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

No.1-10/FBISE/RES/652 30 August, 2024

Subject: **IMPLEMENTATION OF ASSESSMENT FRAMEWORKS AND MODEL QUESTION PAPERS DEVELOPED ON NATIONAL CURRICULUM OF PAKISTAN (NCP) 2022-2023**

In continuation to this office Notifications bearing No.1-10/FBISE/RES/383 dated 14 March 2024 and No.1-10/FBISE/RES/422 dated 19 March 2024 on the subject of Implementation of National Curriculum of Pakistan (NCP) 2022-23, Assessment Frameworks, Model Question Papers along with SLOs Alignment Charts and Tables of Specifications (ToS) at SSC-I and HSSC-I levels in the subjects of English Compulsory, Urdu Compulsory, Pakistan Studies (SSC-I), Islamiyat Compulsory (HSSC-I), Physics, Chemistry, Biology, Mathematics and Computer Science are hereby uploaded on FBISE Website www.fbise.edu.pk. The Weblink is https://fbise.edu.pk/curriculum_model_paper.php .

2. It is important to note that the Assessment Frameworks which contain all the SLOs of the curriculum 2022-23 will guide students, teachers and paper setters. Students will receive clear instructions on how to prepare for examinations. Teachers will use the Frameworks to understand what to teach in class and to prepare their students for the final examinations. Similarly, paper setters will use these documents for guidance in creating examination papers. It may be noted that the SLOs of Summative Assessment mentioned in the Assessment Frameworks will be included in the Final Board Examinations, whereas the SLOs of Formative Assessment will NOT be included in the Final Board Examinations; however, they will be part of teaching-learning activity in the class.

3. It is reiterated that the examinations of all the above mentioned subjects will be based on Student Learning Outcomes (SLOs) given in the respective curriculum (Assessment Frameworks) instead of textbooks. Educational institutions, students and teachers may consult the books of publishers reviewed by National Curriculum Council available on its Weblink https://ncc.gov.pk/SiteImage/Misc/files/Annexures.pdf. Moreover, the institutions are free to rely on any other valid and reliable instructional/reference material to fulfil the instructional requirements of the SLOs of these subjects.

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at SSC & HSSC levels

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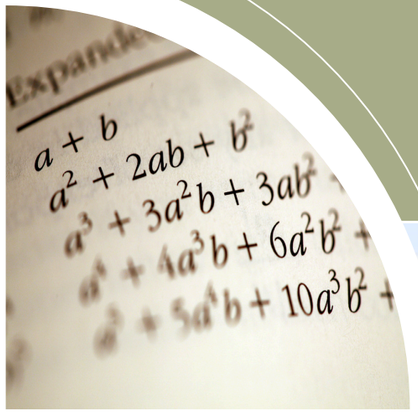
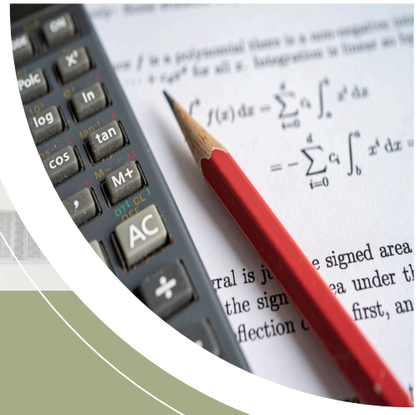
ASSESSMENT FRAMEWORK AND MODEL QUESTION PAPER

MATHEMATICS

Grade XI

NATIONAL CURRICULUM
2022-23





FEDERAL BOARD OF INTERMEDIATE AND SECONDARY EDUCATION, ISLAMABAD

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H-8/4, ISLAMABAD

ASSESSMENT FRAMEWORK

FOR

MATHEMATICS GRADE-XI

CURRICULUM 2022-23

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. Muhammad Anwar Assistant Professor, Islamabad Model College for Boys, G-10/4, Islamabad
2. Dr. Javed Iqbal, Vice Principal, OPF Boys College, H-8, Islamabad
3. Mr. Anwar ul Haq, Assistant Professor, Bahria College, Naval Complex, E-8, Islamabad
4. Mr. Ali Raza, Assistant Professor, Islamabad Model College for Boys, F-8/4, Islamabad
5. Mrs. Zohra Yousaf, HOD Math, Army Public School & College, Hamza Camp Rawalpindi

The whole work was successfully accomplished under the able supervision and guidance of Syed Junaid Akhlaq, 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 AF.

