	(A)	(B)	(C)	(D)	35	(A)	(B)	(C)	(D)	51	(A)	(B)	(C)	(D)
4	(A)	(B)	(C)	(D)	20	(A)	(B)	(C)	(D)	36	(A)	(B)	(C)	(D)	52	(A)	(B)	(C)	(D)
5	(A)	(B)	(C)	(D)	21	(A)	(B)	(C)	(D)	37	(A)	(B)	(C)	(D)	53	(A)	(B)	(C)	(D)
6	(A)	(B)	(C)	(D)	22	(A)	(B)	(C)	(D)	38	(A)	(B)	(C)	(D)	54	(A)	(B)	(C)	(D)
7	(A)	(B)	(C)	(D)	23	(A)	(B)	(C)	(D)	39	(A)	(B)	(C)	(D)	55	(A)	(B)	(C)	(D)
8	(A)	(B)	(C)	(D)	24	(A)	(B)	(C)	(D)	40	(A)	(B)	(C)	(D)	56	(A)	(B)	(C)	(D)
9	(A)	(B)	(C)	(D)	25	(A)	(B)	(C)	(D)	41	(A)	(B)	(C)	(D)	57	(A)	(B)	(C)	(D)
10	(A)	(B)	(C)	(D)	26	(A)	(B)	(C)	(D)	42	(A)	(B)	(C)	(D)	58	(A)	(B)	(C)	(D)
11	(A)	(B)	(C)	(D)	27	(A)	(B)	(C)	(D)	43	(A)	(B)	(C)	(D)	59	(A)	(B)	(C)	(D)
12	(A)	(B)	(C)	(D)	28	(A)	(B)	(C)	(D)	44	(A)	(B)	(C)	(D)	60	(A)	(B)	(C)	(D)
13	(A)	(B)	(C)	(D)	29	(A)	(B)	(C)	(D)	45	(A)	(B)	(C)	(D)	61	(A)	(B)	(C)	(D)
14	(A)	(B)	(C)	(D)	30	(A)	(B)	(C)	(D)	46	(A)	(B)	(C)	(D)	62	(A)	(B)	(C)	(D)
15	(A)	(B)	(C)	(D)	31	(A)	(B)	(C)	(D)	47	(A)	(B)	(C)	(D)	63	(A)	(B)	(C)	(D)
16	(A)	(B)	(C)	(D)	32	(A)	(B)	(C)	(D)	48	(A)	(B)	(C)	(D)	64	(A)	(B)	(C)	(D)



Federal Board HSSC-I Examination

Mathematics Model Question Paper

National Curriculum 2022-2023 (Inclusive Scheme of Studies 2024)
(50% MCQs & 50% Descriptive)

SECTION - A (Marks 48)

Time Allowed: 1:40 hours

**Section – A is compulsory. All parts of this section are to be answered on the OMR Sheet given in the E-Sheet and handed over to the Centre Superintendent.
Deleting/ overwriting is not allowed. Do not use lead pencil.**

Roll Number							Paper Version
							A

Candidate Sign._____

Invigilator Sign._____

Note: Fill the correct bubble for each question on OMR Sheet given in the E-Sheet. Each question carries 0.75 mark.

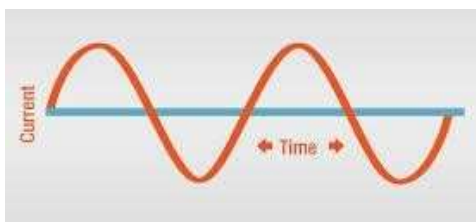
S No.	Question	A	B	C	D
1.	The linear factors of the polynomial $4z^2 + 9y^2$ are:	$(2z - 3yi)^2$	$(2z + 3yi)^2$	$(2z + 3y)(2z - 3y)$	$(2z + 3yi)(2 - 3yi)$
2.	What is the principal argument of $-i - \sqrt{3}$?	$-\frac{4\pi}{3}$	$\frac{4\pi}{3}$	$\frac{\pi}{3}$	$\frac{\pi}{3}$
3.	If $z = r\cos\theta + ir\sin\theta$ then z^{-1} is equal to:	$\frac{\cos\theta - i\sin\theta}{r}$	$\frac{-\cos\theta + i\sin\theta}{r}$	$\frac{-\cos\theta - i\sin\theta}{r}$	$\frac{\cos\theta + i\sin\theta}{r}$
4.	If A is a square matrix of order 3 with $ A = 5$, then the value of $ 2A $ is:	5	10	25	40
5.	For $A = \begin{bmatrix} 3 & 3 & 1 \\ 0 & 5 & -1 \\ 2 & 1 & 4 \end{bmatrix}$, what is the value the cofactor A_{12} ?	-2	0	2	-11
6.	Which condition defines an inconsistent system of linear equations?	One solution	Infinite solutions	Trivial solution	No solution
7.	If the first term of a sequence is 10 and the common difference is 0, what is the 50th term?	0	10	50	500
8.	Row 1 of a theatre has 20 seats. Each successive row has 2 additional seats. At which row number does the seat count reach 40?	10th	11th	12th	20th
9.	A ball is dropped and rebounds to 60%, of its previous height. If the first bounce is 100 cm, what is the height of the 2 nd bounce?	60 cm	48 cm	36 cm	6 cm

