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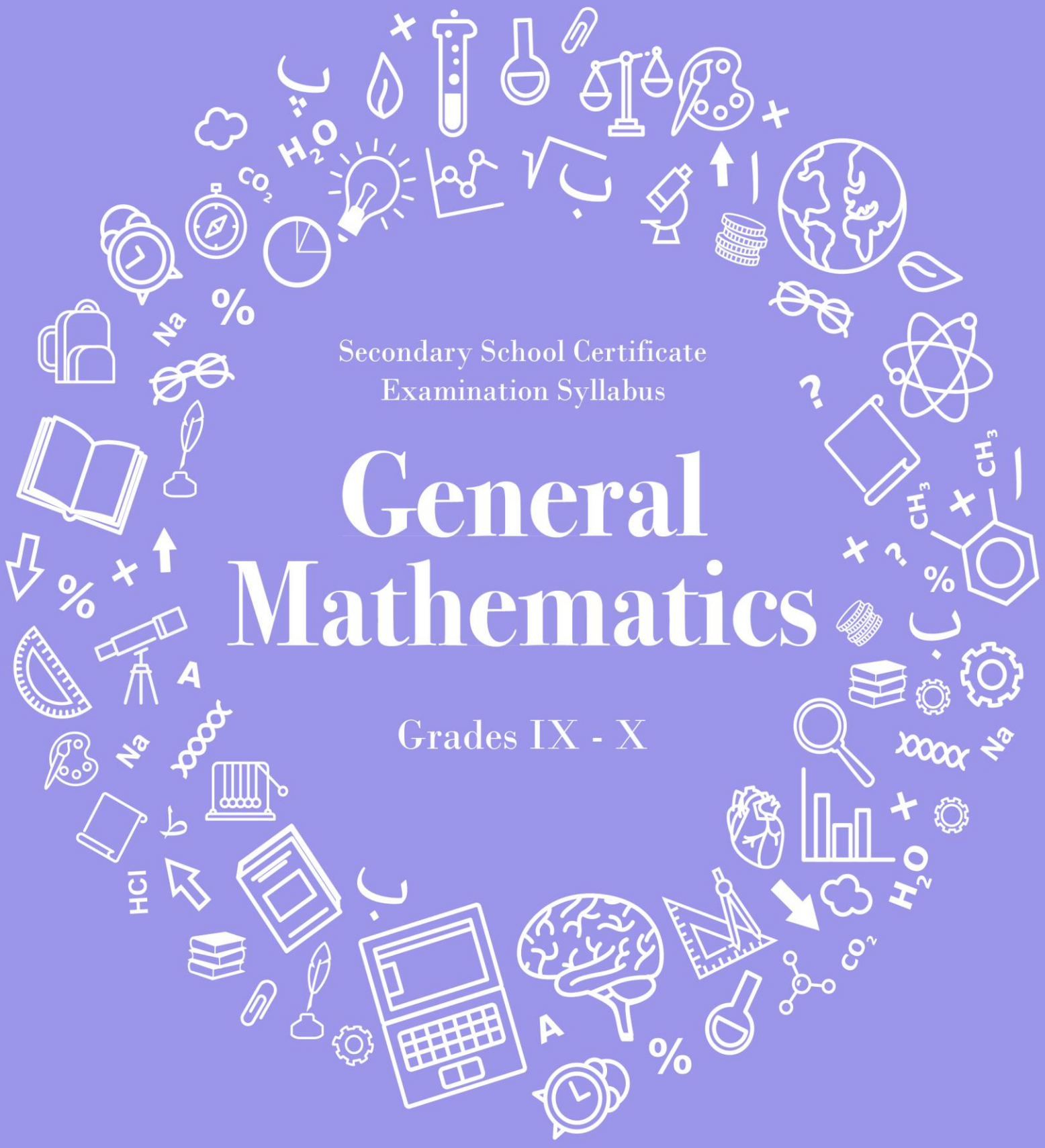

Secondary School Certificate
Examination Syllabus

General Mathematics

Grades IX - X

FOR ANNUAL EXAMINATION 2023 AND ONWARDS

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Secondary School Certificate
Examination Syllabus

GENERAL MATHEMATICS

GRADES IX-X

FOR ANNUAL EXAMINATION 2023 AND ONWARDS

This syllabus will be examined in both Annual and Re-sit Examination sessions from Annual Examinations 2023

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Preface

Established in 2002 through the Pakistan government's ordinance, the Aga Khan University Examination Board (AKU-EB) is country's first private autonomous qualification awarding body for secondary (SSC) and higher secondary (HSSC) school certifications. Its vision is to be a model of excellence and innovation in education in Pakistan and the developing world.

AKU-EB achieves its vision by developing examination syllabi which inculcate conceptual thinking and higher order learning and are aligned with National/ trans-provincial curricula and international standards. AKU-EB revises its syllabi periodically to support the needs of students, teachers and examiners.

The aims of the syllabus review of SSC and HSSC are to:

- Ensure continued compatibility with the goals of the trans-provincial curricula of Pakistan.
- Review the content for inclusion of new knowledge and deletion of obsolete knowledge.
- Review the content for clarity and relevance as per the changing needs of students, teachers and examiners.
- Enhance and strengthen continuation and progression of content both within and across grades IX - XII (SCC and HSSC).
- Ensure the readiness of students for higher education.

During the syllabus review, the needs of all the stakeholders were identified through a needs-assessment survey. Students and teachers of AKU-EB affiliated schools from across Pakistan participated in the survey. Thereafter, a revision panel, which consisted of examiners, teachers of affiliated and non-affiliated schools, teacher trainers and university academicians, reviewed and revised the syllabus following a planned, meticulous and standardised syllabi review process.

The syllabus is organised into topics and subtopics. Each subtopic is further divided into achievable student learning outcomes (SLOs). The SLOs of the cognitive domain are each assigned a cognitive level on which they have to be achieved. These cognitive levels are 'knowledge', 'understanding' and 'application', the latter also including other higher order skills. This is followed by the Exam Specification which gives clear guidance about the weightage of each topic and how the syllabus will be assessed.