MIRZA ALI
Director (Research & Academics)
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 z represented by an expression of the form $z = a + ib$ or of the form (a, b) 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 as a real part of z and b as an imaginary part of z.	**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 $z = a - ib$ as the complex conjugate of $z = a + ib$.	**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 $\|z\| = \sqrt{a^2 + b^2}$ as the absolute value or modulus of a complex number $z = a + ib$.	**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, $\begin{cases} 5z - (3+i)w = 7 - i, \\ (2-i)z + 2iw = -1 + i \end{cases}$	Summative	U	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-08]: Write the polynomial $P(z)$ as a product of linear factors. For example, $z^2 + a^2 = (z + ia)(z - ia)$ $z^3 - 3z^2 + z + 5 = (z + 1)(z - 2 - i)(z - 2 + i)$	Summative	K	Question(s) will be asked in the annual examination.	
		[SLO: M-11-A-09]: Solve quadratic equation of the form $pz^2 + qz + r = 0$ by completing squares, where p, q, r are real numbers and z a complex number. For example, Solve $z^2 - 2z + 5 = 0$ $(z - 1 - 2i)(z - 1 + 2i) = 0$ $z = 1 + 2i, 1 - 2i$	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 3 × 3 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 n natural numbers ($\sum n$),** **• squares of first n natural numbers ($\sum n^2$),** **• cubes of first n natural numbers ($\sum n^3$).**	**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 $\hat{\imath}, \hat{\jmath}$ and $\hat{k}$ 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 $\vec{O}$ as an identity vector,** **• $-\vec{a}$ as additive inverse vector of $\vec{a}$.**	**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 • $\hat{\imath}.\hat{\jmath}\times\hat{k}=\hat{\jmath}.\hat{k}\times\hat{\imath}=\hat{k}.\hat{\imath}\times\hat{\jmath}=1$ • $\boldsymbol{j}.\boldsymbol{i}\times\boldsymbol{k}=\boldsymbol{k}.\boldsymbol{j}\times\boldsymbol{i}=\boldsymbol{i}.\boldsymbol{k}\times\boldsymbol{j}=-\mathbf{1}$. 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: • $a + bsin\theta$, • $a + b\ cos\theta$ • $a + bsin(c\theta + d\ )$, • $a + b\ cos\ cos\ (c\theta + d)$ • the reciprocals of above, where a, b, c and 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 $sin\theta, cos\theta$ and $tan\theta$.	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.	

Federal Board HSSC-I Examination
Model Question Paper Mathematics
(Curriculum 2022-23)

ROLL NUMBER					
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
6	6	6	6	6	6
7	7	7	7	7	7
8	8	8	8	8	8
9	9	9	9	9	9

Version No.			
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Section - A (Marks 20)

Time Allowed: 25 minutes

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

Candidate Sign. _____ **Invigilator Sign. _____**

Q1. Fill the relevant bubble against each question. Each part carries one mark.

Sr no.	Question	A	B	C	D	A	B	C	D
i.	If $z = x + iy$ then what is the real solution of $(x-3) \leq 2$?	$x \leq 5$	$y \leq 2$	$x \leq -5$	$y \leq -2$	○	○	○	○
ii.	If $Z = \sqrt{3} - i$ then principal argument of z is written	$-\frac{\pi}{6}$	$\frac{\pi}{6}$	$-\frac{\pi}{3}$	$\frac{\pi}{3}$	○	○	○	○
iii.	For a square matrix A of order 3×3, $\|A\| = 9$, $A_{21} = 3$, $A_{22} = 3$, $A_{23} = -1$, $a_{21} = 1$, $a_{23} = 2$, what is the value of a_{22}?	2	3	9	-1	○	○	○	○
iv.	For a unique solution of system rank of matrix A must be equal to:	A_b	A^t	$\|A^b\|$	$\|A^t\|$	○	○	○	○
v.	What is the A.M of 20 terms of an A.P with first term 2 and common difference 2?	20	21	22	42	○	○	○	○
vi.	What is the value of H. M between two non-zero real numbers, if their $A.M = \frac{3\sqrt{2}}{2}$ and $G.M = 2$?	$\frac{8}{3\sqrt{2}}$	$\frac{4}{3\sqrt{2}}$	$\frac{3\sqrt{2}}{8}$	$\frac{3\sqrt{2}}{4}$	○	○	○	○
vii.	What is the 8th term of $\left(2x - \frac{1}{2x}\right)^{12}$?	$198x^{-2}$	$198x^2$	$-198x^{-2}$	$-198x^2$	○	○	○	○