10.	Find the 5 th term of an HP whose corresponding AP is 5, 10, 15, ...	$\frac{1}{20}$	$\frac{1}{25}$	$\frac{1}{30}$	$\frac{1}{35}$
11.	The third term in the expansion of $(x^2-2)^4$ is:	$24x^4$	$-24x^4$	$-32x^2$	$32x^2$
12.	Which term in the expansion of $(x^2 - \frac{1}{x^2})^6$ is independent of x?	T_3	T_4	T_5	T_6
13.	The simplified form of $(x+1)^3 - (x-1)^3$ is:	$2x^3 + 6x$	$6x^2 + 2$	$6x^2 + 2x$	$2x^3 + 6x^2$
14.	When 3^{50} is divided by 8, the remainder is:	1	3	5	7
15.	When dividing $x^3 + 2x^2 - 5x + 1$ by $x - 2$, the degree of the remainder is:	0	1	2	7
16.	Dividing $x^4 - 3x^2 + 2$ by $x^2 - 1$, the quotient is:	$x^2 - 2$	$x^2 + 2$	$x^2 - 1$	$x^2 + 1$
17.	For what value of k, $x - 2$ is the factor of $x^3 - kx^2 + 4x - 4$?	-3	0	3	4
18.	Two direction angles of vector $\vec{a}$ are 30° and 60° . What is the value of third direction angle?	135°	90°	45°	30°
19.	The vector parallel to $2\hat{i} + 6\hat{j} - 5\hat{k}$ and with magnitude 3 is:	$[\frac{12}{\sqrt{65}}, \frac{-18}{\sqrt{65}}, \frac{75}{\sqrt{65}}]$	$[\frac{12}{\sqrt{65}}, \frac{18}{\sqrt{65}}, \frac{25}{\sqrt{65}}]$	$-\{ \frac{6}{\sqrt{65}}, \frac{18}{\sqrt{65}}, \frac{-15}{\sqrt{65}} \}$	$[\frac{6}{\sqrt{65}}, \frac{-18}{\sqrt{65}}, \frac{8}{\sqrt{65}}]$
20.	The area of a parallelogram having adjacent sides $\vec{a} = [2, 5, -2]$ and $\vec{b} = [1, 4, -2]$ is:	$\sqrt{17}$	$\frac{\sqrt{17}}{2}$	$\sqrt{17} \cdot 6$	$2\sqrt{17}$
21.	At which angle the work done is zero?	0°	45°	90°	180°
22.	In navigation the velocity of the air-plane is calculated using:	Dot product	Vector addition	Vector subtraction	Cross product
23.	If $\vec{a} = \hat{i} + 2\hat{j} - 2\hat{k}$ and $\vec{b} = 2\hat{i} + 3\hat{j} - 3\hat{k}$ then $\hat{i} \cdot \vec{a} + \hat{j} \cdot \vec{b} = ?$	1	-2	2	4
24.	If $\sin \theta = \frac{3}{5}$ and θ is acute, what is the value of $\sin 2\theta$?	$\frac{24}{25}$	$\frac{12}{25}$	$\frac{7}{25}$	$\frac{16}{25}$
25.	If $\cos \theta = -\frac{1}{3}$ and θ lies in quadrant II, the value of $\sin(\frac{\theta}{2})$ is:	$\frac{\sqrt{6}}{3}$	$-\frac{\sqrt{6}}{3}$	$\frac{\sqrt{3}}{3}$	$\frac{\sqrt{3}}{3}$
26.	Simplifying $2(\sin 3x)(\cos x)$ into a sum or difference we get:	$\sin 4x + \sin 2x$	$\sin 4x - \sin 2x$	$\sin 2x - \sin x$	$\sin 2x + \sin x$
27.	If $\tan \alpha = \frac{1}{2}$ and $\tan \beta = \frac{1}{3}$ (α, β are acute), the exact value of $(\alpha + \beta)$ is:	0°	8°	45°	90°
28.	Which of the following is equivalent to $\sin(270^\circ - \theta)$?	$-\sin \theta$	$-\cos \theta$	$\sin \theta$	$\cos \theta$
29.	If $\sin 25^\circ = t$, then $\cos 50^\circ$ in terms of t is:	$2t^2 - 1$	$2t\sqrt{1-t^2}$	$1 - 2t^2$	$\sqrt{1-2t^2}$