The development of the revised syllabus has been made possible by the creativity and relentless hard work of Curriculum and Examination Development unit and the constant support provided by all the other units of AKU-EB. We are particularly thankful to Dr Sohail Qureshi for his very useful feedback on revising the syllabus review process, to Dr Naveed Yousuf for his continued guidance and support throughout the syllabus revision process and to Raabia Hirani for leading the syllabi revision. We are also thankful to all the students and teachers who took part in the needs-assessment survey and to the principals of AKU-EB affiliated schools who made this endeavour possible by facilitating and encouraging their teachers to be a part of the survey and the syllabus revision panel.

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With your support and collective hard work, AKU-EB has been able to take the necessary steps to ensure effective implementation of the best international and trans-provincial standards through this syllabus. We are confident that this syllabus will continue to provide the support that is needed by students to progress to the next level of education and we wish the very best to our students and teachers in implementing this syllabus.

Dr Shehzad Jeeva
Chief Executive Officer (CEO), Aga Khan University Examination Board
Associate Professor of Practice, Faculty of Arts and Sciences, Aga Khan University

FOR ANNUAL EXAMINATION 2023 AND ONWARDS

Understanding of AKU-EB Syllabi

1. The AKU-EB syllabi guide the students, teachers, parents and other stakeholders regarding the topics that will be taught and examined in each grade (IX, X, XI and XII). In each syllabus document, the content progresses from simple to complex, thereby, facilitating a gradual, conceptual learning of the content.

2. The topics of the syllabi are divided into subtopics and **student learning outcomes (SLOs)**. The subtopics and the SLOs define the depth and the breadth at which each topic will be taught, learnt and examined. The syllabi also provide enabling SLOs where needed to scaffold student learning.

3. Each SLO starts with an achievable and assessable **command word** such as describe, relate, evaluate, etc. The purpose of the command words is to direct the attention of teachers and students to specific tasks that the students are expected to undertake in the course of their studies. The examination questions are framed using the same command words or their connotations to elicit evidence of these competencies in students' responses.

4. The topics of the syllabi are grouped into themes derived from the National/ trans-provincial curricula. The connection between various themes and topics is highlighted in the '**concept map**' provided at the beginning of each syllabus. This ensures that students begin to understand the interconnectedness of knowledge, learn conceptually and think critically.

5. The SLOs are classified under three **cognitive levels**: knowledge (K), understanding (U) and application and other higher order skills (A) for effective planning during teaching and learning. Furthermore, it will help to derive multiple choice questions (MCQs), constructed response questions (CRQs) and extended response questions (ERQs) on a rational basis from the subject syllabi.

6. By focusing on the achievement of the SLOs, these syllabi aim to counter the culture of rote memorisation as the preferred method of examination preparation. While suggesting relevant, locally available textbooks for achieving these outcomes, AKU-EB recommends that teachers and students use multiple teaching and learning resources for achieving these outcomes.

7. The syllabi follow a uniform layout for all subjects to make them easier for students and teachers to follow. They act as a bridge between students, teachers and assessment specialists by providing a common framework of student learning outcomes and **exam specifications**.

8. On the whole, the AKU-EB syllabi for Secondary School Certificate (SSC) provide a framework that helps students to acquire conceptual understanding and learn to critically engage with it. This lays a solid foundation for HSSC and beyond.

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Subject Rationale of AKU-EB General Mathematics

What will you learn in AKU-EB General Mathematics Compulsory?

Mathematics intrinsically fosters logical, critical and analytical skills to work in a problem-solving environment. The current National Curriculum of Pakistan covers a wide array of topics that provide a better conceptual understanding of General Mathematics. The AKU-EB syllabus of General Mathematics has enriched the topics by making conceptual connections and refining the logical flow of the topics.

General Mathematics syllabus-will benefit students to enhance and improve their arithmetical and critical thinking skills which are applicable in business finance, business partnership, foreign exchange, leasing/ financing, etc. The syllabus also entails algebra, basic statistics and geometry. This will help in improving abstract, logical and visual thinking to apply their content knowledge in new situations, rather than on rote learning. This is evident from the fact that most of the SLOs in the syllabus are application based, including theorems where students are not required to reproduce theorems, but to apply them.

Where will it take you?

The AKUEB syllabus of General Mathematics will provide conceptual foundation for higher studies in many subjects and wide career opportunities are available such as:

- Accountant
- Finance Expert
- Actuary
- Banker
- Stock Market Expert
- Entrepreneurship
- Business Consultant

How to approach the syllabus?

The concept map of the syllabus gives an overview of the entire syllabus. The topics and the student learning outcomes (SLOs) provide a detailed guide about the learning accomplishment of the candidates. Finally, the paper specification is a comprehensive outline of what and how the candidates will be assessed in the examination.

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What is the concept map telling you?

PYRAMID

Pyramid is a large structure built in ancient Egypt that usually has a square base and four triangular sides meeting at a point. It is believed that the ancient Egyptians applied various concepts of mathematics to build the pyramids of Egypt since that the design of the pyramid may embody the foundations of mathematics and geometry i.e. Phi (φ), the Golden Ratio that appears throughout nature and Pi (π), the circumference of a circle in relation to its diameter.

The concept map of general mathematics is represented by pyramid (polyhedron). The pyramid illustrates the four core standards/ competencies of mathematics. The pyramid stands on its base which represents reasoning and logical thinking, the most vital competency. The remaining four competencies (Measurements and Geometry, Algebra, Numbers and Operations and Basic Statistics) are built upon the base and are represented by four triangles forming the sides of the pyramid. Concepts within the competencies build up as you move along the height of these four triangles, until they meet to form the apex of the pyramid.