viii.	If $S(n)$: $2^n < n!$ then what is the smallest possible integer for which $S(n)$ is true:	1	2	3	4	○ ○ ○ ○
ix.	$\frac{x^2+3x-16}{x+4} = x-4-\frac{?}{x+4}$	3	-3	$3x$	$-3x$	○ ○ ○ ○
x.	If length of one side of the box having volume x^3-2x^2-x+2 is $(x-2)$, then the remaining two sides are:	$(x-1)^2$	$(x+1)^2$	x^2-1	x^2+1	○ ○ ○ ○
xi.	If the dot product of vector $\underline{a} = \underline{i}-2\underline{j}+3\underline{k}$ and $\underline{b} = \alpha\,\underline{i}-\underline{j}+2\underline{k}$ is 10 then value of α is:	0	1	2	3	○ ○ ○ ○
xii.	If $\underline{a} = \underline{i}-2\underline{j}$ and $\underline{b} = 2\underline{j}+\underline{k}$, then $\underline{a}\times\underline{b}$ is:	$-2\underline{i}-\underline{j}-2\underline{k}$	$-2\underline{i}+\underline{j}-2\underline{k}$	$2\,\underline{i}-\underline{j}+2\underline{k}$	$-2\underline{i}-\underline{j}+2\underline{k}$	○ ○ ○ ○
xiii.	Which of the vector pairs is orthogonal?	$\underline{i}+2\underline{j}-\underline{k}$ and $\underline{i}+\underline{j}+\underline{k}$	$\underline{i}-2\underline{j}-\underline{k}$ and $\underline{i}+\underline{j}-\underline{k}$	$-\underline{i}+2\underline{j}+\mathrm{k}$ and $\underline{i}+\underline{j}+\underline{k}$	$-\underline{i}+2\underline{j}-\underline{k}$ and $-\underline{i}+\underline{j}+\underline{k}$	○ ○ ○ ○
xiv.	If $cos\alpha = \frac{12}{13}; 0<\alpha<\frac{\pi}{2}$ and $sin\beta = \frac{5}{13}; \frac{\pi}{2}<\beta<\pi$ then value of $\cos(\alpha+\beta)$ is:	1	-1	$\frac{144}{169}$	$-\frac{144}{169}$	○ ○ ○ ○
xv.	If the expression $4sin5\alpha.cos3\alpha.cos2\alpha$ is expressed as sum of three sines, then two of them are $sin4\alpha$ and $sin10\alpha$. The third one is:	$\sin8\alpha$	$\sin6\alpha$	$\sin5\alpha$	$\sin12\alpha$	○ ○ ○ ○
xvi.	Which of the given functions is odd?	$f(x) = x+cos\,x$	$f(x) = x-cos\,x$	$f(x) = x^2+cos\,x$	$f(x) = x+\sin x$	○ ○ ○ ○
xvii.	The period of a trigonometric function $3\,sin\,3x$ is:	$\frac{\pi}{3}$	$\frac{2\pi}{3}$	$\frac{\pi}{2}$	$\frac{3\pi}{2}$	○ ○ ○ ○
xviii.	The minimum value of $3+4\,sin\,\theta$ is:	-1	0	1	7	○ ○ ○ ○
xix.	How many four-digit numbers divisible by 10 can be formed using digits 3, 5, 0, 8, 7 without repeating?	12	24	48	60	○ ○ ○ ○
xx.	If DNA sequence of length 8 is constructed using 4 nucleotides (A, C, G, T) with repetition allowed, how many possible sequences can be formed?	4^8	8^4	$\frac{8!}{4!\,4!}$	$4!\times 8$	○ ○ ○ ○

Federal Board HSSC-I Examination
Model Question Paper Mathematics

(Curriculum 2022-23)

Time allowed: 2.35 hours Total Marks: 80

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 48)