30.	What is the range of the function $y = 3(2x)$?	$[-1, 1]$	$[-2, 2]$	$[-3, 3]$	$(-\infty, \infty)$
31.	The sum of $\sin(-x) + \sin x$ is?	0	1	$2\sin x$	$\sin 2x$
32.	The period of $4\cos\left(\frac{x}{3}\right)$ is:	$\frac{4\pi}{3}$	$\frac{2\pi}{3}$	2π	6π
33.	What is the maximum value of $10 \sin x - 5 \cos x + 2$?	3	17	7	13
34.	Which pair of the trigonometric functions has period π ?	$\sin x, \cos x$	$\tan x, \cot x$	$\sec x, \operatorname{cosec} x$	$\sin x, \tan x$
35.	A pizza shop offers 8 toppings. How many different pizzas can be made if you must choose exactly 3 toppings?	24	56	92	336
36.	In how many ways can a student choose 4 questions out of 6 in an exam?	15	24	30	360
37.	In how many ways a DJ can play 5 songs out of 12 (order matters)?	$\binom{12}{5}$	$\frac{12!}{5!}$	${}^{12}P_5$	$\frac{12!}{4!}$
38.	If a coin is tossed 3 times, what is the total number of possible outcomes?	3	6	8	9
39.	The value of ${}^nP_{n-1}$ is?	n	$n!$	$\frac{n!}{(2n-1)!}$	$\frac{n}{2n-1}$
40.	If ${}^{n-1}P_3 : {}^nP_4 = 1:9$ then value of n is:	3	6	7	9

STIMULUS/SITUATION/SCENARIO BASED MCQs

	Scenario for MCQs (41-44)	Given a complex polynomial $z^2 + 4$, where z is a complex number.				
41.	The complex polynomial $z^2 + 4$ is:	reducible to real factors	irreducible to real factors	reducible to complex factors	irreducible to complex factors	
42.	If 4 is replaced with 8 and z^2 is replaced with z^3 in polynomial $(z^2 + 4)$, then the number of linear factor(s) of polynomial are:	1	2	3	Not possible	
43.	The linear factors of polynomial $z^2 + 4$ are:	$z + 4i,$ $z - 4i$	$z - 2i,$ $z - 2i$	$z + 2i,$ $z - 4i$	$z + 2i,$ $z - 2i$	
44.	The two factors of $z^2 + 4$ are:	conjugate of each other	same	additive inverse of each other	reciprocal of each other	
	Scenario for MCQs (45-48)	Three seismic stations track wave data where x, y , and z represent the exact amplitude of primary, secondary, and surface waves respectively. The seismic network model is: $AX = B, \begin{bmatrix} 1 & 1 & 1 \\ 0 & 2 & 0 \\ 5 & 5 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 6 \\ 12 \\ 0 \end{bmatrix}, \text{ then}$				
45.	The value of $ A $ is:	-16	-8	0	16	
46.	The value of $ A_z $ is:	-16	-60	0	60	
47.	The value of z is:	-3.75	0.27	3.75	7.5	

48.	The value of $ A $ if Row 3 is replaced by $\begin{bmatrix} 3 & 3 & 3 \end{bmatrix}$	-48	-16	0	48											
	Scenario for MCQs (49-52)	Use the table below showing the Weekly Savings of a student to answer the questions.														
		<table><tr><th>Week (n)</th><th>Total Savings (S_n)</th></tr><tr><td>1st</td><td>Rs 150</td></tr><tr><td>2nd</td><td>Rs 350</td></tr><tr><td>3rd</td><td>Rs 600</td></tr><tr><td>4th</td><td>Rs 900</td></tr></table>		Week (n)	Total Savings (S_n)	1 st	Rs 150	2 nd	Rs 350	3 rd	Rs 600	4 th	Rs 900			
Week (n)		Total Savings (S_n)														
1 st		Rs 150														
2 nd		Rs 350														
3 rd	Rs 600															
4 th	Rs 900															
49.	What is the value of a_2 ?	150	200	250	350											
50.	What is the total savings for the 3rd week?	200	250	350	600											
51.	Which formula represents the total savings (S_n) for any week (n)?	$S_n = \frac{n}{2} [300 + (n-1)50]$	$S_n = 150 + (n-1)50$	$S_n = \frac{n}{2} [150 + (n-1)50]$	$s_n = 150n + 50$											
52.	By the end of which week will the student's total savings first exceed Rs. 2,500?	6th week	7th week	8th week	9th week											
	Scenario for MCQs (53-56)	A drone is flying in space. Its motion is represented by the vectors $\vec{a} = 2\hat{i} + \hat{j} + 2\hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} + \hat{k}$. An engineer wants to analyze the relationship between these two directions using dot and cross products.														
53.	The engineer computes $\vec{a} \cdot \vec{b}$. What does this quantity help to determine?	The area of parallelogram formed by the vectors	The angle between the vectors	Law of sines	The area of a triangle											
54.	In terms of vectors $\vec{a}$ and $\vec{b}$, how would you express the work done on the drone?	$ \vec{a} + \vec{b} $	$ \vec{a} - \vec{b} $	$\vec{a} \times \vec{b}$	$\vec{a} \cdot \vec{b}$											
55.	If $\vec{a} \times \vec{b} = 0$. What can be concluded about the drone's angle of direction?	0°	45°	60°	90°											
56.	An engineer wants to position a communication antenna perpendicular to both $\vec{a}$ and $\vec{b}$. Which vector gives its orientation?	$-3\hat{i} + 3\hat{k}$	$3\hat{i} + 3\hat{k}$	$-3\hat{i} - 3\hat{k}$	$3\hat{i} - 3\hat{k}$											
	Scenario for MCQs (57-60)	Current in the circuit with the passage of time follows the wave pattern.														
																