Plato, one of ancient Greece's most important patrons of mathematics, was convinced that geometry was the key to unlocking the secrets of the universe and stressed that mathematics is way of understanding more about reality. The sign above his academy in Athens in 387 BC entrance read: "Let no-one ignorant of geometry enter here".

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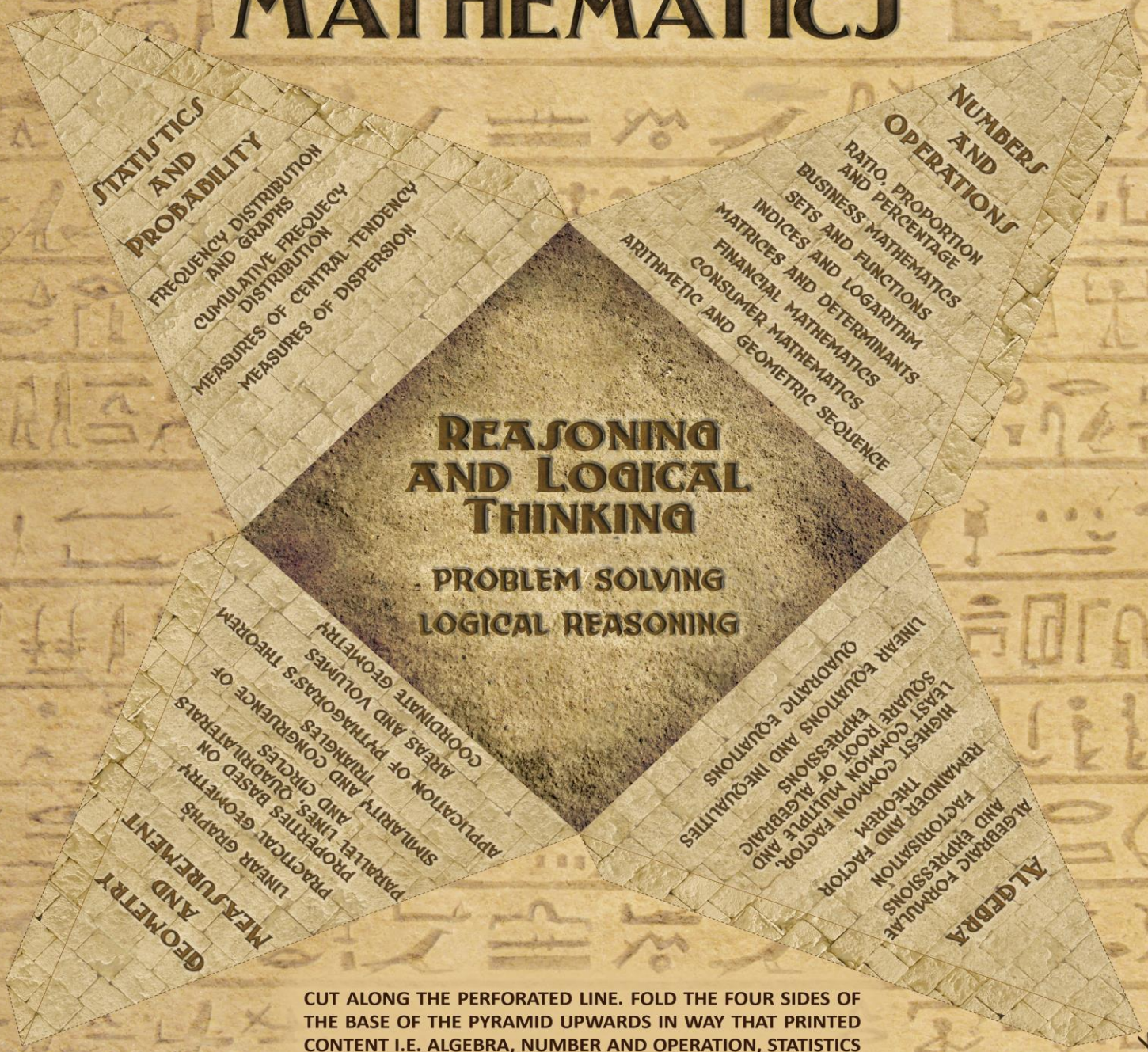
General Mathematics



CUT ALONG THE PERFORATED LINE. FOLD THE FOUR SIDES OF THE BASE OF THE PYRAMID UPWARDS IN WAY THAT PRINTED CONTENT I.E. ALGEBRA, NUMBER AND OPERATION, STATISTICS AND PROBABILITY AND GEOMETRY AND MEASUREMENT ARE VISIBLE ON THE OUTER FACES OF THE PYRAMID. USE GLUE STICK TO JOIN THE FOUR FACES OF THE PYRAMID BY THE EXTENDED EDGES GIVEN ON EACH SIDE.
YOUR PYRAMID IS READY!

Concept Map

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Student Learning Outcomes of AKU-EB SSC General Mathematics

Part I (Grade IX)

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level[1]		
				K	U	A
1. Percentage, Ratio and Proportion		Students should be able to:				
1.1	Percentage	1.1.1	describe percentage;		*	
		1.1.2	convert: a. percentage into a fraction and vice versa b. percentage into a decimal and vice versa;			*
1.2	Application of Percentages	1.2.1	calculate quantities when percentage is given;			*
		1.2.2	solve problems involving percentages,			*
1.3	Ratio	1.3.1	explain ratio;		*	
		1.3.2	find the ratio in which a quantity is increased or decreased;			*
		1.3.3	solve word problems involving ratio;			*
1.4	Proportion and Variation	1.4.1	identify that a proportion is an equality of two ratios, i.e. $a:b::c:d$ or $\left(\frac{a}{b}=\frac{c}{d}\right)$ where a and d are known as extremes and b and c are called means;	*		
		1.4.2	describe direct, inverse and compound proportion;		*	
		1.4.3	solve problems involving direct, inverse, compound proportion and variation (x varies directly or inversely as y).			*

[1] K = Knowledge, U = Understanding, A = Application and other higher-order cognitive skills
CA = Classroom Activity, not to be assessed under examination conditions