$(12 \times 4 = 48)$

Q.2	Question	Marks		Question	Marks
i.	If $z = x + iy$ then simplify the equation $\|z - 2i\| = \|\bar{z} + 3\|$	4	***OR***	If the angle between two vectors $\underline{a} = 2\underline{i} - 3\underline{j} + 4\underline{k}$ and $\underline{b} = \underline{i} + 2\underline{j} + 2\underline{k}$ is θ, then find the values of $cos\ \theta$ and $sin\ \theta$.	4
ii.	Prove that $cos\left(\frac{\pi}{3} + x\right) - sin\left(\frac{\pi}{6} - x\right) = 0$	4	***OR***	Prove that $\binom{n-1}{r} + \binom{n-1}{r-1} = \binom{n}{r}$	4
iii.	Find volume of the tetrahedron if $\mathrm{a} = 2\underline{i} - 3\underline{j} + \underline{k}$, $\mathrm{b} = \underline{i} + 2\underline{j} - \underline{k}$ and $\mathrm{c} = -3\underline{i} - \underline{j} + 5\underline{k}$ are its coterminous edges.	4	***OR***	Find the maximum and minimum values of the function $y = \frac{1}{5 + 6\ sin\ (2x + 3)}$	4
iv.	If $h(x) = 7x^4 - 10x^3 + 3x^2 + 3x - 3$ and one zero of $h(x)$ is 1, then find remaining zeros.	4	***OR***	In H.P if $a_3 = \frac{1}{11}$ and $a_{16} = \frac{1}{63}$, then find values of a_1, d and a_{20}	4
v.	Without drawing graph, find amplitude, period and frequency of the function $y = 3\ sin\ (5x + 2)$	4	***OR***	A force $\vec{F} = 3\underline{i} - 2\underline{j} + 5\underline{k}$ acts on a particle at point $P\ (3, -4, 2)$. Find moment of the force about origin and a point $(1, -1, -1)$.	4
vi.	In an arithmetic progression, sum of the first ten terms is 200 and the sum up to twenty terms is 1000. Find common difference and the first term.	4	***OR***	If A, B, and C are the angle measures of a triangle such that $A + B + C = \pi$, then prove that $tanA + tanB + tanC = tanA\ tanB\ tanC$	4
vii.	Without expansion show that: $\begin{vmatrix} x & -z & 0 \\ 0 & y & -x \\ -y & 0 & z \end{vmatrix} = 0$	4	***OR***	Prove that $\frac{sin5x - sin3x}{cos5x + 2cos4x + cos3x} = \tan\frac{x}{2}$	4
viii.	A carpenter made a set of 50 wooden structures of Minar-e-Pakistan in different sizes. The height of the largest structure in the set was 70 cm. The heights of successive smaller structures were 95% of the preceding larger structure.	4	***OR***	Draw the graph of $y = 2\ cos\ x\ ;\ -\pi \leq x \leq \pi$	4

	(a) Find the height of the smallest structure in the set. (b) Find the total height if all 50 structures were placed one on top of another.				
ix.	Find the last two digits of a number $(23)^{14}$	4	***OR***	Find rank of the matrix: $\begin{bmatrix} 2 & 5 & 7 \\ 1 & 2 & -1 \\ -3 & -6 & 3 \end{bmatrix}$	4
x.	If $z = x + iy$ and $arg\left(\frac{z-1}{z+1}\right) = \frac{\pi}{2}$, then show that $x^2 + y^2 = 1$	4	***OR***	Find the value of r, if $P_{r+6}^{56} : P_{r+3}^{54} = 30800 : 1$	4
xi.	Use Binomial Theorem to find the remainder when 5^{99} is divided by 13.	4	***OR***	Find roots of the cubic polynomial $P(x) = 3x^3 - 5x^2 - 11x - 3$	4
xii.	If $A = \begin{bmatrix} x & 0 \\ y & 1 \end{bmatrix}$, then show that $A^n = \begin{bmatrix} x^n & 0 \\ \frac{y(x^n-1)}{(x-1)} & 1 \end{bmatrix}$, $n \epsilon z^+$	4	***OR***	Apply the principle of Mathematical Induction to prove that $7^{2n} + 7$ is divisible by 8 for all positive integral values of n.	4

SECTION – C (Marks 32)

$(4 \times 8 = 32)$

Note: Attempt all questions. Marks of each question are given.