57.		Wave shown in the figure is often known as:	secant wave	tangent wave	sine wave	longitudinal wave										
58.		If the function $y = 2\sin x$ represents the wave, then what is the domain of the function?	$(-\infty, 0]$	$[0, \infty)$	$(-\infty, \infty)$	$[1, \infty)$										
59.		What is the maximum value of $y = 2\sin x$?	0	1	2	∞										
60.	If $y = 2\sin x$ is replaced by $y = 3\cos x$, then what is the range of the new function?	$(-3, 3)$	$[-3, 3]$	$(-3, 3]$	$[-3, 3)$											
	Scenario for MCQs (61-64)	A student council has 12 members: 5 from Grade 11 and 7 from Grade 12. A committee of 4 members is to be formed. The committee must have exactly 2 students from Grade 11 and 2 from Grade 12. The order of selection does not matter.														

61.	The number of ways to choose 2 students from Grade 11 is:	5	10	20	25	
62.	How many ways to choose 2 students from Grade 12?	7	14	21	42	
63.	The total number of ways to form the committee is:	31	210	420	840	
64.	If the committee instead had no grade restriction, the number of possible committees would be:	210	330	495	792	



Federal Board HSSC-I Examination
Model Question Paper Mathematics
National Curriculum 2022-2023 (Inclusive Scheme of Studies 2024)
(50% MCQs & 50% Descriptive)

Time allowed: 1.20 hours

Total Marks: 52

Note: Answer all parts from Section „B“ and all questions from Section „C“ on the **E-sheet**.
Write your answers on the allotted/given spaces.

SECTION – B (Marks 52)

(7 × 4 = 28)

Q.No	Question	Marks	Question	Marks
1.	Find the quadratic equation of: $\arg(z - 2) - \arg(z + 2) = \pi/4$	4	OR Find A^{-1} , If $A = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 1 & 3 \\ 3 & 7 & 7 \end{bmatrix}$ by using row operations.	4
2.	The 2 nd term of an H.P. is $\frac{1}{5}$ and 5 th term is $\frac{1}{11}$. Find the 12 th term?	4	OR Solve the simultaneous linear equations: $\frac{3}{2}z - 6(1 + \frac{i}{3})w = 5,$ $\frac{i}{2}z + (\frac{3}{4} - \frac{1}{2}i)w = (\frac{1}{2} + 2i)$	4
3.	If the vectors $u \rightarrow = p\hat{i} + \hat{j} + \hat{k}$, $v \rightarrow = \hat{i} + q\hat{j} + \hat{k}$ and $w \rightarrow = \hat{i} + \hat{j} + r\hat{k}$ are coplanar, then prove that $\frac{1}{1-p} + \frac{1}{1-q} + \frac{1}{1-r} = 1$	4	OR Divide $3x^4 - 2x^3 + 4x^2 - x + 5$ by $x^2 - x + 1$. Find the quotient and remainder.	4
4.	In a class of 40 students, 25 passed Mathematics and 18 passed Science. A student claims: “At least 3 students passed both subjects.” Using the principle of inclusion-exclusion, justify whether this claim is correct.	4	OR Express the vector $a \rightarrow = 3\hat{i} + 7\hat{j} + 2\hat{k}$ as a sum of two vectors one of which is parallel and other is perpendicular to the vector $b \rightarrow = 5\hat{i} + \hat{j} + 8\hat{k}$.	4
5.	Given: $y = 2 \cos(5x) \cos(x) + 2 \sin(3x) \sin(x)$ i. Simplify y into a single sum or difference of cosine functions. ii. Calculate the exact numerical value of y when $x = 15^\circ$.	4	OR In an A.P, the sum of the first n terms is given by: $S_n = 3n + tn^2$. If $S_4 = 28$, i. Find the value of t . ii. Determine first term and the common difference.	4
6.	In a lottery, a player selects 5 distinct numbers from 1 to 50.		A Ferris wheel has a radius of 10 meters and its centre is 12 meters	