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Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
2. *Zakat, Ushr* and Inheritance		Students should be able to:				
2.1 *Zakat*		2.1.1	describe the rate of *Zakat* (in order to find out how much *Zakat* is due as per *Nisab*);		*	
		2.1.2	solve word problems based on *Zakat*;			*
2.2 *Ushr*		2.2.1	describe the rate of *Ushr* levied on land owner/land holder;		*	
		2.2.2	solve word problems based on *Ushr*;			*
2.3 Inheritance		2.3.1	describe the ratio of shares among legal inheritors of a property;		*	
		2.3.2	solve word problems based on inheritance.			*

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Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
3. Business Mathematics		Students should be able to:				
3.1	Profit and Loss	3.1.1	define cost price (C.P.), selling price (S.P.), profit and loss;	*		
		3.1.2	calculate: a. cost price and selling price b. profit and profit percentage c. loss and loss percentage;			*
3.2	Discount	3.2.1	explain marked price/ list price/ tag price/ catalogue price, discount on an article and sale price;		*	
		3.2.2	calculate: a. discount b. percentage discount;			*
		3.2.3	solve word problems related to Topics 3.1 and 3.2;			*
3.3	Business Partnership	3.3.1	explain the concept of business partnership;		*	
		3.3.2	solve word problems based on business partnership (at most four partners).			*

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Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
4. Sets and Functions		Students should be able to:				
4.1	Set and Operations on Sets	4.1.1	identify the sets denoted by N,Z,W,O,P ,Q and by other symbols;	*		
		4.1.2	identify operations on sets $(\cup, \cap, -$ or $\setminus)$;	*		
		4.1.3	apply the following operations on sets: a. union b. inter-section c. difference d. complement;			*
4.2	Properties of Union and Intersection	4.2.1	verify the following fundamental properties of union and intersection of two or three given sets: a. commutative property of union and intersection b. associative property of union and intersection;			*
4.3	Venn Diagram	4.3.1	draw a Venn diagram to represent: a. union and intersection of sets b. difference of two sets and complement of a set;			*
		4.3.2	draw a Venn diagram to verify: a. commutative laws for union and intersection of sets b. De Morgan's laws;			*
4.4	Ordered Pairs and Cartesian Product	4.4.1	describe ordered pairs and Cartesian product;		*	
		4.4.2	solve problems related to SLO 4.4.1;			*
4.5	Binary Relation	4.5.1	describe binary relation;		*	
		4.5.2	find the domain, co-domain and range of binary relation;			*
4.6	Functions	4.6.1	describe function, its domain and range;		*	
		4.6.2	distinguish between function and binary relation;		*	
		4.6.3	find function from one set to another set.			*

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
5. Exponents and Logarithms		Students should be able to:				
5.1	Laws of Exponents/ Indices	5.1.1	identify base and exponent;	*		
		5.1.2	apply the laws of exponents to simplify expressions with real exponents;			*
5.2	Radicals and Radicands	5.2.1	identify radicals and radicands;	*		
		5.2.2	distinguish between radical form and exponential form of an expression;		*	
		5.2.3	convert an expression given in radical form to an exponential form and vice versa;			*
5.3	Scientific Notation	5.3.1	convert a number in ordinary form (common form) to scientific notation and vice versa;			*
5.4	Logarithm	5.4.1	explain logarithmic and exponential form and their relationship $\left(\text{i.e.}\, a^x = y \Leftrightarrow \log_a y = x, a > 0, y > 0 \text{ and } a \neq 1\right)$;		*	
		5.4.2	solve problems related to SLO 5.4.1;			*
		5.4.3	find characteristic and mantissa of log of a number;			CA
5.5	Laws of Logarithm	5.5.1	apply the following laws of logarithm to solve related problems (without using log and antilog tables); a. $\log_a (mn) = \log_a m + \log_a n$ b. $\log_a \left(\frac{m}{n}\right) = \log_a m - \log_a n$ c. $\log_a m^n = n \log_a m$.			*

FOR ANNUAL EXAMINATION 2023 AND C

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
6. Algebraic Formulae and Applications		Students should be able to:				
6.1	Algebraic Expressions	6.1.1	define a rational expression as the quotient $\frac{p(x)}{q(x)}$ of two polynomials $p(x)$ and $q(x)$, where $q(x)$ is not the zero polynomial;	*		
		6.1.2	discuss whether a given algebraic expression is a: a. polynomial or not b. rational expression or not;		*	
		6.1.3	describe $\frac{p(x)}{q(x)}$ as a rational expression in its lowest terms;		*	
		6.1.4	simplify a given rational expression to its lowest terms;			*
		6.1.5	solve problems based on multiplication and division of rational expressions;			*
		6.1.6	find the value of algebraic expression for a given real number;			*
6.2	Algebraic Formulae	6.2.1	find the value of a^2+b^2, a^2-b^2, $a+b$, $a-b$ and ab, using the given formulae: a. $(a+b)^2+(a-b)^2=2(a^2+b^2)$ b. $(a+b)^2-(a-b)^2=4ab$ c. $a^2-b^2=(a-b)(a+b)$;			*
		6.2.2	find the values of $a^2+b^2+c^2$, $a+b+c$ and $ab+bc+ca$, when values of any two of these are given using the formula $(a+b+c)^2=a^2+b^2+c^2+2ab+2bc+2ca$;			*
6.3	Surds and their Application	6.3.1	explain the surds of second order;		*	
		6.3.2	apply basic operations on surds of second order;			*

FOR ANNUAL EXAMINATION ONLY

Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			K	U	A
	Students should be able to:				
	6.3.3	simplify the surds e.g. $\frac{1}{a\sqrt{x}+b\sqrt{y}}$ and $\frac{c\sqrt{x}-d\sqrt{y}}{a\sqrt{x}+b\sqrt{y}}$, where x and y are natural numbers and a and b are integers.			*