Q. No.	Question	Marks		Question	Marks
Q3	(a) Factorize $x^3 - x^2 + 4x - 12$ (b) Solve $x^3 - x^2 + 4x - 12 = 0$ and identify real and complex roots.	8	***OR***	If $\underline{a} = 2\underline{i} - \underline{j} + 3\underline{k}$, $\underline{b} = 3\underline{i} + 2\underline{j} + 4\underline{k}$ and $\underline{c} = \underline{i} + 3\underline{j} - 5\underline{k}$, then verify that $\underline{a} \,.\, \underline{b} \times \underline{c} = \underline{b} \,.\, \underline{c} \times \underline{a} = \underline{c} \,.\, \underline{a} \times \underline{b}$.	8
Q4	If x is very small such that its square and higher powers can be neglected, then show that $\frac{(8+3x)^{\frac{2}{3}}}{(2+3x)\sqrt{4-5x}} \approx 1 - \frac{5x}{8}$	8	***OR***	Prove the fundamental law of trigonometry $\cos(\alpha - \beta) = \cos\alpha \cos\beta + \sin\alpha \sin\beta$ where α and β be any two real angles.	8
Q5	Solve the following system of non-homogeneous linear equations by Gaussian Elimination Method: $2x - 3y + 5z = 2,$ $x + 4y - 2z = 1,$ $4x + 5y + z = 4$	8	***OR***	A Ferris wheel with a radius of 25 meters completes one full revolution in 4 minutes. Calculate the frequency of the Ferris wheel's rotation, the speed of a passenger at the edge of the wheel, and the time it takes for the passenger to travel from the bottom to the top of the wheel.	8
Q6	Find sum of the series $(a) \sum_{i=1}^{n} \frac{i}{7^i}$ *and* $(b) \sum_{i=1}^{\infty} \frac{i}{7^i}$	8	***OR***	Find the number of ways to select 3 balls from a collection of 4 orange, 5 red, and 6 green balls, such that: (a) All balls are of different colors. (b) All balls are of the same color. (c) No ball is red. (d) Exactly one ball is green.	8

Federal Board HSSC-I Examination

Mathematics Model Question Paper

(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(i)	Domain: Algebra	[SLO: M-11-A-08]: Write the polynomial $P(z)$ as a product of linear factors. For example,	**K**	1
Q1(ii)	Domain: Algebra	[SLO: M-11-A-11]: Describe the polar representation of a complex number.	**K**	1
Q1(iii)	Domain: Algebra	[SLO: M-11-A-17]: Use row operations to find the inverse and the rank of a matrix.	**K**	1
Q1(iv)	Domain: Algebra	[SLO: M-11-A-18]: Explain a consistent and inconsistent system of linear equations and demonstrate through examples.	**U**	1
Q1(v)	Domain: Algebra	[SLO: M-11-A-22]: Solve problems by analyzing arithmetic sequences and series up to n terms.	**K**	1
Q1(vi)	Domain: Algebra	[SLO: M-11-A-25]: Solve problems by analyzing harmonic sequences and series up to n terms.	**K**	1
Q1(vii)	Domain: Algebra	[SLO: M-11-A-37]: Expand using the Binomial Theorem, and use appropriate techniques to simplify the expression.	**U**	1
Q1(viii)	Domain: Algebra	[SLO: M-11-A-32]: Apply the principle of Mathematical Induction to prove statements, identities, divisibility of numbers and summation formulae.	**A**	1
Q1(ix)	Domain: 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**	1
Q1(x)	Domain: Algebra	[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).	**A**	1
Q1(xi)	Domain: Geometry	[SLO: M-11-B-06]: Explain Dot or Scalar Product of two vectors and give its geometrical interpretation.	**K**	1
Q1(xii)	Domain: Geometry	[SLO: M-11-B-07]: Express dot product in terms of components.	**K**	1
Q1(xiii)	Domain: Geometry	[SLO: M-11-B-08]: Find the condition for orthogonality of two vectors.	**A**	1
Q1(xiv)	Domain: Geometry	[SLO: M-11-B-22]: Establish fundamental law of trigonometry.	**U**	1