	i. Calculate the total number of possible combinations. ii. If a player buys 5 tickets with different combinations, what is the probability of winning the jackpot (matching all 5 numbers)?	4	OR	above the ground. It completes one revolution in 40 seconds. A passenger starts at the lowest point at time $t = 0$. i. Model the passenger's height $h(t)$ above the ground using a cosine function of the form $h(t) = a\cos(kt) + c$. Find the	4
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				values of a , k , and c . ii. Calculate the passenger's height after 10 seconds.	
7.	Determine whether the function $(x) = x \sin x$ is even, odd, or neither. Also, check whether it is periodic; if yes, find its fundamental period.	4	OR	Find n if $\frac{1}{2(n-2)!} : \frac{1}{4!(n-4)!} = 2:1$ for $n \geq 4$	4

SECTION – C (Marks 24)

Note: Attempt all questions. Marks of each question are given. ($3 \times 8 = 24$)

Q. No.	Question	Marks		Question	Marks
Q8	Consider the system of linear equations: $3x + y - \beta z = 0$ $4x - 2y - 3z = 0$ $2x + 4y + \beta z = 0$ Find the value(s) of β for which the given system of homogeneous equations has non-trivial solution. Also solve the system for the value(s) of β .	8	OR	Expand $(3 + x)^5$ using the Binomial Theorem. Then evaluate the expansion at $x = 0.1$ to find the numerical value of $(3.1)^5$ without a calculator (show terms).	8
Q9	Given that $1 + \frac{4}{5} + \frac{7}{5^2} + \frac{10}{5^3} + \dots$ i. Find the sum of first n terms of the series. ii. Find the sum to infinity of the series.	8	OR	iii. Given the cubic polynomial iv. $Q(x) = x^3 - 6x^2 + 11x - 6$. v. Use the Factor Theorem to find one linear factor by testing integral roots. vi. Perform polynomial division to find the quadratic factor, then factorize completely.	8
Q10	If $\vec{a} = 3\hat{i} - \hat{j} + 5\hat{k}$, $\vec{b} = 4\hat{i} + 3\hat{j} - 2\hat{k}$ and $\vec{c} = 2\hat{i} + 5\hat{j} + \hat{k}$, then verify that $\vec{a} \cdot \vec{b} \times \vec{c} = \vec{b} \cdot \vec{c} \times \vec{a} = \vec{c} \cdot \vec{a} \times \vec{b}$	8	OR	Show that $\cos 5\theta + 2\cos 3\theta + \cos \theta = 4 \cos 3\theta \cos^2 \theta$ and verify the identity for $\theta = 20^\circ$	8

Federal Board HSSC-I Examination
Mathematics (Curriculum 2022-23)
Alignment of Questions with Student Learning Outcomes

OBJECTIVE PART
SECTION A

Q. No. (Part no.)	Content Area/ Domain	Student Learning Outcomes	Cognitive Level *	Allocated Marks
Q1(1)	Domain: Numbers and Algebra	[SLO: M-11-A-08]: Write the polynomial (z) as a product of linear factors.	K	0.75
Q1(2)	Domain: Numbers and Algebra	[SLO: M-11-A-11]: Describe the polar representation of a complex number.	U	0.75
Q1(3)	Domain: Numbers and Algebra	[SLO: M-11-A-12]: Apply the operations with complex numbers in polar representation.	A	0.75
Q1(4)	Domain: Numbers and Algebra	[SLO: M-11-A-20]: Solve a system of three homogeneous linear equations in three unknowns using the Gaussian elimination method.	K	0.75
Q1(5)	Domain: Numbers and Algebra	[SLO: M-11-A-16]: Evaluate determinant of 3×3 matrices by using cofactors and properties of determinants.	U	0.75
Q1(6)	Domain: Numbers and Algebra	[SLO: M-11-A-18]: Explain a consistent and inconsistent system of linear equation	K	0.75
Q1(7)	Domain: Numbers and Algebra	[SLO: M-11-A-22]: Solve problems by analyzing arithmetic sequences and series up to n terms.	U	0.75
Q1(8)	Domain: Numbers and Algebra	[SLO: M-11-A-22]: Solve problems by analyzing arithmetic sequences and series up to n terms.	A	0.75
Q1(9)	Domain: Numbers and Algebra	[SLO: M-11-A-23]: Solve problems by analyzing geometric sequences and series up to n terms.	A	0.75
Q1(10)	Domain: Numbers and Algebra	[SLO: M-11-A-25]: Solve problems by analyzing harmonic sequences and series up to n terms.	U	0.75
Q1(11)	Domain: Numbers and Algebra	[SLO: M-11-A-34]: State and apply the Binomial Theorem to expand expressions of the form $(a +)^n$ where n is a positive integer.	A	0.75
Q1(12)	Domain: Numbers and Algebra	[SLO: M-11-A-37]: Expand using the Binomial Theorem, and use appropriate techniques to simplify the expression.	K	0.75
Q1(13)	Domain: Numbers and Algebra	[SLO: M-11-A-37]: Expand using the Binomial Theorem, and use appropriate techniques to simplify the expression.	U	0.75
Q1(14)	Domain: Numbers and Algebra	[SLO: M-11-A-39]: Use Binomial Theorem to find the remainder when a number to some large exponent is divided by a number.	U	0.75