FOR ANNUAL EXAMINATION 2023 AND ONWARDS

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
7. Factorisation		Students should be able to:				
7.1	Factorisation	7.1.1	factorise the expression of the following types: a. $kx + ky + kz$ b. $ax + ay + bx + by$ c. $a^2 \pm 2ab + b^2$ d. $a^2 - b^2$ e. $(a^2 \pm 2ab + b^2) - c^2$ f. $a^4 + a^2b^2 + b^4$ or $a^4 + 4b^4$ g. $ax^2 + bx + c$;			*
7.2	Remainder and Factor Theorems	7.2.1 7.2.2 7.2.3	find the remainder using remainder theorem, when a polynomial is divided by a linear polynomial; define zeros of a polynomial; solve problems based on the concept of zeros of a polynomial;	 * 		* *
7.3	Factorisation of a Cubic Polynomial	7.3.1	apply factor theorem to factorise a cubic polynomial.			*

FOR ANNUAL EXAMINATION 2022

Topics and Subtopics		Student Learning Outcomes	Cognitive Level		
			K	U	A
8. Linear Graphs		Students should be able to:			
8.1 Cartesian Plane and Linear Graphs	8.1.1	identify pair of real numbers as an ordered pair;	*		
	8.1.2	describe rectangular or Cartesian plane;		*	
	8.1.3	locate an ordered pair (a, b) as a point in the rectangular plane and recognise: a. a as the x-coordinate (abscissa) b. b as the y-coordinate (ordinate);		*	
	8.1.4	illustrate different geometrical shapes, e.g. line segment, triangle and rectangle, etc. by joining a set of given points;		*	
	8.1.5	construct a table for pairs of values satisfying a linear equation in two variables;		*	
	8.1.6	draw the graph of given linear equations: a. y = constant b. x = constant c. $y = mx$ d. $y = mx+c$;			*
8.2 Conversion Graphs	8.2.1	interpret a given graph to develop a relation between quantities corresponding to other quantities;		*	
	8.2.2	use graph for conversions of: a. miles and kilometres b. acres and hectares c. degrees Celsius and degrees Fahrenheit d. Pakistani currency and other currencies (other inter-related quantities).			*

FOR ANNUAL EXAMINATION 2022 ONLY

Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
9. Matrices and Determinants		Students should be able to:				
9.1	Introduction to Matrices	9.1.1	define matrix with real entries;	*		
		9.1.2	define: a. rows and columns of a matrix b. the order of a matrix c. equality of two matrices;	*		
9.2	Types of Matrices(up to order 3×3)	9.2.1	describe row matrix, column matrix, rectangular matrix, square matrix, zero/ null matrix, identity matrix, scalar matrix, diagonal matrix and symmetric matrix;		*	
		9.2.2	describe the transpose of a matrix;		*	
9.3	Addition and Subtraction of Matrices (up to order 3×3)	9.3.1	discuss whether the given matrices are conformable for addition/ subtraction;		*	
		9.3.2	find the addition and subtraction of matrices;			*
		9.3.3	verify commutative and associative laws under addition;			*
		9.3.4	define the additive identity of a matrix;	*		
		9.3.5	describe the additive inverse of a matrix;		*	
9.4	Multiplication of Matrices (up to order 2×2)	9.4.1	discuss whether the given matrices are conformable for multiplication;		*	
		9.4.2	find the multiplication of a matrix by a real number;			*
		9.4.3	find the multiplication of matrices (up to three matrices);			*
		9.4.4	verify associative law under multiplication;			*
		9.4.5	verify distributive laws;			*
		9.4.6	verify with the help of examples that commutative law under multiplication does not hold in general (i.e. $AB \neq BA$);			*
		9.4.7	verify with the help of examples that $(AB)^t = B^tA^t$.			*

FOR ANNUAL EXAMINATION 2022

Topics and Subtopics		Student Learning Outcomes		Cognitive Level		
				K	U	A
		Students should be able to:				
9.5	Multiplicative Inverse of Matrix (order 2×2)	9.5.1	describe the determinant of a square matrix;		*	
		9.5.2	calculate the determinant of a matrix;			*
		9.5.3	define singular and non-singular matrix;	*		
		9.5.4	solve problems related to singular and non-singular matrix;			*
		9.5.5	solve problems related to adjoint of a matrix;			*
		9.5.6	define multiplicative identity of a matrix;	*		
		9.5.7	find the multiplicative inverse of a matrix A and verify that $AA^{-1} = I = A^{-1}A$, where I is the multiplicative identity matrix;			*
		9.5.8	apply adjoint method to calculate the inverse of a matrix;			*
		9.5.9	verify the result $(AB)^{-1} = B^{-1}A^{-1}$ with the help of examples;			*
9.6	Solution of Simultaneous Linear Equations in Two Variables	9.6.1	solve matrix equations, e.g. Find A, if $A+\begin{bmatrix}2 & 1\\ 0 & 3\end{bmatrix}\begin{bmatrix}1\\ 0\end{bmatrix}=5\begin{bmatrix}3\\ 2\end{bmatrix}$;			*
		9.6.2	solve a system of two linear equations in two variables using: a. Inverse Matrix method b. Cramer's rule. (**Note:** Word problems based on simultaneous linear equations are NOT included.)			*

FOR ANNUAL EXAMINATION 2023

Topics and Subtopics	Student Learning Outcomes		Cognitive Level		
			K	U	A
10. Practical geometry	Students should be able to:				
10.1 Construction of Triangle	10.1.1	draw a triangle when: a. two sides and one angle are given b. one side and two of the angles are given;			*
	10.1.2	draw for a given triangle: a. angle bisectors b. perpendicular bisectors c. medians d. altitudes;			*
	10.1.3	verify, for a given triangle, the concurrency of: a. angle bisectors b. altitudes c. perpendicular bisectors d. medians;			*
10.2 Construction of Quadrilateral	10.2.1	draw a rectangle when: a. two adjacent sides are given b. diagonal and one side are given;			*
	10.2.2	draw a square when its diagonal is given;			*
	10.2.3	draw a parallelogram when two adjacent sides and the angle between them is given.			*