Q1(xv)	Domain: Geometry	[SLO: M-11-B-24]: Express the product (of sines and cosines) as sums or differences (of sines and cosines).	**U**	1
Q1(xvi)	Domain: Geometry	[SLO: M-11-B-26]: Discuss even, odd functions and the periodicity of trigonometric functions.	**K**	1
Q1(xvii)	Domain: Geometry	[SLO: M-11-B-26]: Discuss even, odd functions and the periodicity of trigonometric functions.	**K**	1
Q1(xviii)	Domain: Geometry	[SLO: M-11-B-27]: Find the maximum and minimum value of a given function of the type: • $a + bsin\theta$, • $a + b\ cos\theta$ • $a + bsin(c\theta + d)$, • $a + b\ cos\ cos\ (c\theta + d)$ • the reciprocals of above, where a, b, c and d are real numbers.	**K**	1
Q1(xix)	Domain: Information Handling	[SLO: M-11-C -01]: Explain and solve problems that involve the fundamental counting principle.	**U**	1
Q1(xx)	Domain: Information Handling	[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.	**A**	1

SUBJECTIVE PART
SECTION B & C

Q. No. (Part no.)	**Content Area/ Domain**	**Description of Student Learning Outcomes**	**Cognitive Level ***	**OR**	**Content Area/ Domain**	**Description of Student Learning Outcomes**	**Cognitive Level ***	**Allocated Marks**
Q2(i)	Domain: Algebra	[SLO: M-11-A-07]: Solve the simultaneous linear equations with complex coefficients. For example, $\begin{cases} 5z - (3+i)w = 7 - i, \\ (2-i)z + 2iw = -1 + i \end{cases}$	**K**	***OR***	Domain: Geometry	[SLO: M-11-B-15]: Solve situations in daily life based on Cross or dot Vector Product.	**U**	**4**
Q2(ii)	Domain: Geometry	[SLO: M-11-B-22]: Establish fundamental law of trigonometry.	**K**	***OR***	Domain: Information Handling	[SLO: M-11-C -03]: Explain and Solve problems that involve combinations.	**K**	**4**
Q2(iii)	Domain: Geometry	[SLO: M-11-B-19]: Find the volume of a • parallelepiped, • tetrahedron,	**K**	***OR***	Domain: Geometry	[SLO: M-11-B-27]: Find the maximum and minimum value of a given	**A**	**4**

		determined by three given vectors.				function of the type: • $a + bsin\theta$, • $a + b\ cos\theta$ • $a + bsin(c\theta + d)$, • $a + b\ cos\ cos\ (c\theta + d)$ • the reciprocals of above, where a, b, c and d are real numbers.		
Q2(iv)	Domain: Algebra	[SLO: M-11-A-43]: Demonstrate and apply Remainder Theorem.	**U**	***OR***	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.	**U**	**4**
Q2(v)	Domain: Geometry	[SLO: M-11-B-29]: Explain the properties of graphs of $sin\theta, cos\theta$ and $tan\theta$.	**U**	***OR***	Domain: Geometry	[SLO: M-11-B-12]: Solve daily life problems based on vectors. Cross or Vector Product.	**U**	**4**
Q2(vi)	Domain: Algebra	[SLO: M-11-A-22]: Solve problems by analyzing arithmetic sequences and series up to n terms.	**K**	***OR***	Domain: Geometry	[SLO: M-11-B-22]: Establish fundamental law of trigonometry.	**U**	**4**
Q2(vii)	Domain: Algebra	[SLO: M-11-A-17]: Use row operations to find the inverse and the rank of a matrix.	**U**	***OR***	Domain: Geometry	[SLO: M-11-B-24]: Express the product (of sines and cosines) as sums or differences (of sines and cosines).	**K**	**4**
Q2(viii)	Domain: Algebra	[SLO: M-11-A-23]: Solve problems by analyzing geometric sequences and series up to n terms.	**A**	***OR***	Domain: Geometry	[SLO: M-11-B-28]: Graph and analyze the trigonometric functions sine, cosine, and tangent to solve problems.	**U**	**4**
Q2(ix)	Domain: Algebra	[SLO: M-11-A-40]: Use Binomial Theorem to find the last digit of a number, test the divisibility by a	**U**	***OR***	Domain: Algebra	[SLO: M-11-A-17]: Use row operations to find the inverse and the rank of a	**K**	**4**