Q1(15)	Domain: Numbers and Algebra	[SLO: M-11-A-42]: Divide a polynomial of degree up to 4 by a linear and quadratic polynomial to identify quotient and remainder.	K	0.75
Q1(16)	Domain: Numbers and Algebra	[SLO: M-11-A-42]: Divide a polynomial of degree up to 4 by a linear and quadratic polynomial to identify quotient and remainder.	U	0.75
Q1(17)	Domain: Numbers and Algebra	[SLO: M-11-A-43]: Demonstrate and apply Remainder Theorem.	U	0.75
Q1(18)	Domain: Geometry	[SLO: M-11-B-15]: Solve situations in daily life based on Cross or dot Vector Product.	U	0.75
Q1(19)	Domain: Geometry	[SLO: M-11-B-12]: Solve daily life problems based on vectors. Cross or Vector Product.	A	0.75
Q1(20)	Domain: Geometry	[SLO: M-11-B-20]: Define coplanar vectors and find the condition for planarity of three vectors.	K	0.75
Q1(21)	Domain: Geometry	[SLO: M-11-B-11]: Find the work done by a constant force in moving an object along a given vector.	K	0.75
Q1(22)	Domain: Geometry	[SLO: M-11-B-15]: Solve situations in daily life based on Cross or dot Vector Product.	U	0.75
Q1(23)	Domain: Geometry	[SLO: M-11-B-06]: Explain Dot or Scalar Product of two vectors and give its geometrical interpretation.	U	0.75
Q1(24)	Domain: Geometry	[SLO: M-11-B-23]: Apply fundamental law and its deductions to derive: Trigonometric ratios of allied angles, double angle, half angle and triple angle identities.	A	0.75
Q1(25)	Domain: Geometry	[SLO: M-11-B-23]: Apply fundamental law and its deductions to derive: Trigonometric ratios of allied angles, double angle, half angle and triple angle identities.	A	0.75
Q1(26)	Domain: Geometry	[SLO: M-11-B-24]: Express the product (of sines and cosines) as sums or differences (of sines and cosines).	U	0.75
Q1(27)	Domain: Geometry	[SLO: M-11-B-23]: Apply fundamental law and its deductions to derive: Trigonometric ratios of allied angles, double angle, half angle and triple angle identities.	U	0.75
Q1(28)	Domain: Geometry	[SLO: M-11-B-23]: Apply fundamental law and its deductions to derive: Trigonometric ratios of allied angles, double angle, half angle and triple angle identities.	K	0.75
Q1(29)	Domain: Geometry	[SLO: M-11-B-23]: Apply fundamental law and its deductions to derive: Trigonometric ratios of allied angles, double angle, half angle and triple angle identities.	U	0.75
Q1(30)	Domain: Geometry	[SLO: M-11-B-25]: Find the domain and range of the trigonometric functions.	U	0.75
Q1(31)	Domain: Geometry	[SLO: M-11-B-26]: Discuss even, odd functions and the periodicity of trigonometric functions.	K	0.75
Q1(32)	Domain: Geometry	[SLO: M-11-B-26]: Discuss even, odd functions and the periodicity of trigonometric functions.	U	0.75