FOR ANNUAL EXAMINATION

Part II (Grade X)

Topics and Subtopics	Student Learning Outcomes		Cognitive Level		
			K	U	A
11. Financial Mathematics	Students should be able to:				
11.1 Commercial Banking	11.1.1	compare various types of bank accounts such as PLS saving bank account, current deposit account, PLS term deposit account and foreign currency account;		CA	
	11.1.2	describe negotiable instruments, i.e. cheque, demand draft and pay order;		CA	
	11.1.3	describe on-line banking, transactions through ATM (Auto Teller Machine), debit card and credit card (Visa and Master);		CA	
11.2 Exchange of Currencies	11.2.1	convert an amount in one currency to another currency;			*
11.3 Simple Interest	11.3.1	describe simple interest;		*	
	11.3.2	solve problems related to simple interest;			*
11.4 Financing	11.4.1	describe the following concepts: a. down payment b. processing charges c. payment in monthly instalments;		*	
	11.4.2	solve problems related to SLO 11.4.1.			*

FOR ANNUAL EXAMINATION 2022 ONLY

Topics and Subtopics	Student Learning Outcomes		Cognitive Level		
			K	U	A
12. Consumer Mathematics	Students should be able to:				
12.1 Taxes	12.1.1	describe direct and indirect tax;		*	
	12.1.2	distinguish between direct tax and indirect tax;		*	
	12.1.3	explain the following basic concepts: a. sales tax b. excise duty c. property tax d. income tax;		*	
	12.1.4	calculate the amount of: a. sales tax, levied on various commodities b. excise duty, levied on different items c. property tax, imposed on property d. income tax, imposed on an individual with fixed income;			*
12.2 Utility Bills	12.2.1	calculate amount of bill for: a. electricity b. gas c. telephone;			*
12.3 Personal Income	12.3.1	calculate personal income (weekly, monthly and annually) of: a. a worker who is paid on daily basis b. a worker who is paid for overtime on hourly basis in addition to his daily wages c. a salesman who is paid for overtime on hourly basis and commission on different sales in addition to his regular pay;			*

FOR ANNUAL EXAMINATION

Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			K	U	A
	Students should be able to:				
	12.3.2	calculate gross income of a salaried person who is paid on the basis of government pay scales or otherwise;			*
	12.3.3	calculate net income taking into account assorted deductions (income tax, etc.).			*

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Topics and Sub-topics		Student Learning Outcomes	Cognitive Level		
			K	U	A
13. Basic Statistics	Students should be able to:				
13.1 Frequency Distribution and Graphs	13.1.1	construct a grouped frequency table;		*	
	13.1.2	draw and interpret bar charts and histograms with equal class intervals;			*
	13.1.3	draw and interpret a frequency curve and a frequency polygon;			*
	13.1.4	draw and interpret a pie-chart;			*
13.2 Cumulative Frequency Distribution	13.2.1	construct a cumulative frequency table;		*	
	13.2.2	draw and interpret cumulative frequency polygon and curve;			*
13.3 Measures of Central Tendency	13.3.1	calculate arithmetic mean, median and mode for ungrouped and grouped data;			*
	13.3.2	estimate median and mode graphically;			*
13.4 Measures of Dispersion	13.4.1	calculate the range, variance and standard deviation for ungrouped data.			*

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Topics and Sub-topics		Student Learning Outcomes		Cognitive Level		
				K	U	A
14. Algebraic Manipulation		Students should be able to:				
14.1	Highest Common Factor and Least Common Multiple	14.1.1	find the highest common factor (HCF) and the least common multiple (LCM) of algebraic expressions using factorisation method;			*
		14.1.2	find the highest common factor (HCF) and the least common multiple (LCM) of algebraic expressions using division method;			*
		14.1.3	apply HCF, LCM and their relationship in solving problems;			*
14.2	Basic Operations on Algebraic Fractions	14.2.1	simplify fractional expressions or rational expressions involving basic operations of $+, -, \times, \div$;			*
14.3	Square Root of Algebraic Expression	14.3.1	calculate the square root of algebraic expression by factorisation and division.			*

FOR ANNUAL EXAMINATION 2022 AND ONWARDS

Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			K	U	A
15. Linear Equations and Inequalities	Students should be able to:				
15.1 Linear Equations	15.1.1	define linear equation in one variable;	*		
	15.1.2	solve linear equation with real coefficients;			*
	15.1.3	find the solution of equations involving radicals;			*
	15.1.4	solve word problems based on the linear equation;			*
	15.1.5	verify solutions for problems based on SLOs 15.1.3 and 15.1.4;			*
15.2 Equations involving Absolute Value	15.2.1	define absolute value;	*		
	15.2.2	solve equation involving absolute value in one variable;			*
15.3 Linear Inequalities	15.3.1	define inequalities ($>, \geq, <, \leq$);	*		
	15.3.2	describe the properties of inequalities, i.e. trichotomy, transitive, additive and multiplicative;		*	
15.4 Solving Linear Inequalities	15.4.1	solve linear inequalities with real coefficients in one variable;			*
	15.4.2	represent the solution of linear inequalities on the number line.		*	

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Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			K	U	A
16. Quadratic Equations	Students should be able to:				
16.1 Quadratic Equation	16.1.1 16.1.2	define quadratic equation; distinguish between quadratic equation and other equations;	*	 *	
16.2 Solution of Quadratic Equations	16.2.1	solve a quadratic equation in one variable by: a. factorisation method b. completing the square method;			*
16.3 Quadratic Formula	16.3.1 16.3.2 16.3.3	derive quadratic formula using completing the square method; use quadratic formula to solve quadratic equations; solve word problems based on the quadratic equation.		*	 * *