		number and compare two large numbers.				matrix.		
Q2(x)	Domain: Algebra	[SLO: M-11-A-12]: Apply the operations with complex numbers in polar representation.	**U**	***OR***	Domain: Information Handling	[SLO: M-11-C - 02]: Explain and Solve problems that involve permutations.	**U**	**4**
Q2(xi)	Domain: 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.	**A**	***OR***	Domain: Algebra	[SLO: M-11-A-44]: Analyze and apply Factor Theorem to factorize a cubic polynomial.	**U**	**4**
Q2(xii)	Domain: Algebra	[SLO: M-11-A-17]: Use row operations to find the inverse and the rank of a matrix.	**U**	***OR***	Domain**:** Algebra	[SLO: M-11-A-32]: Apply the principle of Mathematical Induction to prove statements, identities, divisibility of numbers and summation formulae.	**A**	**4**
Q3	Domain: Algebra	[SLO: M-11-A-43]: Demonstrate and apply Remainder Theorem.	**U**	***OR***	Domain: Geometry	[SLO: M-11-B-18]: Prove that • $\hat{\imath}.\hat{\jmath}\times\hat{k} = \hat{\jmath}.\hat{k}\times\hat{\imath} = \hat{k}.\hat{\imath}\times\hat{\jmath} = 1$ • $j.i\times k = k.j\times i = i.k\times j = -1.$ Prove that dot and cross are inter-changeable in scalar triple product.	**K**	**8**
Q4	Domain: Algebra	[SLO: M-11-A-37]: Expand using the Binomial Theorem, and use appropriate techniques to simplify the expression.	**U**	***OR***	Domain: Geometry	[SLO: M-11-B-22]: Establish fundamental law of trigonometry.	**U**	**8**
Q5	Domain: Algebra	[SLO: M-11-A-20]: Solve a system of three homogeneous linear equations in three unknowns using the Gaussian elimination method.	**K**	***OR***	Domain: Geometry	[SLO: M-11-B-30]: Apply the concepts of trigonometric functions, identities, graphs, periodicity, even & odd functions and extreme	**A**	**8**

						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.		
Q6	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.	**U**	***OR***	Domain: Information Handling	[SLO: M-11-C - 03]: Explain and Solve problems that involve combinations.	**A**	**8**

*Cognitive Level

K: Knowledge
U: Understanding
A: Application

Table of Specification

Model Paper Mathematics – Grade XI (HSSC-I)

Domain Title/ Content Area Cognitive Domain	Domain A: Numbers and Algebra	Domain B: Geometry	Domain C: Information Handling	Total Marks	Percentage of Cognitive Domains
Knowledge	Q1(i)1, Q1(ii)1, Q1(iii)1, Q1(v)1, Q1(vi)1, Q2(i/f)4, Q2(vi/f)4, Q2(ix/s)4 Q5(f)8 (25 marks)	Q1(xi)1, Q1(xii)1, Q1(xvi)1, Q1(xvii) 1, Q1(xviii)1 Q2(ii/f)4, Q2(iii/f)4, Q2(vii/s)4 Q3(s)8 (25 marks)	Q2(ii/s)4, (04 marks)	54	30%
Understanding	Q1(iv)1, Q1(vii)1, Q1(ix)1, Q2(iv/f)4, Q2(vii/f)4, Q2(ix/f)4, Q2(x/f)4, Q2(xii/f)4, Q2(iv/s)4, Q2(xi/s)4 Q4(f)8, Q3(f)8, Q6(f)8 (54 marks)	Q1(xiv)1, Q1(xv)1, Q2(v/f)4, Q2(i/s)4, Q2(v/s)4, Q2(vi/s)4, Q2(viii/s)4, Q4(s)8, (30 marks)	Q1(xix)1, Q2(x/s)4, (05 marks)	90	50%
Application	Q1(viii)1, Q1(x)1 Q2(viii/f)4, Q2(xi/f)4, Q2(xii/s)4, (15 marks)	Q1(xiii)1, Q2(iii/s)4, Q5(s)8, (13 marks)	Q1(xx)1 Q6(s)8 (09 marks)	36	20%
Total Marks	71	68	41	180	-
Total Percentages	39%	38%	23%	-	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 **± 5%** variation.
4 While selecting alternative questions for Short Response Questions (SRQs) and Extended Response Questions (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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