Q1(33)	Domain: Geometry	[SLO: M-11-B-27]: Find the maximum and minimum value of a given function.	U	0.75
Q1(34)	Domain: Geometry	[SLO: M-11-B-26]: Discuss even, odd functions and the periodicity of trigonometric functions.	K	0.75
Q1(35)	Domain: Information Handling	[SLO: M-11-C-03]: Explain and Solve problems that involve combinations.	U	0.75
Q1(36)	Domain: Information Handling	[SLO: M-11-C-03]: Explain and Solve problems that involve combinations.	A	0.75
Q1(37)	Domain: Information Handling	[SLO: M-11-C-04]: Apply the concepts of permutation and combination to real world problems.	U	0.75
Q1(38)	Domain: Information Handling	[SLO: M-11-C-01]: Explain and solve problems that involve the fundamental counting principle.	A	0.75
Q1(39)	Domain: Information Handling	[SLO: M-11-C-02]: Explain and Solve problems that involve permutations.	K	0.75
Q1(40)	Domain: Information Handling	[SLO: M-11-C-02]: Explain and Solve problems that involve permutations.	U	0.75
Q1(41)	Domain: Numbers and Algebra	[SLO: M-11-A-08]: Write the polynomial (z) as a product of linear factors.	K	0.75
Q1(42)	Domain: Numbers and Algebra	[SLO: M-11-A-08]: Write the polynomial (z) as a product of linear factors.	U	0.75
Q1(43)	Domain: Numbers and Algebra	[SLO: M-11-A-08]: Write the polynomial (z) as a product of linear factors.	U	0.75
Q1(44)	Domain: Numbers and Algebra	[SLO: M-11-A-08]: Write the polynomial (z) as a product of linear factors.	K	0.75
Q1(45)	Domain: Numbers and Algebra	[SLO: M-11-A-21]: Apply the concepts of matrices to real world problems.	K	0.75
Q1(46)	Domain: Numbers and Algebra	[SLO: M-11-A-21]: Apply the concepts of matrices to real world problems.	U	0.75
Q1(47)	Domain: Numbers and Algebra	[SLO: M-11-A-21]: Apply the concepts of matrices to real world problems.	A	0.75
Q1(48)	Domain: Numbers and Algebra	[SLO: M-11-A-21]: Apply the concepts of matrices to real world problems.	U	0.75
Q1(49)	Domain: Numbers and Algebra	[SLO: M-11-A-22]: Solve problems by analyzing arithmetic sequences and series up to n terms.	U	0.75
Q1(50)	Domain: Numbers and Algebra	[SLO: M-11-A-22]: Solve problems by analyzing arithmetic sequences and series up to n terms.	K	0.75
Q1(51)	Domain: Numbers and Algebra	[SLO: M-11-A-22]: Solve problems by analyzing arithmetic sequences and series up to n terms.	A	0.75
Q1(52)	Domain: Numbers and Algebra	[SLO: M-11-A-22]: Solve problems by analyzing arithmetic sequences and series up to n terms.	U	0.75
Q1(53)	Domain: Geometry	[SLO: M-11-B-09]: Use dot product to find the angle between two vectors.	K	0.75
Q1(54)	Domain: Geometry	[SLO: M-11-B-11]: Find the work done by a constant force in moving an object along a given vector.	U	0.75
Q1(55)	Domain: Geometry	[SLO: M-11-B-08]: Find the condition for orthogonality of two vectors.	K	0.75

Q1(56)	Domain: Geometry	[SLO: M-11-B-09]: Use dot product to find the angle between two vectors.	K	0.75
Q1(57)	Domain: Geometry	[SLO: M-11-B-30]: Apply the concepts of trigonometric functions, identities, graphs, periodicity, even & odd functions and extreme values to real world problems.	A	0.75
Q1(58)	Domain: Geometry	[SLO: M-11-B-25]: Find the domain and range of the trigonometric functions.	U	0.75
Q1(59)	Domain: Geometry	[SLO: M-11-B-25]: Find the domain and range of the trigonometric functions.	U	0.75
Q1(60)	Domain: Geometry	[SLO: M-11-B-25]: Find the domain and range of the trigonometric functions.	U	0.75
Q1(61)	Domain: Information Handling	[SLO: M-11-C-03]: Explain and Solve problems that involve combinations.	K	0.75
Q1(62)	Domain: Information Handling	[SLO: M-11-C-03]: Explain and Solve problems that involve combinations.	U	0.75
Q1(63)	Domain: Information Handling	[SLO: M-11-C-03]: Explain and Solve problems that involve combinations.	A	0.75
Q1(64)	Domain: Information Handling	[SLO: M-11-C-03]: Explain and Solve problems that involve combinations.	A	0.75

SUBJECTIVE PART

SECTION B & C

Q. No.	Content Area/ Domain	Description of Student Learning Outcomes	Cognitive Level *	OR	Content Area/ Domain	Description of Student Learning Outcomes	Cognitive Level *	Marks
Q1	Domain: Algebra	[SLO:M-11-A-13]: Demonstrate simple equations and in equations involving complex numbers in polar form.	U	OR	Domain: Algebra	[SLO:M-11-A-17]: Use row operations to find the inverse and the rank of a matrix.	A	4
Q2	Domain: Algebra	[SLO:M-11-A-25]: Solve problems by analyzing harmonic sequences and series up to n terms.	U	OR	Domain: Algebra	[SLO:M-11-A-07]: Solve the simultaneous linear equations with complex coefficients.	U	4
Q3	Domain: Geometry	[SLO:M-11-B-20]: Define coplanar vectors and find the condition for planarity of three vectors.	K	OR	Domain: Geometry	[SLO:M-11-A-42]: Divide a polynomial of degree up to 4 by a linear and quadratic polynomial to identify quotient and remainder.	K	4
Q4	Domain: Algebra	[SLO:M-11-A-33]: Evaluate and justify conclusions, communicating a position clearly in an appropriate mathematical form in daily life.	A	OR	Domain: Geometry	[SLO:M-11-B-08]: Write the polynomial () as a product of linear factors.	K	4