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Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			K	U	A
17. Arithmetic and Geometric Sequences	Students should be able to:				
17.1 Sequence	17.1.1 17.1.2	describe a sequence/ progression; find the general term of a sequence;		*	 *
17.2 Arithmetic Sequence	17.2.1 17.2.2	describe an arithmetic sequence; solve problems involving arithmetic sequence;		*	 *
17.3 Arithmetic Mean	17.3.1 17.3.2	find the arithmetic mean between two numbers; find *n* arithmetic means between two numbers, where *n* is a natural number;			* *
17.4 Geometric Sequence	17.4.1 17.4.2	describe a geometric sequence; solve problems involving geometric sequence;		*	 *
17.5 Geometric Mean	17.5.1 17.5.2	find the geometric mean between two numbers; find *n* geometric means between two numbers, where *n* is a natural number.			* *

FOR ANNUAL EXAMINATION 2023 AND

Topics and Sub-topics		Student Learning Outcomes	Cognitive Level		
			K	U	A
18. Fundamentals of Geometry	Students should be able to:				
18.1 Properties of Angles	18.1.1	identify adjacent, complementary, supplementary angles and vertically opposite angles;		*	
	18.1.2	calculate unknown angles involving adjacent angles, complementary angles, supplementary angles and vertically opposite angles;			*
	18.1.3	calculate the unknown angles of a triangle (interior and exterior angles);			*
18.2 Parallel Lines	18.2.1	apply the following properties to solve related problems: a. two lines which are parallel to a given line are parallel to each other b. if three parallel lines are intersected by two transversals in such a way that the two intercepts on one transversal are equal to each other, the two intercepts on the second transversal are also equal c. a line through the midpoint of a side of a triangle parallel to another side bisects the third side;			*
	18.2.2	illustrate corresponding angles, alternate angles and interior angles;		*	
	18.2.3	apply the following properties to solve related problems: a. pairs of corresponding angles are equal b. pairs of alternate interior angles are equal c. pairs of interior angles on the same side of transversal are supplementary;			*
18.3 Congruent and Similar-Triangles	18.3.1	describe congruent and similar figures;		*	
	18.3.2	apply the following properties of congruency and similarity of triangles to solve related problems:			*

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Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			K	U	A
	Students should be able to:				
		a. if two angles of a triangle are congruent, then the sides opposite to them are also congruent b. in any correspondence of two triangles, if one side and any two angles of one triangle are congruent to the corresponding side and angles of the other, then the two triangles are congruent, i.e. *AAS* ≅ *AAS* c. in a correspondence of two triangles, if three sides of one triangle are congruent to the corresponding three sides of the other, then the two triangles are congruent, i.e. *SSS* ≅ *SSS* d. if in the correspondence of two right-angled triangles, the hypotenuse and one side of one are congruent to the hypotenuse and the corresponding side of the other, then the triangles are congruent, i.e. *RHS* ≅ *RHS* e. in any correspondence of two triangles, if two sides and the included angle of one triangle are congruent to corresponding two sides and the included angle of the other, then the two triangles are congruent, i.e. *SAS* ≅ *SAS* f. if two triangles are similar, the measures of their corresponding sides are proportional;			
18.4 Quadrilaterals	18.4.1	apply the following properties of a square to find the unknown measurements: a. the four sides of a square are equal b. the four angles of a square are right angles c. diagonals of a square bisect each other and are equal;			*

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Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			K	U	A
	Students should be able to:				
	18.4.2	apply the following properties of a rectangle to find the unknown measurements: a. opposite sides of a rectangle are equal b. the four angles of a rectangle are right angles c. diagonals of a rectangle bisect each other;			*
	18.4.3	apply the following properties of a parallelogram to find the unknown measurements: a. opposite sides of a parallelogram are equal b. opposite angles of a parallelogram are equal c. diagonals of a parallelogram bisect each other;			*
18.5 Circle	18.5.1	describe circle and its related terms, i.e. centre, radius, diameter, chord, secant, tangent, arc, major arc, minor arc, segment of the circle, semicircle, concentric circles;		*	
	18.5.2	apply the following properties of a circle to find the unknown measurements: a. the angle in a semicircle is a right angle b. the angles in the same segment of a circle are equal c. the central angle of a minor arc of a circle is double that of the angle subtended by the corresponding major arc;			*
	18.5.3	apply the properties in sub-topics 18.2, 18.3, 18.4, and 18.5 to find unknown measurements in different geometrical figures.			*

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Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			K	U	A
19. Areas and Volumes	Students should be able to:				
19.1 Pythagoras' Theorem	19.1.1	state Pythagoras' theorem;	*		
	19.1.2	find the unknown sides of a right angled triangle using Pythagoras theorem;			*
19.2 Areas	19.2.1	find the area of: a. a triangle when three sides are given by applying Heron's formula b. a triangle whose base and altitude or height are given c. an equilateral triangle when its one side is given d. a rectangle when its two adjacent sides are given e. a parallelogram when base and altitude or height are given f. a square when its one side is given;			*
	19.2.2	find the area of a circle and a semi-circle when radius or diameter is given;			*
	19.2.3	find the area enclosed by two concentric circles whose radii are given;			*
	19.2.4	solve problems related with areas of triangle, rectangle, square, parallelogram and circle;			*
19.3 Volumes	19.3.1	find the volume of: a. a cube when one of its edges is given b. a cuboid when its length, breadth and height are given c. a right circular cylinder when its base radius and height are given d. a right circular cone when its radius and height are given e. a sphere and a hemisphere when its radius or diameter is given;			*

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Topics and Sub-topics	Student Learning Outcomes		Cognitive Level		
			K	U	A
	Students should be able to:				
	19.3.2	solve problems related to volume of cube, cuboid, cylinder, cone and sphere.			*

FOR ANNUAL EXAMINATION 2023 AND ONWARDS

Topics and Sub-topics		Student Learning Outcomes	Cognitive Level		
			K	U	A
20. Introduction to Coordinate Geometry		Students should be able to:			
20.1 Distance Formula	20.1.1	describe coordinate geometry and its scope;		*	
	20.1.2	prove distance formula between two points in a Cartesian plane;		*	
	20.1.3	find distance between two given points using distance formula;			*
20.2 Collinear Points	20.2.1	apply distance formula to show whether the given points are collinear or non-collinear;			*
	20.2.2	apply distance formula to show that three given non-collinear points form: a. an equilateral triangle b. an isosceles triangle c. a right angled triangle d. a scalene triangle;			*
20.3 Midpoint Formula	20.3.1	apply the formula to find the midpoint of the line segment joining two given points;			*
	20.3.2	solve problems related to midpoint formula.			*

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Scheme of Assessment

Grade IX

Table 1: Number of Student Learning Outcomes by Cognitive level

Topic No.	Topic	No. of Sub-Topics	SLOs			Total SLOs
			K	U	A	
1.	Percentage, Ratio and Proportion	4	1	3	6	10
2.	*Zakat*, *Ushr* and Inheritance	3	0	3	3	6
3.	Business Mathematics	3	1	2	4	7
4.	Sets and Functions	6	2	4	7	13
5.	Exponents and Logarithms	5	2	2	5	9
6.	Algebraic Formulae and Applications	3	1	3	7	11
7.	Factorisation	3	1	0	4	5
8.	Linear Graphs	2	1	5	2	8
9.	Matrices and Determinants	6	5	6	16	27
10.	Practical geometry	2	0	0	6	6
	Total	**37**	**14**	**28**	**60**	**102**
	Percentage		**14**	**27**	**59**	**100**

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Table 2: Exam Specification

Topic No.	Topics	Marks Distribution		Total Marks
		MCQs	CRQs	
1.	Percentage, Ratio and Proportion	8	Total 3 Marks Choose any ONE from TWO	11
2.	*Zakat*, *Ushr* and Inheritance			
3.	Business Mathematics	5	Total 4 Marks (1 CRQ)	9
4.	Sets and Functions	5	Total 3 Marks (1 CRQ)	8
5.	Exponents and logarithms	7	Total 3 Marks (1 CRQ)	10
6.	Algebraic Formulae and Applications	6	Total 4 Marks (1 CRQ)	10
7.	Factorisation	5	Total 4 Marks Choose any ONE from TWO	9
8.	Linear Graphs	3	Total 3 Marks (1 CRQ)	6
9.	Matrices and Determinants	6	Total 3 Marks Choose any ONE from TWO	9
10.	Practical Geometry		Total 3 Marks (1 CRQ)	3
	Total Marks	**45**	**30**	**75**

- Multiple Choice Question (MCQ) requires candidates to choose one best/ correct answer from four options for each question. Each MCQ carries ONE mark.
- Constructed Response Question (CRQ) requires students to respond with a short text (few phrases/ sentences), calculations or diagrams.

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Table 3: Number of Student Learning Outcomes by Cognitive level

Topic No.	Topic	No. of Sub-Topics	SLOs			Total SLOs
			K	U	A	
11.	Financial Mathematics	4	0	2	3	5
12.	Consumer Mathematics	3	0	3	5	8
13.	Basic Statistics	4	0	2	7	9
14.	Algebraic Manipulation	3	0	0	5	5
15.	Linear Equations and Inequalities	4	3	2	6	11
16.	Quadratic Equations	3	1	2	3	6
17.	Arithmetic and Geometric Sequence	5	0	3	7	10
18.	Fundamentals of Geometry	5	0	4	10	14
19.	Areas and Volumes	3	1	0	7	8
20.	Introduction to Coordinate Geometry	3	0	2	5	7
	Total	**37**	**5**	**20**	**58**	**83**
	Percentage		**6**	**24**	**70**	**100**

FOR ANNUAL EXAMINATION 2023 AND ONWARDS

Table 4: Exam Specification

Topic No.	Topics	Marks Distribution		Total Marks
		MCQs	CRQs	
11.	Financial Mathematics	7	3 Marks Choose any ONE from TWO	10
12.	Consumer Mathematics			
13.	Basic Statistics	6	Total 4 Marks (1 CRQ)	10
14.	Algebraic Manipulation	5	4 Marks Choose any ONE from TWO	9
15.	Linear Equations and Inequalities	6	Total 3 Marks (1 CRQ)	9
16.	Quadratic Equations	4	Total 4 Marks (1 CRQ)	8
17.	Arithmetic and Geometric Sequences	5	Total 4 Marks (1 CRQ)	9
18.	Fundamentals of Geometry	4	4 Marks Choose any ONE from TWO	8
19.	Areas and Volumes	5	Total 4 Marks (1 CRQ)	9
20.	Introduction to Coordinate Geometry	3		3
	Total Marks	**45**	**30**	**75**

- Multiple Choice Question (MCQ) requires candidates to choose one best/ correct answer from four options for each question. Each MCQ carries ONE mark.

- Constructed Response Question (CRQ) requires students to respond with a short text (few phrases/ sentences), calculations or diagrams.

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- Tables 1 and 3 indicate the number and nature of SLOs in each topic in classes IX and X respectively. This will serve as a guide in the construction of the examination paper. It also indicates that more emphasis has been given to the Understanding (27% in IX and 24% in X), Application and higher order skills (59% in IX and 70% in X) to discourage rote memorization. Tables 1 and 3, however, do not translate directly into marks.

- There will be two examinations, one at the end of Class IX and one at the end of Class X.

- In each class, the theory paper will be in two parts: paper I and paper II. Both papers will be of duration of 3 hours.

- Paper I theory will consist of 45 compulsory, multiple choice items. These questions will involve four response options.

- Paper II theory will carry 30 marks and consist of a number of compulsory, constructed response questions. There will be no choice among the topics in the constructed response but it may be within the topic.

- All constructed response questions will be in a booklet which will also serve as an answer script.

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FOR ANNUAL EXAMINATION 2023 AND ONWARDS

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