Q5	Domain: Geometry	[SLO:M-11-B-24]: Express the product (of sines and cosines) as sums or differences (of sines and cosines).	U	OR	Domain: Algebra	[SLO:M-11-A-22]: Solve problems by analyzing arithmetic sequences and series up to n terms.	U	4
Q6	Domain: Information Handling	[SLO:M-11-C-04]: Apply the concepts of permutation and combination to real world problems.	A	OR	Domain: Geometry	[SLO:M-11-B-30]: Apply the concepts of trigonometric functions, identities, graphs, periodicity, even & odd functions and extreme values to real world problems.	U	4
Q7	Domain: Geometry	[SLO:M-11-B-26]: Discuss even, odd functions and the periodicity of trigonometric functions.	K	OR	Domain: Information Handling	[SLO:M-11-C-02]: Explain and Solve problems that involve permutations.	U	4
Q8	Domain: Algebra	[SLO: M-11-A-20]: Solve a system of three homogeneous linear equations in three unknowns using the Gaussian elimination method.	A	OR	Domain: Algebra	[SLO:M-11-A-34]: State and apply the Binomial Theorem to expand expressions of the form $(a + b)^n$ where n is a positive integer.	U	8
Q9	Domain: Algebra	[SLO: M-11-A-27]: Recognize the arithmetic geometric sequence, determine its general term, find sum to n terms and sum to infinite number of terms, using sigma notation.	K	OR	Domain: Geometry	[SLO:M-11-A-44]: Analyze and apply Factor Theorem to factorize a cubic polynomial.	U	8
Q10	Domain: Geometry	[SLO: M-11-B-17]: Express Scalar Triple Product of vectors in terms of components (determinant form).	K	OR	Domain: Geometry	[SLO:M-11-B-24]: Express the product (of sines and cosines) as sums or differences (of sines and cosines).	U	8

*Cognitive Level

K: Knowledge

U: Understanding

A: Application

Table of Specification
Mathematics – Grade XI (HSSC-I) P1

Domain Title/ Content Area	Domain A: Numbers and Algebra	Domain B: Geometry	Domain C: Information Handling	Total Marks	Percentage of Cognitive Domains
Cognitive Domain					
Knowledge	Q1(1), Q1(4), Q1(6), Q1(12), Q1(15), Q1(41), Q1(44), Q1(45), Q1(50), Q9. (14.75 marks)	Q1(20), Q1(21), Q1(28), Q1(31), Q1(34), Q1(53), Q1(55), Q1(56), Q3, Q3(OR), Q4(OR), Q7, Q10. (30 marks)	Q1(39), Q1(61). (1.5 marks)	46.25	30%
Understanding	Q1(2), Q1(5), Q1(7), Q1(10), Q1(13), Q1(14), Q1(16), Q1(17), Q1(42), Q1(43), Q1(46), Q1(48) Q1(49), Q1(52) Q1, Q2, Q2(OR), Q5(OR), Q8(OR). (34.5 marks)	Q1(18), Q1(22), Q1(23), Q1(26), Q1(27), Q1(29), Q1(30), Q1(32), Q1(33), Q1(54), Q1(58), Q1(59), Q1(60), Q5, Q6(OR), Q9 (OR), Q10(OR). (33.75 marks)	Q1(35), Q1(37), Q1(40), Q1(62), Q7(OR) (07 marks)	75.25	50%
Application	Q1(3), Q1(8), Q1(9), Q1(11), Q1(51), Q1(47), Q1(OR), Q4, Q8. (20.5 marks)	Q1(19), Q1(24), Q1(25), Q1(57). (03 marks)	Q1(36), Q1(38), Q1(63), Q1(64), Q6. (07 marks)	30.5	20%
Total Marks	69.75	66.75	15.5	180	-
Total Percentages	46%	44%	10%	-	100%

Note:

- 1 This ToS does not reflect policy, but it is particular to this model question paper.
- 2 Proportionate / equitable representation of the content areas may be ensured.
- 3 The percentage of cognitive domain is 20%, 50%, and 30% for knowledge, understanding, and application, respectively with $\pm 5\%$ variation.
- 4 While selecting alternative questions for SRQs and ERQs, it must be kept in mind that:
 - difficulty levels of both questions should also be same
 - SLOs of both the alternative questions must be different

Key: Question Number (part/ first choice) marks example: **Q2 (i / f) 4**
 Question Number (part/ second choice) marks example: **Q2 (i / s) 4**



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